T E N D E R S P E C I F I C A T I O N

NO: BHE/PW/PUR/WNT2-CVL BOP/1574

(CIVIL AND ARCHITECTURAL WORK OF BOP)

All Civil and Architechural work BOP & Non Plant Buildings (But Not Limited to):- Civil work of all RCC Framed Buildings of BOP like praking,chlorination plant, clarified water & fire water pump house, clarified and fire water tank, CPU building, Ozone building, fire station bldg., DM Plant plant & chemical house , Neutralization pit, LDO/HFO Day tank fdns., dykes, FO Transfer pump house, LDO/HFO Pipe Corridor, FO pressuring pump house, store, CWTP,FOAM PH,Booster PH, balance civil work of remaining Pipe rack, chemical house, canteen building , fencing all types, Balance Civil foundation , Storm Water Sump, Service water tank, Storm Water Drain connecting outfall,SSF,Sewer System thrust block,road & drain ,watch tower,water harvesting well, Customer site office, CST & CST Pump House including piling, pilecap,pedestals with bolts,septic tanks and soak pits miscleneous items which are not covered under other Packages item rate.

AT

1X800 MW Thermal Power Station, Wanakbori, Distt- Kheda, Gujarat

Volume 1 E – Technical Specification Section-C and Section D

TENDER SPECIFICATIONS CONSISTS OF:

- **Notice Inviting Tender**
- **Volume 1 A - Technical Conditions of Contract,**
- **Volume 1 B - Special conditions of Contract,**
- **Volume 1 C - General conditions of Contract**
- **Volume 1 D - Forms & Procedures**
- **Volume 1 E – Technical Specification Section-C, Section D and Plot Plan AND Geo technical investigation Report**

Bharat Heavy Electricals Limited
(*A Government of India Undertaking*)
Power Sector - Western Region
345-Kingsway, Nagpur-440001

Date
Seal and Signature
Place

GUJARAT STATE ELECTRICITY CORPORATION LTD.

1x800 MW SUPERCRITICAL THERMAL POWER PROJECT WANAKBORI, GUJARAT

TECHNICAL SPECIFICATION
(SECTION C)

DOCUMENT NO. PE-TS-J57-600-C001
REVISION 00

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
PPEI BUILDING, POWER SECTOR,
PLOT NO. 25, SECTOR-16A,
NOIDA -201031

Project Title	
Job no.	
Document No.	
Subject	

Rev No.	Particulars	Prepared by	Checked by	Approved by	Remarks
00					

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2.3.0 FOUNDATIONS

2.4.0 LOADING

2.5.0 MASONRY

2.6.0 DOORS, WINDOWS AND VENTILATORS

2.7.0 ROOF AND FLOORING

2.8.0 WATER PROOFING

2.9.0 SOIL ENGINEERING

2.10.0 WATER SUPPLY, DRAINAGE AND SEWERAGE

2.11.0 PAVING AND RAOD WORKS

2.12.0 EARTHQUAKE RESISTANT DESIGN

2.13.0 CHIMNEY

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2.16.0 PAINTING

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7.0.0 INTERFACE WITH STRUCTURES UNDER OTHER'S SCOPE

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9.0.0 CONSTRUCTION METHODOLOGY

PART- II

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VOLUME: IIG/1

GENERAL SPECIFICATION AND DESIGN CRITERIA FOR CIVIL AND STRUCTURAL WORKS

CONTENTS

VOLUME: IIG/1 : GENERAL SPECIFICATION AND DESIGN CRITERIA FOR CIVIL AND STRUCTURAL WORKS

CLAUSE NO. DESCRIPTION

[illegible]	[illegible]
2[illegible]	[illegible]
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VOLUME: IIG/1

GENERAL SPECIFICATION AND DESIGN CRITERIA FOR CIVIL AND STRUCTURAL WORKS

GENERAL

2 SCOPE OF CIVIL AND STRUCTURAL WORKS

2.1 General

- Earthwork in excavation and filling for foundations, trenches, roads, drains, etc.
- Dewatering, shoring and bracing of excavations.
- Soil improvement, piling and ground treatment.
- Plain cement concrete, reinforced cement concrete and prestressed concrete.
- Structural steel, steel grating, handrails, ladders and platforms.
- Brickwork, blockwork and masonry.
- Roofing, cladding and insulation.
- Flooring, finishes and painting.
- Waterproofing and damp proofing.
- Expansion joints, construction joints and movement joints.
- Anchor bolts, embedded plates and inserts.
- Roads, paving, kerbs and footpaths.
- Storm water drainage and sewerage.
- Fencing, gates and boundary walls.
- Temporary works, scaffolding and formwork.
- Any other civil and structural works required for the complete and satisfactory execution of the Project.

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2 River Water Intake

2.2 List of Exclusions

2.3 Terminal Points

2.4 Notes

CODES AND STANDARDS

General

UNITS AND LANGUAGE

Drawings

- All drawings shall be in metric units.
- Dimensions
  - Dimensions shall be in millimeters except where otherwise specified.
  - Dimensions shall be in meters for plan and elevation drawings of buildings and structures.
  - Dimensions shall be in millimeters for detailed drawings of buildings and structures.
- Language

2 Units for Calculations

GENERAL SITE INFORMATION

Meteorological Data	

SITE DEVELOPMENT AND DRAINAGE

Plant Coordinate System

-

-

-

-

Grading

-

-

-

-

-

Drainage

-
-
-
-

2

Roads

-

-

-

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[illegible] [illegible]

[illegible]

[illegible] **Fencing**

[illegible]

[illegible]

[illegible]

[illegible] **Electrical Conduit Protection**

[illegible]

[illegible]

[illegible] **Pipe and Electrical Concrete Trenches**

[illegible]

[illegible]

[illegible]

[illegible] **Electrical Manholes**

[illegible]

[illegible]

[illegible]

GEO-TECHNICAL CRITERIA

General Description of Soils

Ground Water and Dewatering Requirements

Excavation Criteria including De-watering

Backfill Criteria

Compaction Criteria

2

Foundation System

Item	Settlement Criteria

LOADS

Materials

	Materials				Unit weight

		Materials					**Unit weight**

Stability of Structures

LOADING COMBINATIONS

Basic Load Cases

Note:

Load Combination for Steel & RCC Structure

Note:

BUILDING DESIGN CONCEPT

Framing System and Method of Analysis

[illegible]

[illegible]

[illegible]

[illegible]

Method of Design

[illegible]

[illegible]

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Acceptance Criteria

B. Boiler Feed Pump Foundation

STRUCTURAL MATERIALS

Structural Steel

Concrete

Concrete Reinforcing Steel

11.03.02 Concrete Cover

Following minimum clear concrete cover to steel reinforcement will be provided.

A.	**Substructure Works**	Bottom	Sides	Top	Ends
i)	Foundation	75	50	50	50
ii)	Columns, Pedestals, Grade Beams/Tie Beam	50	50	50	50
iii)	Trenches, Pits, Walls, Duct Bank etc. in contact with				
	Earth	50	50	50	50
	Water	50	50	50	50
	Others	25	25	25	40
iv)	Equipment Foundations	50	50	50	50
v)	Slab on Grade	25	50	25	50
B.	**Super structure Works**				
i)	Columns	-	40	-	-
ii)	Beams	35	35	35	50
iii)	Slabs/Walls	20	20	20	40
iv)	Lintel, Chajja, Bands etc.	20	20	20	25
v)	Pre-cast Concrete	20	20	20	20

GENERAL DESCRIPTION

Sl. No.	List of Structures/Buildings	Length (M)	Width (M)	Height (M)	No. Reqd.	No. of Storey	Remarks (Types of Building/Structure/Foundation)				
							Frame/ Structure	Foundation	Roof	Floors	Cladding

Sl. No.	List of Structures/Buildings	Length (M)	Width (M)	Height (M)	No. Reqd.	No. of Storey	Remarks (Types of Building/Structure/Foundation)				
							Frame/ Structure	Foundation	Roof	Floors	Cladding

Sl. No.	List of Structures/Buildings	Length (M)	Width (M)	Height (M)	No. Reqd.	No. of Storey	Remarks (Types of Building/Structure/Foundation)				
							Frame/ Structure	Foundation	Roof	Floors	Cladding
2											
2											
22											
2											
2											
2											
2											
2											
2											
2											

Sl. No.	List of Structures/Buildings	Length (M)	Width (M)	Height (M)	No. Reqd.	No. of Storey	Remarks (Types of Building/Structure/Foundation)				
							Frame/ Structure	Foundation	Roof	Floors	Cladding

MISCELLANEOUS REQUIREMENTS

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□

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□

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□

□

□

□

□

Concrete Slab & beam

2 Structural steel

STATUTORY REQUIREMENTS

2

- (a)
- (b)
- (c)
- (d)
- (e)
- (f)
- (g)

DOCUMENTS TO BE SUBMITTED

Calculations, Reports & Drawings

[illegible]

[illegible]

[illegible]

2

LAYOUT

WORKMANSHIP

TEMPORARY WORK

INTERFACE WITH STRUCTURES UNDER OTHER'S SCOPE

SEQUENCE OF WORK AND PROGRESS REPORT

ARCHITECTURAL WORK

ANNEXURE-1

PRELIMINARY GEOTECHNICAL INVESTIGATION DATA

VOLUME: IIG/2

GENERAL SPECIFICATION AND DESIGN CRITERIA FOR ARCHITECTURAL WORK

CONTENTS

VOLUME: IIG/2 : GENERAL SPECIFICATION AND DESIGN CRITERIA FOR ARCHITECTURAL WORK

CLAUSE NO. DESCRIPTION

2

VOLUME: IIG/2

GENERAL SPECIFICATION AND DESIGN CRITERIA FOR ARCHITECTURAL WORK

1.0 INTRODUCTION

1.1 [illegible]

1.2 [illegible]

1.3 [illegible]

2.0 MAIN PLANT STRUCTURES/COMPONENTS

2.1 [illegible]

2.2 [illegible]

3.0 DESIGN REQUIREMENTS

3.1 [illegible]

2.0 [illegible]

[illegible]

[illegible]

[

Sl. No.	Name of the Building	External wall cladding	Roof

Sl. No.	Name of the Building	External wall cladding	Roof
2			
2			
22			
2			
2			
2			
2			
2			
2			

2 [illegible]

Service and Technical Building

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Roof Insulation and Ventilation

Roof Waterproofing

Partition Wall

Plastering

False Ceiling

Special Finish

Doors

Windows & Ventilators

Glazing and Glazed Partition

Sealant

Landscaping

Facilities in Buildings

Potable Water System and Plumbing

shall run unexposed.

Finish Schedule

Sl. No.	Building/Area	Floor/Skirting/ Dado	Wall	Ceiling

Sl. No.	Building/Area	Floor/Skirting/ Dado	Wall	Ceiling
		2		

Sl. No.	Building/Area	Floor/Skirting/ Dado	Wall	Ceiling

Sl. No.	Building/Area	Floor/Skirting/ Dado	Wall	Ceiling

WORKMANSHIP

DOCUMENT SUBMISSION

As Built Drawings

CODES AND STANDARDS

General

Masonry

Doors, Windows and Ventilators

Waterproofing

Water Supply, Drainage and Sewerage

Painting

BRIEF SPECIFICATION OF ARCHITECTURAL WORK

22

Doors & Windows

[illegible]

[illegible]

[illegible]

[illegible]

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WORK

Fencing

WATER SUPPLY AND SANITARY WORK

RULES AND BYE LAWS

LIST OF PRODUCTS TO BE USED IN THE BUILDING

Sl. No.	Name of the Product	Name of the manufacturer	Remarks
2			
2			
		2 2	
		2 2	
		2 2	

Sl. No.	Name of the Product	Name of the manufacturer	Remarks

Sl. No.	Name of the Product	Name of the manufacturer	Remarks
	Paintings		

LIST OF FURNITURE TO BE PROVIDED IN SERVICE & TECHNICAL BUILDING AND CANTEEN BUILDING

Name of the building	Description	Quantity	Manufacturer
Service and Technical Building	**Furniture**	**Each**	**Godrej**

Name of the building	Description	Quantity	Manufacturer

VOLUME: IIG/3

TECHNICAL SPECIFICATION
FOR
CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

CONTENTS

VOLUME: IIG/3 : TECHNICAL SPECIFICATION FOR CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

TECHNICAL SPECIFICATION
FOR
I) LAND SURVEY AND ESTABLISHING REFERENCE GRIDS AND BENCH MARK PILLARS

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

I) LAND SURVEY AND ESTABLISHING REFERENCE GRIDS AND BENCH MARK PILLARS

SCOPE

2 GENERAL

2 Work to be Provided for by the Contractor

2

2 With Tender

2 After Award

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2.1 Contour Intervals

2.2 Scale of Drawings

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Time of Completion

Security Rules and Statutory Regulations

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Establishing of Grid Pillars

Reference Grid Pillars and Bench Marks

Topographical Surveying and Mapping

Traversing and Ground Controls

Contouring

Route Survey

TECHNICAL SPECIFICATION
FOR
II) GEO TECHNICAL INVESTIGATION

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

II) GEOTECHNICAL INVESTIGATION

SCOPE

GENERAL

Work to be provided for the Contractor

Work to be provided by others

2 Location and Levels

2 Codes and Standards

SOIL EXPLORATION

Test Boring

Stabilization of Boreholes

Open Trial Pits

Boring in River Bed

Rock Drilling

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2 Chunk Samples

Sampling in rock

Record of Boring

PENETRATION TESTS

Standard Penetration Test

Static Cone Penetration Test

Dynamic Cone Penetration Test

GROUNDWATER INVESTIGATION

Ground Water Level Observation

In-Situ Permeability Test

Pump-in Test

Constant Head Method (in borehole)

Falling Head Method (in borehole)

Percolation test (in trial pit)

Pump-Out Test

FIELD TESTS

Menard Pressure meter Test

Direct Load Tests on Soils

Vane shear Tests

Determination of Dry-Density of Soils

Sand Replacement Method

Core-cutter Method

Ring and Water Replacement Method

Rubber balloon Method

In-situ Block Shear/Wedge Shear Test

Test for Measurement of soil Resistivity

2

2

2

2

TESTS FOR DYNAMIC PROPERTIES

Block Vibration Test

2 Wave Propagation Test

Cyclic Plate Load Test

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LABORATORY TESTS ON SOIL SAMPLES/ROCK CORES

REPORT ON SUB-SOIL INVESTIGATION

General

2.0 Data to be furnished

Geological information

Recommendations

Additional Recommendations

[illegible]

[illegible]

[illegible]

TECHNICAL SPECIFICATION
FOR
III) AREA GRADING AND SLOPE PROTECTION

CONTENTS

SECTIONS	DESCRIPTION
[illegible]	[illegible]
[illegible]	[illegible]

PART-A

TECHNICAL SPECIFICATION - GENERAL

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2[illegible]	[illegible]
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[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

PART-A

TECHNICAL SPECIFICATION - GENERAL

SCOPE OF WORK

2 DESCRIPTION AND FEATURES OF THE SITE

Location of Power Plant

Meteorological Data

SOIL CHARACTERISTICS

SPECIFICATIONS

DRAWINGS

Sl. No.	Drawing No.	Description

[illegible]

[illegible]

[illegible] **LAYOUT**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **WORKMANSHIP**

[illegible]

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[illegible]

[illegible] **TEMPORARY WORK**

[illegible]

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[illegible]

TENDER DRAWINGS (Refer Volume IIL of Specification)

PART-B

TECHNICAL SPECIFICATION
FOR
III) AREA GRADING AND SLOPE PROTECTION

CONTENTS

CLAUSE NO. **DESCRIPTION**

2

SECTION-II

TECHNICAL SPECIFICATION
FOR
A) AREA GRADING AND SLOPE PROTECTION

1.0 SCOPE

1.1 The scope of work under this specification shall include area grading, slope protection, construction of retaining walls, drainage system, culverts, bridges, roads, boundary wall, gates, fencing, etc. complete in all respects as per the requirements of this specification and as per the drawings and instructions of the Engineer-in-Charge. The work shall also include all temporary works, such as temporary drainage, temporary roads, etc. required for the execution of the work. The work shall be carried out in accordance with the relevant Indian Standard Codes of Practice, unless otherwise specified in this specification.

2.0 GENERAL

2.1 Work to be provided for by the Contractor

The Contractor shall provide for all labour, materials, tools, plant, equipment, transportation, etc. required for the execution of the work.

a) Area grading and slope protection, construction of retaining walls, drainage system, culverts, bridges, roads, boundary wall, gates, fencing, etc. complete in all respects as per the requirements of this specification and as per the drawings and instructions of the Engineer-in-Charge.

b) Temporary works, such as temporary drainage, temporary roads, etc. required for the execution of the work.

c) Disposal of surplus excavated material, debris, etc. to the designated areas within the site.

d) Any other work not specifically mentioned in this specification but required for the completion of the work in accordance with the intent of this specification.

2.2 Work to be provided for by others

The following work shall be provided for by others:

a) Supply of water and electricity for the execution of the work.

2 Codes and Standards

2 Conformity with Designs

2 Materials to be used

2

2

2.2

2

2

2

2

Quality Control

2

2

2 Information regarding Site Conditions

EXECUTION

General

[illegible]

[illegible]

[illegible]

Classification

Classification

Classification

Classification

Classification

Classification

Earthwork in Excavation

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Where excavated material is mostly rock, the boulders shall be broken into pieces not longer than 150 mm size, mixed with properly graded fine material consisting of murum or earth to fill up the voids and the mixtures used for filling.

If any material rejected by the Engineer, Contractor shall remove the same forthwith from the site at no extra cost of the Owner. Surplus fill material shall be deposited/disposed of as directed by the Engineer after the fill work is completed.

No earthfill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by the Engineer.

Before commencement of area filling the existing top soil shall be removed upto a minimum depth of 200 mm or more, as directed by the Engineer in order to clear the surface of undesirable materials. After this the filling operation shall be performed with earth in layers not exceeding 250 mm, loose thickness. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as given below and got approved by the Engineer.

a) Each layer of earth of cohesive nature shall be compacted to 90% of proctors dry density unless otherwise permitted/directed by the Engineer.

b) Each layer of earth of non-cohesive nature shall be compacted to minimum 75% relative density unless otherwise permitted/directed by the Engineer.

Each shall be compacted with approved machine (mechanical plant) and usually manual compaction shall not be allowed unless specifically permitted by the Engineer. The original ground formation and each fill layer shall be compacted by rollers as described below with a maximum of six passes of 8/10 tonne roller.

i) When the optimum moisture content of soil is relatively high, a pneumatic tyred roller (type pressure 3.0 - 3.5 kg/sq.cm) shall be considered to give better performance for mechanical compaction.

ii) When the optimum moisture content of soil is relatively low, a vibrating roller shall be considered to give better performance for mechanical compaction.

Since the degree of compaction depends on the moisture content of the soil, a close watch shall be kept on this aspect and corrections done to optimise the moisture content. The adequacy of the compaction and moisture content of the soil shall be determined by performing field density tests and other tests as and when directed by the Engineer and shall conform to the stipulations laid down in IS:4701.

The cohesionless soil to be used for area filling, should be placed in fully saturated condition to obtain the maximum possible density. The saturation

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TESTING AND ACCEPTANCE CRITERIA

Soil Testing

Acceptance Criteria

2.2 [illegible]

[illegible]

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INFORMATION TO BE SUBMITTED

With Tender

[illegible]

a) [illegible]

b) [illegible]

c) [illegible]

After Award

[illegible]

a) [illegible]

b) [illegible]

TECHNICAL SPECIFICATION
FOR
IV) EARTHWORK IN EXCAVATION AND BACKFILLING

CONTENTS

CLAUSE NO.	DESCRIPTION
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2[illegible]	[illegible]
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[illegible]	[illegible]
[illegible]	[illegible]

IV) EARTHWORK IN EXCAVATION AND BACKFILLING

SCOPE

GENERAL

Work to be provided for by the Contractor

Work to be provided for by others

Codes and Standards

IS 2720 :	Determination of Moisture Content (Part-II)	
IS 2720 :	Determination of Moisture content/Dry Relation (Part-VII) using Light Compaction.	
IS 2720 :	Determination of Density Index (Relative Density) (Part-xiv) of cohesionless soils.	
IS 2720 :	Determination of Dry Density, in place, by core (Part-xxix) cutter method.	
IS 2720 :	Determination of Dry Density of soils, in place, (xxviii)	(Part-by sand replacement methods.
IS:3764 :	Safety code for Excavation work.	
IS:4081 :	Blasting and Related Drilling Operations	
IS:4701 :	Earthwork on canals	

2.04.00 Conformity with Designs

The Contractor is to carry out the work as per the drawings issued to him and/or Contractor's drawings which are approved by the Engineer and/or the Engineer's instructions.

2.05.00 Materials to be used

2.05.01 General

All materials required for the work shall be of best commercial variety and approved by the Engineer.

2.05.02 Borrow Material

Borrow material required for back-filling shall be excavated from approved locations & levels and shall consist of material, approved by the Engineer free from roots & vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and clods. If specified, clean graded sand free from harmful and deleterious material from approved quarries shall be used as fill material.

2.06.00 Quality Control

The Contractor shall submit the Quality Assurance Plan (QAP) for total work to the Owner/Engineer for approval and follow the approved plan during work execution.

The Contractor shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. The quality control operation shall include but not be limited to the following items of work:

2 Information regarding site conditions

EXECUTION

Setting Out

2 Initial Levels

Clearing and Grubbing, etc.

Classification

Ordinary Soil

Hard Soil

Soft and Decomposed Rock

Hard Rock (requiring blasting)

[illegible]

Hard Rock (blasting prohibited)

[illegible]

Excavation for Foundations and Trenches

General

[illegible]

[illegible]

[illegible]

[illegible]

Blasting

General

Storage of Explosive

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **Carriage of Explosives**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **Use of Explosives**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Disposal

Disposal of Surplus

Protection

Dealing with Surface Water

Dewatering

Timber Shoring

Close Timbering

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **Open Timbering**

[illegible]

[illegible]

[illegible] **Treatment of Slips**

[illegible]

[illegible]

[illegible] **Back-filling**

[illegible]

[illegible] **General**

[illegible]

[illegible]

[illegible]

[illegible]

Filling and Compaction in Pits and Trenches around Structures

Plinth Filling

Filling in Trenches for Water Pipes and Drains

Filling in Disposal Area

Approaches and Fencing

Lighting

TESTING AND ACCEPTANCE CRITERIA

Excavation

2.2.2.2 Back-filling

INFORMATION TO BE SUBMITTED

With Tender

After Award

a) [illegible]

b) [illegible]

TECHNICAL SPECIFICATION
FOR
V) CEMENT CONCRETE – PLAIN AND REINFORCED

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

V) CEMENT CONCRETE - PLAIN AND REINFORCED

SCOPE

General

GENERAL

Work to be provided for by the Contractor

2.2 Work by Others

2.3 Information to be submitted by the Tenderer

2.3.1 With Tender

2.2.2 After Award

(a) Contractor shall submit to Employer for approval the Contract Performance Guarantee in the form and amount as specified in the Contract Agreement.

(b) Upon receipt of the Contract Performance Guarantee, Employer shall return the Bid Security to Contractor.

(c) (i) Contractor shall submit to Employer for approval the Contractor's Representative, Contractor's Key Personnel and Contractor's Equipment as specified in the Contract Agreement. Contractor shall not remove or replace any of the Contractor's Representative or Contractor's Key Personnel except as Employer may agree or direct. If any of the Contractor's Representative or Contractor's Key Personnel dies or is incapacitated, Contractor shall immediately appoint a replacement. If Employer requires the removal of any of the Contractor's Representative or Contractor's Key Personnel, Contractor shall appoint a replacement.

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2 Conformity with Design

2 Materials to be used

2 General Requirement

2.2 Cement

2 Aggregates

2 Water

2 Admixture

2

Reinforcement

2 Storage of Materials

2 General

2

2 Cement

2

2

2 Aggregates

2

2

2 Reinforcement

2 Quality Control

INSTALLATION

Washing and Screening of Aggregates

2 Admixture

Grades of Concrete

Proportioning and Works Control

General

2 Mix Design Criteria

TABLE-I

STRENGTH REQUIREMENT OF CONCRETE

Note-1

Note-2

TABLE-II

MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE DIFFERENT DEGREES OF WORKABILITY WITH DIFFERENT VALUES OF WATER - CEMENT RATIO

(FOR GUIDANCE) CEMENT/TOTAL AGGREGATE RATIOS

Strength Requirements

Minimum Cement Content

Water-Cement Ratio

Strength Requirement

Durability Requirement

TABLE-IV

MAXIMUM PERMISSIBLE WATER/CEMENT RATIOS FROM DURABILITY CONSIDERATIONS FOR DIFFERENT TYPES OF STRUCTURES AND DEGREES OF EXPOSURE USING ORDINARY PORTLAND CEMENT

	Exposure Conditions	
	In Air	**In Air**

						Exposure Conditions

Workability

TABLE-V

LIMITS OF CONSISTENCY

Size of Coarse Aggregates

[illegible]

[illegible]

[illegible]

2 Placing and Compacting Concrete

2

Construction Joints and Cold Joints

Construction Joints

2

Cold Joint

[illegible]

[illegible] [illegible] [illegible] [

2 Finishing Unformed Surface

Protection and Curing of Concrete

Reinforcement

Bar Bending Schedules

Cleaning

Cutting & Bending of Reinforcement

Placing in Position

2

Welding

2

Control

2

Cold Weather Concreting

Hot Weather Concreting

Concreting under Water

2 Form Work

General

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Cleaning and Treatment of Forms

[illegible]

[illegible]

[illegible]

[illegible] Design

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Inspection of Forms

[illegible]

[illegible]

[illegible]

[illegible] Removal of Forms

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

TABLE-VI

SCHEDULE OF REMOVAL OF FORM

2.0 Tolerance

2.0 Re-use of Forms

2.0 Classification

2 Opening, Chases, Grooves, Rebates, Blockouts etc.

22 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and Other misc. Embedded Fixtures

2.0 Expansion and Isolation Joints

2.1 General

Expansion joints shall be provided in the floor slabs, walls, roofs, etc. at locations as shown in the drawings and as specified herein. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained.

2.2 Bitumen Board/Expanded Polystyrene Board

Material

Bitumen board shall be provided in the expansion joints as shown in the drawings and as specified herein. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained.

Installation

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2.3 Joint Sealing Strips

Joint sealing strips shall be provided in the expansion joints as shown in the drawings and as specified herein. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained.

2 Grouting under Machinery or Structural Steel Bases

2

2

2 Precast Concrete

2

2

2

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Waterproofing of Concrete Structure

[illegible] General

[illegible]

[illegible]

[illegible]

[illegible] Water Bar/Seal/Special Treatment of Construction Joint

[illegible]

[illegible]

[illegible]

Method 1 :

Method 2 :

2 Waterproofing Admixtures

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Protective coating on Concrete Surface

On Foundation

Waterproofing by Pressure / Chemical Grouting

SAMPLING AND TESTING

General

Cement

Aggregates

Water

Admixture

Air Entraining Agents (A.E.A)

Other Admixtures

Concrete

ACCEPTANCE CRITERIA

Standard Deviation

Acceptance Criteria

Inspection and Core Tests

Load Test

LIST OF IS : CODES AND STANDARDS FOR REFERENCE

TECHNICAL SPECIFICATION
FOR
VI) DRIVEN PRECAST CONCRETE PILES

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

VI) DRIVEN PRECAST CONCRETE PILE

SCOPE

GENERAL

Work to be Provided by the Contractor

2.2 Work to be Provided by Others

2.3 Codes and Standards

[illegible]

[illegible] [illegible] [illegible] [

2 Storage of Materials

2 Quality Control

INSTALLATION

General

2 Casting and Curing

2

Storing and Handling

2

Driving

2

Stripping of Pile Heads

Lengthening of Piles

[illegible]

[illegible]

[illegible] **Risen Piles**

[illegible]

[illegible] **Defective Piles**

[illegible]

[illegible] **Idle Period**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **Test Pile**

[illegible]

[illegible]

TESTING AND ACCEPTANCE CRITERIA

General

Static Load Test on Working Piles

2

2

Acceptance Criteria

Recording Data

INFORMATION TO BE SUBMITTED

With Tender

Programme of Construction

After Award

Execution Plan

Detailed Construction Programme

Requirement of Materials, Tools and Plants and Equipment

Test Results

TECHNICAL SPECIFICATION
FOR
VII) DRIVEN CAST IN SITU CONCRETE PILES

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

VII) DRIVEN CAST-IN-SITU CONCRETE PILES

SCOPE

GENERAL

Work to be provided by the Contractor

[illegible]

2.2 Work to be provided by others

[illegible]

2. Codes and Standard

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

2 Steel

2 Structural steel conforming to IS 2062 or equivalent shall be used.

2 Storage of Materials

2 General

All steel materials shall be stored in a manner to prevent damage and deterioration. Materials shall be stored off the ground on platforms, skids or other supports. Materials shall be kept free from dirt, grease and other foreign matter. Storage shall be provided for all materials subject to damage by the weather. Long members shall be supported to prevent sagging. Materials shall be stored in such a manner as to facilitate inspection.

2 Cast Iron or Steel Shoes and Shells

Cast iron or steel shoes and shells shall be provided where indicated on the drawings. Shoes and shells shall be of the size and dimensions indicated on the drawings. Shoes and shells shall be free from defects and shall be machined where necessary to provide a true and even bearing surface.

2 Quality Control

Quality control procedures shall be established and maintained to ensure that all materials and workmanship comply with the requirements of the specifications. The quality control procedures shall include, but not be limited to, the following:

- Inspection of all materials upon receipt at the site.
- Inspection of all fabrication and erection work.
- Maintenance of records of all inspections and tests.
- Submission of reports to the Engineer-in-Charge.

2 Non-conformance

Any material or workmanship that does not conform to the requirements of the specifications shall be rejected. Rejected materials shall be removed from the site. Rejected workmanship shall be corrected or replaced. The Engineer-in-Charge shall be notified of all rejections.

INSTALLATION

General

Type of Pile

Identification of Piles

Sequence of Construction

Driving of Piles

Concrete in Pile

Trimming of Pile Heads

Lengthening of Piles

Reinforcement in Piles

2

Dowels

Inspection

Record for driving of Piles

[illegible]

[illegible]

[illegible] **Defective Piles**

[illegible]

[illegible]

[illegible] **Idle Period**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **Test Pile**

[illegible]

[illegible]

2

TESTING AND ACCEPTANCE CRITERIA

General

Components of R.C.C

Static Load Test on Working Piles

2

2

2

Acceptance Criteria

Lateral Load Tests/Pull out Tests

Non-destructive Dynamic Testing on Working Piles

"Low Strain" Method for Integrity Investigation of Concrete Piles

"High Strain" Method for Determination of Pile Capacity

Lateral Dynamic Load Test on Piles

INFORMATION TO BE SUBMITTED

With Tender

Design Data

2 Programme of Construction

After Award

Execution Plan

Detailed Construction Programme

Requirement of Materials, Tools and Plants and Equipment

Test Results

TECHNICAL SPECIFICATION
FOR
VIII) BORED CAST IN SITU CONCRETE PILES

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

VIII) BORED CAST IN SITU CONCRETE PILE

SCOPE

GENERAL

Work to be provided by the Contractor

2.2 Work to be provided by others

2.3 Codes and Standards

2 Conformity with Design

2 Materials

2 General

2 Casing

2 Concrete

2 **Reinforcement**

2 Reinforcement shall be as per approved drawings and shall be free from loose rust, scales, oil, paint, mud or any other coating which may reduce the bond between concrete and steel.

2 **Storage of Materials**

2 **General**

2 All cement, aggregates, reinforcement and admixtures shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter. Any material which has deteriorated or which has been contaminated shall not be used for concrete and shall be removed from the site of work. Cement shall be stored in dry and weather proof sheds with adequate provision for ventilation, drainage and inspection. Cement bags shall be stacked on platforms at least 150 mm above the ground level and shall be covered properly to protect from moisture. Cement bags shall be stacked in such a way that first bag to be used is the first bag received at site. Cement bags shall not be stacked more than 10 bags high. Cement which has been in storage for more than 3 months shall be tested before use. Aggregates shall be stored in such a manner as to prevent segregation and intrusion of foreign matter. Reinforcement shall be stored in such a way as to prevent deterioration by rusting or accumulation of dirt, oil or other coatings. Admixtures shall be stored in such a way as to protect them from deterioration or intrusion of foreign matter.

2 **Casing**

2 Casing shall be used for all concrete work except where the Engineer-in-Charge permits otherwise. Casing shall be of steel, timber or other suitable material. Casing shall be sufficiently rigid to prevent bulging during placing and compaction of concrete. Casing shall be removed without causing damage to the concrete.

2 **Quality Control**

2 Quality control tests for concrete shall be carried out in accordance with IS 456. Tests shall be carried out by an approved testing agency. The Contractor shall provide all facilities for sampling and testing of concrete.

2 (a) Slump test shall be carried out for every batch of concrete.

2 (b) Compressive strength test shall be carried out for every 50 cubic meters of concrete or part thereof. Three cubes shall be cast for each test and tested at 7 days and 28 days.

2 (c) Flexural strength test shall be carried out when required by the Engineer-in-Charge.

2 (d) Tensile strength test shall be carried out when required by the Engineer-in-Charge.

2 (e) Modulus of elasticity test shall be carried out when required by the Engineer-in-Charge.

2 (f) Durability tests shall be carried out when required by the Engineer-in-Charge.

2 (g) Any other test required by the Engineer-in-Charge.

2 [illegible]

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[illegible] INSTALLATION [illegible]

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[illegible]

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[illegible] 2 [illegible] Design of Pile [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Identification of Piles

Sequence of Piling

Boring

With Casing

[illegible]

[illegible]

[illegible]

Concreting

Tremie Method of Concreting

2 Concreting in Cased Holes

Cut-off Level

Steel Pipe or Casing Tube

Trimming of Pile Heads

Lengthening of Piles

Removal of Spoil

Back-Filling of Abandoned Borings

Record for Installation of Piles

(iii) Details of pile load tests carried out in the past in the area, if any, should be furnished.

(iv) Pile load tests shall be carried out in accordance with IS 2911 (Part IV) and as per the direction of the Engineer-in-Charge.

(v) Pile load tests shall be carried out on working piles. The load shall be applied in increments of 20% of the working load. Each load increment shall be maintained till the rate of settlement does not exceed 0.1 mm in the last hour. The load shall be applied till the pile settles by 2.5 mm under the working load.

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Test Pile

Offshore Piles

TESTING AND ACCEPTANCE CRITERIA

General

Components of RCC

Components of Steel

Load Tests

General

Vertical Load Test [as per IS : 2911 (Part-IV)]

Lateral Load Test

Pull-out Test

Non-destructive Dynamic Test on Working Piles

"Low Strain" Method for Integrity Investigation of Concrete Piles

"High Strain" Method for Determining of Pile Capacity

Acceptance Criteria

Lateral Dynamic Load Test on Piles

INFORMATION TO BE SUBMITTED

With Tender

Design Data

Programme of Construction

2.2.2 After Award

2.2.3 Execution Plan

2.2.4 Detailed Construction Programme

2.2.5 Requirement of Materials, Tools and Plants and Equipment

2.2.6 Test Results

TECHNICAL SPECIFICATION
FOR
IX) FABRICATION OF STRUCTURAL STEEL WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

IX) FABRICATION OF STRUCTURAL STEEL WORK

SCOPE

GENERAL

Work to be provided for by the Contractor

[illegible]

[illegible] [illegible]

[illegible]

2.2 Work by others

[illegible]

[illegible]

[illegible]

2. Codes and standards

[illegible]

[illegible]

[illegible]

List of IS Codes - Relevant to Fabrication of Structural Steel Work

[illegible]

IS Codes	Description
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Painting

2 Conformity with Designs

2 Materials to be used

2 General

2 2 Steel

[illegible]

2[illegible] Electrodes

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

2[illegible] Bolts and Nuts

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

2[illegible] Washers

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] Paints

[illegible]

[illegible] Storage of Material

[illegible] General

[illegible] Steel

[illegible] Electrodes

[illegible] Bolts, Nuts and Washers

2 Paints

2 Quality Control

2 Standard dimensions, forms and weights

2 Shop Drawings

WORKMANSHIP

Fabrication

General

Straightening Material

Cutting

[illegible]

[illegible] **Planning of edges**

[illegible]

[illegible]

[illegible] **Clearances**

[illegible]

[illegible]

[illegible] **Bolted construction**

[illegible]

[illegible] **Holes**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Assembly

Welded Construction

General

Preparation of Material

Assembling

Welding Sequence

Welding technique

Temperature

2

Peening

Equipment

Finish

2

Slab bases and caps

Lacing bars

Separators

Bearing Plates

Architectural Clearances

Shop connections

Castings

Shop erection

Shop painting

General

Painting on Structural Steel

Inaccessible parts

Contact surfaces

Finished surfaces

Surfaces adjacent to field welds

Galvanizing

General

2 Surface Preparation

Procedure

INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

Inspection

2.0 Testing and Acceptance Criteria

2.1 General

2.2 Steel

2.3 Testing Criteria for checking Lamination in raw steel plates

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Acceptance

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Delivery of materials

[illegible] General

[illegible]

[illegible] Marking

[illegible]

[illegible] Packing and Shipping

[illegible]

[illegible]

INFORMATION TO BE SUBMITTED

With Tender

2

TECHNICAL SPECIFICATION
FOR
X) ERECTION OF STRUCTURAL STEEL WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

X) ERECTION OF STRUCTURAL STEEL WORK

SCOPE

GENERAL

Work to be provided for by the Contractor

Work by others

Codes and Standards

Conformity with designs

2 Material

2 General

2

2 Storage of materials

2 General

2 Yard

sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved programme of work.

The Tenderer should visit the site prior to submission of his Tender to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc. all of which shall be carried out by the Contractor at his own cost as directed the Engineer.

2.06.03 Covered Store

All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in a properly covered store building to be built at the cost of the Contractor

2.07.00 Quality control

The contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Enginee to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the following items of work

a) Erection : Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.

b) Grouting : Cleaning and roughness of foundation quality of materials used for grouting, admixtures, consistency and strength of grout.

c) Painting : Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

2.08.00 Taking Delivery

The erection Contractor shall take delivery of fabricated structural steel and necessary connection materials supplied by the fabrication Contractor from railhead, trucks at site as may be necessary and as per terms & conditions of the contract or as directed by the Engineer. He shall check, unload, transpor the materials to his stores for proper storing at his own cost. The erection Contracto shall submit claims to insurance or other authorities and pursue the same in case of loss or damage during transit and handling and all loss thereof hall be borne by him.

The erection contractor shall also take all precautions against damage of the materials in his custody after taking delivery and till the same are erected in place and accepted.

WORKMANSHIP

Erection

Plant and equipment

Method and sequence of erection

Temporary bracing

Temporary floors for buildings

Setting out

Field bolting

TABLE-I

Field Welding

Holes, cutting and fitting

Drifting

Grouting of stanchion bases and bearings of beams and girders on stone, brick or concrete (Plain or reinforced)

Painting after erection

[illegible]

[illegible]

[illegible]

Stiffness Test

Strength Test

Structure of same design

[illegible]

[illegible]

[illegible]

Acceptance

INFORMATION TO BE SUBMITTED

Before Tender

Tentative Programme

Constructional Plant & Equipment, Tools, Temporary Works & Manpower

Erection yard

After award of the Contract

Fortnightly Progress Report

TECHNICAL SPECIFICATION
FOR
XI) ROADS AND DRAINAGE

PART-I : CONSTRUCTION OF ROADS & DRAINS

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XI) ROADS AND DRAINAGE

PART-I : CONSTRUCTION OF ROADS & DRAINS

SCOPE

GENERAL

Work to be Provided for by the Contractor

Work to be Provided for by Others

Codes and Standards

Conformity with Designs

Materials to be Used

General

Quality Control

TABLE-I

PERMITTED TOLERANCES OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sl. No.	Type of Construction	Longitudinal Profile with 3 m straight edge				Cross Profile
		Max. Permissible undulation.	Max. number of undulations permitted in any 300 metres length exceeding :			Max. permissible variation from specified profile under camber template
			mm	mm	mm	
			18	12	10	6	

Notes

2

EXECUTION

Shoulder Construction

Description

2 **Materials**

Construction Operations

Kerb

Material

Laying

Sub-base (Granular Sub-base)

Description

Materials

TABLE-II
GRADING FOR GRANULAR SUB-BASE MATERIALS

Sieve designation	Percent by weight passing the sieve		
	Grading 1	Grading 2	Grading 3

Note

Physical Requirements

Spreading and Compacting

Water Bound Macadam Sub-base/Base Course

Description

Materials

TABLE-III

PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WATER BOUND MACADAM

Sl. No.	Type of Construction	Test	Test method	Requirements

TABLE-IV

GRADING REQUIREMENTS OF COARSE AGGREGATES

Grading No.	Size range	Sieve designation	Percent by weight passing the sieve

TABLE-V

GRADINGS FOR SCREENINGS

Grading Classifi-cation	Size of screenings	Sieve designation	Percent by weight passing the sieve

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Bituminous Macadam Binder Course

Description

Materials

TABLE-VI

PHYSICAL REQUIREMENTS OF AGGREGATES FOR BITUMINOUS MACADAM

Sl. No.	Test	Test method	Requirements

TABLE-VII

AGGREGATES GRADING FOR 75 MM COMPACTED THICKNESS OF BITUMINOUS MACADAM

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]
2[illegible]	2[illegible]	[illegible]
2[illegible]	[illegible]	[illegible]
[illegible]2[illegible]	[illegible]2[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
2[illegible]	[illegible]	[illegible]2[illegible]
[illegible]	[illegible]	[illegible]

TABLE-VIII

AGGREGATE GRADING FOR 50 MM COMPACTED THICKNESS OF BITUMINOUS MACADAM

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
[illegible]	[illegible]	
[illegible]	[illegible]	
2[illegible]	[illegible]	[illegible]
2[illegible]	[illegible]	[illegible]
[illegible]2[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
2[illegible]	[illegible]	[illegible]2[illegible]
[illegible]	[illegible]	[illegible]

[illegible]2[illegible] [illegible]

[illegible]

[illegible]

[illegible]2[illegible] [illegible]

[illegible]

[illegible]

[illegible]

Construction Operations

Open-Graded Premix Carpet

Description

2

2 Materials

2.1 General

Materials and workmanship shall conform to the relevant Indian Standard Specifications, Codes of Practice and Standard Methods of Tests. Where Indian Standards are not available, the relevant British Standards shall be followed.

2.2 Earthwork

Earthwork shall be carried out in accordance with IS: 3764 and IS: 4081. Soil shall be free from organic matter, rubbish, boulders and stones larger than 75 mm in any dimension. Soil for embankment shall be compacted in layers not exceeding 200 mm loose thickness to achieve the specified dry density.

2.3 Aggregates

Aggregates for bituminous mixes shall conform to IS: 383. Coarse aggregates shall be crushed stone or crushed gravel. Fine aggregates shall be natural sand or crushed stone dust.

2.4 Bituminous Materials

Bituminous materials shall conform to IS: 73 for paving bitumen and IS: 8887 for bituminous emulsions.

TABLE-IX

QUANTITIES OF MATERIALS REQUIRED FOR 10 SQ.M OF ROAD SURFACE FOR 2 CM THICK OPEN-GRADED PREMIX CARPET

(a)	Quantity of premix required for 10 sq.m @ 2 cm thick			
	2 cm thick @ 10 sq.m per cubic metre	0.2 cubic metre	Nil	0.2 cubic metre
(b)	Quantity of binder required for premix @ 4.5 per cent			
	4.5 per cent of 0.2 cubic metre	0.009 cubic metre	Nil	0.009 cubic metre
	Total		0.009 cubic metre	0.209 cubic metre
	Add 10 per cent for wastage		0.0009 cubic metre	0.0209 cubic metre
	Total quantity of binder required		0.0099 cubic metre	0.2299 cubic metre
(c)	Quantity of aggregates required for premix @ 95.5 per cent			
	95.5 per cent of 0.2 cubic metre	0.191 cubic metre	Nil	0.191 cubic metre
	Add 10 per cent for wastage	0.0191 cubic metre	Nil	0.0191 cubic metre
	Total quantity of aggregates required	0.2101 cubic metre	Nil	0.2101 cubic metre

3 Construction Operation

3.1 Preparation of Base

The base shall be prepared to the required profile and cross-fall. All loose material, dust and debris shall be removed before the application of the prime coat.

3.2 Application of Prime Coat

The prime coat shall be applied uniformly at the rate specified by the Engineer-in-Charge. The surface shall be allowed to cure for a minimum period of 24 hours before the application of the premix carpet.

2

DEVELOPMENT CONSULTANTS **Page: V2/G3/XI/Part-I/17**
(K9213R-EPC-SPC-001-IIG3.doc)

[illegible]

[illegible] [illegible] [illegible] [

Construction Operations

Opening to Traffic

Repair of Existing Water Bound Macadam Surface

Road Side Drains

Formation of Drains

Culverts

Pipe Culverts and Drainage Pipes

Materials

Laying of Pipes

2 Relation with Water Supply Pipeline

Manholes and Inspection Chambers

Masonry

Brick Masonry

2 Stone Masonry

Pointing to Masonry

Plaster to Masonry and Concrete

Finish

Cement Concrete (Plain and Reinforced)

General

22

Materials

Storage of Materials

Workmanship

TESTING AND ACCEPTANCE CRITERIA

Roads

Masonry and Plastering

Cement Concrete

INTERLOCKING PAVING BLOCKS

PART-II
TECHNICAL SPECIFICATION FOR
CONSTRUCTION OF WET MIX MACADUM ROAD

WET MIX MACADAM

Description

Materials

Aggregates - General Requirements

Table-1

Physical Requirements of Aggregates for Wet-Mix Macadam

Sl. No.	Type of Construction	Test Method	Test	Requirement

Note :

2.2 Crushed Stone/Gravel

Crushed stone/gravel shall be obtained from approved quarries. Stone shall be hard, durable, clean and free from soft, friable, thin, elongated or laminated pieces, dirt and other extraneous matter.

2.3 Crushed Slag

Crushed slag shall be obtained from approved sources. Slag shall be hard, durable, clean and free from soft, friable, thin, elongated or laminated pieces, dirt and other extraneous matter. Slag shall be free from unburnt coal or other combustible matter and shall not contain more than 2 percent of sulphates and sulphides calculated as magnesium sulphate when tested in accordance with IS:1622. Slag shall not be used unless it has been stored in the stockpiles for a period of at least 2 months.

2.4 Aggregates - Grading Requirements

The composition of the mixed aggregates shall be determined by the Engineer-in-Charge to suit the requirements of the grading given in Table-2 and shall be such that when applied to the road in the required quantity, it shall form a dense mass with the minimum practicable percentage of voids after adequate rolling.

Table-2

Grading Requirements of Aggregates for Wet-Mix Macadam

Sieve Designation (IS:460)	Percent by Weight Passing the Sieve Grading 1 Max. Nominal Size 40 mm	 Grading 2 Max. Nominal Size 20 mm
90 mm	100	
63 mm	90 to 100	
45 mm	25 to 60	100
22.4 mm	0 to 15	90 to 100
11.2 mm	0 to 5	40 to 80
5.6 mm		0 to 15
2.8 mm		0 to 5
Water Bound Macadam	Screenings	22 mm	Screenings
Grouted Macadam	Screenings	45 mm	22.4 mm

Aggregates shall be tested in accordance with IS:2386 (Part-I) and shall satisfy the requirements of Table-1 of IS:1609.

[illegible]

[illegible]

2 Quantity of Aggregates

[illegible]

[illegible]

Construction Operations

[illegible]

Preparation of Foundation for Receiving the Wet-Mix Macadam Courses

[illegible]

[illegible]

[illegible]

[illegible]

2 Provision of Lateral Confinement of Aggregates

[illegible]

[illegible]

Mixing of Aggregates with Water

[illegible]

[illegible]

[illegible]

Spreading of Aggregates

Rolling

Opening of Traffic

Surface Evenness of Wet-Mix Macadam Course

Rectification of Defective Construction

TECHNICAL SPECIFICATION
FOR
XI) ROADS AND DRAINAGE

PART-III : CONSTRUCTION OF RCC ROAD WITHIN PLANT

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XI) ROADS AND DRAINAGE

PART-III : CONSTRUCTION OF REINFORCED CEMENT CONCRETE ROAD WITHIN PLANT

SCOPE

GENERAL

Work to be provided for by the Contractor

Work to be provided for by Others

Codes and Standards

[illegible]

2[illegible] Conformity with Designs[illegible]

[illegible]

2[illegible] Materials to be Used[illegible]

[illegible]

2[illegible] General

[illegible]

2[illegible] Quality Control[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

TABLE- : 600-2. Texture Depth

EXECUTION

TESTING AND ACCEPTANCE CRITERIA

TECHNICAL SPECIFICATION
FOR
XII) REINFORCED CONCRETE CHIMNEY

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

I) REINFORCED CONCRETE CHIMNEY

SCOPE

GENERAL

Work to be provided for by the Contractor

2.2 Work by others

2.3 Codes and Standards

[illegible]

[illegible]

[illegible]

maximum utilisation of the available sizes and shapes for metal components.

2.05.00 Materials to be used

2.05.01 General Requirement

All materials, whether to be incorporated in the work or to be used temporarily for the construction, shall conform to the relevant IS specifications unless stated otherwise and shall be of the quality approved by the Engineer.

2.05.02 Cement

Generally, cement shall be 43 grade / 53 grade ordinary Portland Cement conforming to IS-8112 / IS 12269. In special cases any of the following type of cement may be permitted or directed to be used with prior approval by the Engineer :

a) 33 Grade ordinary Portland Cement conforming to IS 269.

b) Rapid hardening Portland Cement conforming to IS-8041.

c) Portland slag cement conforming to IS-455.

d) Portland Pozzolona Cement (fly ash based) Conforming to IS-1489 (Part-1).

e) Portland pozzolona Cement (calcined clay based) conforming to IS-1489 (Part 2).

f) Hydrophobic Cement conforming to IS-8043.

g) Low heat Portland Cement conforming to IS-12600.

h) Sulphate Resisting Portland Cement conforming to IS-12330.

2.05.03 Coarse Aggregate

Coarse aggregate shall be graded crushed or broken stone from approved sources, free from impurities and shall be screened free of dust and other deleterious matter. It shall conform to IS:383 or IS:515 and shall be washed clean, if necessary. The max. size of coarse aggregate for chimneys shall be 20 mm. down graded, unless otherwise stated (vide serial 5(b) of clause 3.3.6). Grading for a particular size shall conform to relevant IS Codes and shall be such as to produce a dense concrete of specified proportion and strength and shall be of consistency that will work readily into position without segregation.

2.05.04 Fine Aggregate

Fine aggregate shall be river or pit sand, free from any clay, earth, vegetable matters, salt or other impurities and shall be clean and fit for use, to the satisfaction of the Engineer. Sand acceptable for the work shall normally have a grading falling within the limits of one of the three grades, mentioned

2 Water

2 Reinforcement

2 Structural Steel

2 Paints

2 Fire Bricks, Acid Resistant Bricks and Castable Refractories

2 Storage of Materials

2 General

2.2.2 Cement

Aggregate

Reinforcement

Steel, Metal and Fittings

Paints

Bricks

Insulation Material

Electrical Items

2 Quality Control

EXECUTION

Concrete

Trial Mix, Grades of Concrete

TABLE-II

MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE DIFFERENT DEGREES OF WORKABILITY WITH DIFFERENT VALUES OF WATER - CEMENT RATIO (FOR GUIDANCE)

CEMENT/TOTAL AGGREGATE RATIOS

WORKABILITY	WATER/ CEMENT RATIO	RATIO BY WEIGHT OF CEMENT TO GRAVEL AGGREGATE		RATIO BY WEIGHT OF CEMENT TO CRUSHED STONE AGGREGATE [1]	
		20 mm to 10 mm	40 mm to 20 mm	20 mm to 10 mm	40 mm to 20 mm
Very low (Pressed concrete)	0.45	0.34	0.36	0.32	0.34
	0.50	0.32	0.34	0.30	0.32
	0.55	0.30	0.32	0.28	0.30
	0.60	0.28	0.30	0.26	0.28
Low (Vibrated concrete)	0.45	0.32	0.34	0.30	0.32
	0.50	0.30	0.32	0.28	0.30
	0.55	0.28	0.30	0.26	0.28
	0.60	0.26	0.28	0.24	0.26
Medium (Vibrated concrete)	0.45	0.30	0.32	0.28	0.30
	0.50	0.28	0.30	0.26	0.28
	0.55	0.26	0.28	0.24	0.26
	0.60	0.24	0.26	0.22	0.24
High (Concrete for trowelling)	0.45	0.28	0.30	0.26	0.28
	0.50	0.26	0.28	0.24	0.26
	0.55	0.24	0.26	0.22	0.24
	0.60	0.22	0.24	0.20	0.22

Note: 1 The proportion of sand to be taken as 35 percent of the total aggregate by absolute volume. The total aggregate may be taken as the sum of the quantities of gravel and crushed stone in the proportion in which they are actually used.

Note: 2

Batching of concrete

Mixing of Concrete

Workability of Concrete

LIMITS OF CONSISTENCY

Degree of workability	Slump in mm. with standard concrete		Use for which concrete is suitable
	Min.	Max.	

Note :

Placing and Compaction of Concrete

[illegible]

[illegible]

[illegible]

2.2.2.4 Reinforcement

2.2.2.4.1 Bending of Reinforcement

All reinforcement bars shall be bent cold to the shapes and dimensions shown on the drawings or as required by the Engineer-in-Charge. Bars shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the drawings shall not be used, unless specifically permitted by the Engineer-in-Charge. Bars shall be bent in accordance with IS 2502.

2.2.2.4.2 Placing

Reinforcement shall be placed in accordance with the drawings and as directed by the Engineer-in-Charge. Before placing, all reinforcement shall be cleaned of loose mill scale, loose rust, mud, oil or other coatings which may destroy or reduce the bond. Reinforcement shall be placed and maintained in position during the placing of concrete by means of approved supports, spacers, chairs or ties. The minimum clear cover to reinforcement shall be as shown on the drawings or as specified in the relevant clauses of IS 456.

Reinforcement shall not be displaced beyond the tolerances specified in IS 456 before or during the placing of concrete. Bars projecting from previous concrete work shall be carefully cleaned and straightened before new concrete is placed around them.

2.2.2.4.3 Fixing of Reinforcement

All reinforcement shall be fixed rigidly and securely tied at all intersections with annealed black iron wire of not less than 16 gauge. The ends of the wire shall be turned inwards away from the face of the concrete. Welding of reinforcement shall not be permitted except where specifically shown on the drawings or approved by the Engineer-in-Charge.

2.2.2.5 Forms

2.2.2.5.1 Design and Material of formwork

Forms shall be designed and constructed to withstand the pressure of the concrete and all other loads, vibration and construction operations without deflection or movement beyond the tolerances specified. They shall be of such material as will not affect the concrete surface adversely. Steel forms shall be used wherever practicable.

Forms shall be so constructed that they can be removed without damaging the concrete. They shall be removed in such manner as to ensure the complete safety of the structure. Forms shall not be removed without the approval of the Engineer-in-Charge.

2 Installation of Formwork

Tolerance

Stripping of formwork

Re-use of formwork

Construction by slip-form Method

Chimney Steel and Metal Work

General

Fabrication

Assembly

Painting

Galvanizing

[illegible]

[illegible]

[illegible]

[illegible] **Erection**

[illegible]

[illegible]

[illegible] **Cast Iron Chimney Cap**

[illegible]

[illegible]

[illegible]

[illegible] **Insulation and Protective Treatment**

[illegible]

[illegible] **Acid and Heat Resistant Paint**

[illegible]

[illegible]

[illegible]

[illegible]

2 Cement Paint

Acid Resistant Brick Lining

Fire Brick Lining

Insulation and Packing

Asbestos Rope

Slag or mineral wool

Slag or mineral wool insulation shall be used for insulation of hot surfaces of equipment and piping operating at temperatures above 200°C. The insulation shall be manufactured from slag or mineral wool fibres bonded with suitable binders. The insulation shall be supplied in the form of mattresses, slabs, sections or loose wool as required. The density of the insulation shall be not less than 120 kg/m3 for mattresses and slabs. The thermal conductivity of the insulation shall be not more than 0.045 W/m°C at 100°C mean temperature. The insulation shall be non-combustible and shall not support combustion. The insulation shall be resistant to moisture and shall not absorb more than 2% moisture by weight when exposed to atmosphere for 24 hours. The insulation shall be resistant to vermin and shall not support their growth. The insulation shall be supplied with suitable wire mesh or metal bands for holding the insulation in place.

Vermiculite Concrete

Vermiculite concrete insulation shall be used for insulation of hot surfaces of equipment and piping operating at temperatures above 200°C. The insulation shall be manufactured from vermiculite aggregate bonded with suitable binders. The insulation shall be supplied in the form of blocks or slabs as required. The density of the insulation shall be not less than 400 kg/m3. The thermal conductivity of the insulation shall be not more than 0.12 W/m°C at 100°C mean temperature. The insulation shall be non-combustible and shall not support combustion. The insulation shall be resistant to moisture and shall not absorb more than 5% moisture by weight when exposed to atmosphere for 24 hours. The insulation shall be resistant to vermin and shall not support their growth. The insulation shall be supplied with suitable wire mesh or metal bands for holding the insulation in place.

Asbestos Mill Board

Asbestos mill board insulation shall be used for insulation of hot surfaces of equipment and piping operating at temperatures above 200°C. The insulation shall be manufactured from asbestos fibres bonded with suitable binders. The insulation shall be supplied in the form of boards or sheets as required. The density of the insulation shall be not less than 1000 kg/m3. The thermal conductivity of the insulation shall be not more than 0.16 W/m°C at 100°C mean temperature. The insulation shall be non-combustible and shall not support combustion. The insulation shall be resistant to moisture and shall not absorb more than 5% moisture by weight when exposed to atmosphere for 24 hours. The insulation shall be resistant to vermin and shall not support their growth. The insulation shall be supplied with suitable wire mesh or metal bands for holding the insulation in place.

Lightning Protection System

The lightning protection system shall be provided for the protection of the power plant buildings and structures against lightning strikes. The system shall consist of air terminations, down conductors, earth electrodes and bonding conductors. The air terminations shall be provided on the roof of the buildings and structures at suitable intervals. The down conductors shall be provided from the air terminations to the earth electrodes. The earth electrodes shall be provided at suitable locations around the buildings and structures. The bonding conductors shall be provided for bonding the metallic parts of the buildings and structures to the earth electrodes. The system shall be designed in accordance with IS 2309.

Air Terminations

Air terminations shall be provided on the roof of the buildings and structures at suitable intervals. The air terminations shall be made of copper or aluminium rods or tapes. The air terminations shall be supported on suitable supports.

Down Conductors

Down conductors shall be provided from the air terminations to the earth electrodes. The down conductors shall be made of copper or aluminium rods or tapes. The down conductors shall be supported on suitable supports.

Earth Electrodes

Earth electrodes shall be provided at suitable locations around the buildings and structures. The earth electrodes shall be made of copper or galvanized iron rods or plates. The earth electrodes shall be buried in the ground at suitable depths.

Bonding Conductors

Bonding conductors shall be provided for bonding the metallic parts of the buildings and structures to the earth electrodes. The bonding conductors shall be made of copper or aluminium rods or tapes. The bonding conductors shall be supported on suitable supports.

Aviation Obstruction Lighting System

The aviation obstruction lighting system shall be provided for the protection of aircraft flying in the vicinity of the power plant. The system shall consist of obstruction lights, control panel and power supply. The obstruction lights shall be provided on the top of the chimney and other tall structures. The control panel shall be provided for controlling the operation of the obstruction lights. The power supply shall be provided for supplying power to the obstruction lights and control panel. The system shall be designed in accordance with ICAO Annex 14.

Obstruction Lights

Obstruction lights shall be provided on the top of the chimney and other tall structures. The obstruction lights shall be red in colour and shall be visible from a distance of at least 5 km. The obstruction lights shall be provided with suitable lenses and reflectors.

Control Panel

Control panel shall be provided for controlling the operation of the obstruction lights. The control panel shall be provided with suitable switches and indicators. The control panel shall be provided with suitable protection devices.

Sampling Port

22

MS insert plates for mounting of instruments for the measurement of amplitude of vibration and wind speed

TESTING AND ACCEPTANCE CRITERIA

General

Cement

Aggregate

Water

Concrete

INFORMATION TO BE SUBMITTED

With Tender

[illegible]

[illegible] [illegible]

[illegible]

[illegible] **After Award**

[illegible]

[illegible]

[illegible]

[illegible] **Programme of execution and requirement of materials**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **Samples**

[illegible]

[illegible]

[illegible]

[illegible] **Design Mix**

[illegible]

[illegible]

[illegible]

[illegible] **Detail Drawings**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

TECHNICAL SPECIFICATION
FOR
XIII) PROPERTIES, STORAGE AND HANDLING OF COMMON BUILDING MATERIAL

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]

XIII) PROPERTIES, STORAGE AND HANDLING OF COMMON BUILDING MATERIAL

SCOPE

MATERIALS

Bricks

Stone

Lime

Cement

Coarse Aggregates

Sand

Water

Reinforcement

STORAGE AND HANDLING OF MATERIALS

Bricks

Stones

Lime

Cement

Coarse and Fine Aggregates

Reinforcement

TECHNICAL SPECIFICATION
FOR
XIV) ANTI-TERMITE TREATMENT

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XIV) ANTI-TERMITE TREATMENT

SCOPE

EXECUTION

General

Chemicals and Rate of Application

Chemicals	Concentration by Weight, Percentage

Treatment of Column Pits, Wall Trenches and Basement Excavations

2.2.2.2 Treatment of Top Surface of Plinth Filling

2.2.2.3 Treatment of Soil Surrounding Pipes, Wastes and Conduits

2.2.2.4 Treatment of Expansion Joints

2.2.2.5 Treatment at Junction of the Wall and the Floor

2.3.0.0 ACCEPTANCE CRITERIA

2.4.0.0 I.S. CODE

TECHNICAL SPECIFICATION
FOR
XV) MASONRY AND ALLIED WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]

XV) MASONRY AND ALLIED WORK

SCOPE

INSTALLATION

Soling

Brick Soling

Stone Soling

Brick Edging

Masonry

General

Mortar

[illegible]

[illegible] [illegible] [illegible] [

2 Reinforced Brickworks

2 Stone Masonry (Not Used)

2 Exposed Stonework (Not Used)

2 Hollow and Solid concrete block Masonry (Not Used)

[illegible]

2[illegible] Composite Masonry (Not Used)

[illegible]

2[illegible] Expansion & Separation Joints

[illegible]

2[illegible] Moldings, Cornices, Drip Course

[illegible]

2[illegible]2[illegible] Curing

[illegible]

2[illegible] Embedding of fixtures

[illegible]

2[illegible] Encasing of Structural Steel

[illegible]

[illegible]

2[illegible] **Damp Proof Course**

[illegible]

[illegible]2[illegible]

2[illegible]

2[illegible] **Damp Proof Membrane**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **I.S. CODES**

[illegible]

[illegible]

[illegible]2[illegible]

[illegible]2[illegible]

[illegible]

[illegible]

[illegible]

[illegible]22[illegible]2[illegible]

[illegible]22[illegible]

[illegible]

[illegible]

[illegible]

TECHNICAL SPECIFICATION
FOR
XVI) FINISH TO MASONRY AND CONCRETE

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XVI) FINISH TO MASONRY AND CONCRETE

SCOPE

INSTALLATION

Preparation of Surface

Plastering

Mortar

[illegible]

[illegible]

2.2.2 Application of Plaster

[illegible]

[illegible]

[illegible]

Neat Cement Finish

Coloured Plaster Finish (Not Applicable)

2.02.01

2

Pebble-dash Finish (Not Applicable)

2.02.01

2

2

Rough-Cast Finish (Not Applicable)

2

Scraped Finish (Not Applicable)

2.02.01

Textured Finish (Not Applicable)

2.02.01

Textured Finish with Granules

2.02.02 Curing

2.02.03 Pointing to Masonry (Not applicable)

2.02.04 Plaster with Metal Lath

[illegible]

[illegible]

[illegible]

2[illegible] Lime Punning (Not Applicable)

[illegible]

[illegible]

[illegible]

2[illegible] Plaster of Paris Punning (Not Applicable)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Wall Putty Finish to interior & Exterior Surfaces.

[illegible]

[illegible]

[illegible]

[illegible]

2[illegible] Stone Facing

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

ACCEPTANCE CRITERIA

I.S. CODE

TECHNICAL SPECIFICATION
FOR
XVII) SINGLE SHEET / SANDWICH / DOUBLE SKIN METAL CLADDING

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XVII) SINGLE SHEET / SANDWICH / DOUBLE SKIN METAL CLADDING

GENERAL

Description

Applicable Codes and Standards

Submittals

[illegible]

[illegible]

[illegible]

2 □

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DOUBLE SKIN INSULATED METAL CLADDING

General

EXECUTION

Inspection

2.0 Installation

Clean-Up

TECHNICAL SPECIFICATION
FOR
XVIII) CARPENTRY AND JOINERY

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XVIII) CARPENTRY AND JOINERY

SCOPE

INSTALLATION

Materials

Timber

Plywood

Decorative Laminated Plastic Sheets

Flush Doors

Panel Doors

Fixtures

Workmanship

General

Finish

Surface Treatment

ACCEPTANCE CRITERIA

Door and Window Frames

Door and Window Shutters

Partitions, Paneling, Pelmets, Furniture, etc.

General

Partition

Pelmets

Cupboard Shutters

Drawers

Loose Furniture

IS CODES

TECHNICAL SPECIFICATION
FOR
XIX) METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XIX) METAL DOORS, WINDOWS, VENTILATORS, LOUVRES, ETC.

SCOPE

INSTALLATION

Materials

2.2 Fabrication

2.2.1 Steel Doors, Windows, Ventilators, Louvres, etc.

a) Door Frames

b) Double Plate Flush Door Shutters

Single Sheet Door Shutters

2

Sliding Doors

2

Fire Proof Door

2

Door Threshold

Steel Windows, Sashes, and Ventilators etc.

[illegible]

[illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] **M.S grill**

[illegible] [illegible] [illegible]

[illegible] **Aluminium Door, Windows and Frames**

[illegible]

[illegible]

[illegible] [illegible]

[illegible] **Shop Coat or Paint**

[illegible]

[illegible]

[illegible] [illegible]

[illegible]

2 Handling & Storage of Fabricated Material

2 Assembly & Erection at Site

ACCEPTANCE CRITERIA

For Fabricated Items

For Installed Items

INFORMATION TO BE SUBMITTED

With Tender

After Award

I.S. CODES

TECHNICAL SPECIFICATION
FOR
XX) ALUMINIUM FRAMED GLAZED CURTAIN WALLS AND STRUCTURAL GLAZING

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XX) ALUMINIUM FRAMED GLAZED CURTAIN WALLS AND STRUCTURAL GLAZED WALL

SCOPE

INSTALLATION

System and Materials

- **Stick wall system**

- **Ladder or semi-unitized system**

- **Unitized system**

Structural glazing

[illegible]

[illegible]

[illegible]

[illegible]

INFORMATION TO BE SUBMITTED BY CONTRACTOR

[illegible]

After award of contract

[illegible]

[illegible]

[illegible]

[illegible]

I.S. Code

2

TECHNICAL SPECIFICATION
FOR
XXI) ROLLING STEEL SHUTTERS AND GRILLS

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXI) ROLLING STEEL SHUTTERS AND GRILLS

SCOPE

INSTALLATION

Components

Materials

Fabrication

Finishing

Installation

[illegible]

[illegible]

[illegible]

ACCEPTANCE CRITERIA

Shop Inspection

Field Inspection

Guarantee

I.S. CODE

TECHNICAL SPECIFICATION
FOR
XXII) GLASS AND GLAZING

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXII) GLASS AND GLAZING

SCOPE

INSTALLATION

General

Materials

2.2 Glazing, Setting and Finish

ACCEPTANCE CRITERIA

I. S. CODES

TECHNICAL SPECIFICATION
FOR
XXIII) FLOOR FINISHED AND ALLIED WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXIII) FLOOR FINISHED AND ALLIED WORK

SCOPE

In Situ Finishes

Tiled Finishes

Base

2.2.4 Sequence

[illegible]

2.3 INSTALLATION

2.3.1 Special Materials

[illegible]

[illegible]

2.3.2 Workmanship

[illegible]

2.3.3 Preparation of the Base Surface

[illegible]

[illegible]

[illegible]

[illegible]

In Situ Finishes

Integral Finish to Concrete Base

Red Oxide of iron finish (Not Applicable)

Thickness

Mix

Underbed

Topping

Laying

d) Polishing

Terrazo Finish : In Situ (Not Applicable)

Thickness

Mix

Underbed

Topping

Laying

[illegible]

[illegible]

[illegible]

2 Granolithic Finish

Thickness

Mix

Laying of Monolithic Topping

Laying of Topping Separately on Hardened Base

Curing

Grinding

2

Finishing

Patent Stone

Thickness

Mix

Underbed

2

Topping

Laying

2

2 Metallic Hardener Like “Ironite” Finish

Thickness

Material

Mix

Laying

2 Non Metallic Hardener Like SIKA' Chapdur' Finish

2 Mastic Asphalt Finish (Not used)

Thickness

Materials

Composition

Laying

Chemical Resistant in Situ Finish (Not used)

Tiled Finish

Terrazzo Tile Finish

Thickness

Tiles : Terrazzo

Mix : Underbed

Laying

Grinding and Polishing

Heavy duty Cement Concrete (Carborundum) tile

[illegible]

[illegible]

[illegible]

Tiles : Glazed/ mat finish Ceramic tiles

Mix : Underbed

Laying

Finishing

2.2 Vitrified tiles

2.2 Tesserae Finish (Mosaic etc.) (Not Used))

Thickness

Tesserae Finish

Mix : Underbed

Laying

Chemical Resistant Tiled Finish

Tiles

Laying

Rubber, Vinyl or Vinyl Asbestos Tiles Finish

Thickness

Tiles

Mix : Underbed

Laying

Finishing

Store Slab Finish : Marble, Stone and Similar Fine Grained Stone

Thickness

Stone Slab

Mix : Underbed

Laying

Polishing, Finishing

Stone Slab Finish : Sand Stone & Similar Coarse Grained Stone Finish

Base and Sub base for Flooring

ACCEPTANCE CRITERIA

I.S. CODES

TECHNICAL SPECIFICATION
FOR
XXIV) FALSE FLOORING

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXIV) FALSE FLOORING

SCOPE

FALSE FLOORING SYSTEM

Base

Supporting Structure

Floor Panel

Strength

Surface Finish

Skirting

Installation

ACCEPTANCE CRITERIA

TECHNICAL SPECIFICATION
FOR
XXV) PAINTING, WHITE WASHING AND POLISHING ETC.

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXV) PAINTING, WHITE WASHING AND POLISHING ETC.

SCOPE

INSTALLATION

Materials

White Washing (Not Used)

Dry Distemper (Not Used)

Oil Bound Washable Distemper (Not Used)

Waterproof Cement Paint

Acrylic Emulsion Paint internal and external use.

Acrylic Washable distemper.

e)

Synthetic Enamel Paint

Aluminium Paint

French Polish (Not Used)

Storage

Preparation of Surface

Wood

2.2.2 Masonry, Concrete and Plastered Surface

2.2.2.1 Mildew

2.2.3 Metal

2.3 Application

2.3.1 General

[illegible]

[illegible]

[illegible]

2 Waterproof Cement Paint

2 Acrylic Emulsion Paint

2 Synthetic Enamel Paint

2 Aluminium Paint

2 Clear Synthetic Varnish * Not Used)

2 French Polish (Not Used)

2 Chemical Resistant Paint

2 Epoxy coating/painting

Protection

Cleaning up

ACCEPTANCE CRITERIA

I.S. CODE

TECHNICAL SPECIFICATION
FOR
XXVI) SUSPENDED CEILING

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXVI) SUSPENDED CEILING

SCOPE

INSTALLATION

Suspension System

General

Metal Grid Suspension System

[illegible]

2[illegible] Timber Grid Suspension System (Not used)

[illegible]

2[illegible]2[illegible] Ceiling Panels

2[illegible]2[illegible] Materials

[illegible]

[illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]2[illegible]

[illegible]

[illegible]

2[illegible]2[illegible]2[illegible] Installation of Ceiling Panels[illegible]

[illegible]

[illegible]

[illegible]

[illegible]2[illegible]

[illegible]

[illegible]

ACCEPTANCE CRITERIA

I. S. CODES

TECHNICAL SPECIFICATION
FOR
XXVII) SHEET WORK IN ROOF AND SIDING

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

SHEET WORK IN ROOF AND SIDING

SCOPE

INSTALLATION

Storage of Materials

Workmanship

Asbestos Sheeting

C.G.I. Sheeting and Aluminium Sheeting

2.2.2.2 Fibre Glass Reinforced Plastic Sheeting

2.2.2.2.1 [illegible]

2.2.2.2.2 [illegible]

2.2.2.2.3 [illegible]

2.2.2.2.4 [illegible]

2.2.2.3 Poly Carbonate Roofing vault etc.

2.2.2.3.1 [illegible]

2.2.2.3.2 [illegible]

ACCEPTANCE CRITERIA

IS CODES

TECHNICAL SPECIFICATION
FOR
XXVIII) ROOF WATER PROOFING, INSULATION AND ALLIED WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXVIII) ROOF WATER PROOFING, INSULATION AND ALLIED WORK

SCOPE

INSTALLATION

Grading Underbed

Concrete

2 Insulation

2 Foam Concrete (Not Used)

2 Expanded Polystyrene Blocks

2 **Fillets**

2 Fillets shall be provided at the junction of floor and wall, wall and wall, wall and ceiling, wall and beam, beam and ceiling, beam and beam, beam and column, column and floor, column and column, column and ceiling, floor and ceiling, floor and floor, floor and beam, ceiling and ceiling, ceiling and column, ceiling and floor, ceiling and beam, beam and floor, beam and ceiling, beam and column, column and floor, column and ceiling, column and beam, floor and column, floor and beam, floor and ceiling, ceiling and column, ceiling and beam, ceiling and floor, beam and column, beam and floor, beam and ceiling, column and beam, column and floor, column and ceiling

[illegible]

[illegible]

[illegible]

2 Flashing

2 Elastromeric Membrane

2 Primer Coat

2 Finishing Coats

Water Proof Membrane

Surface Finish

ACCEPTANCE CRITERIA

I.S. CODES AND STANDARDS

XXIX) WATER SUPPLY

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXIX) WATER SUPPLY

SCOPE

Materials

Pipes and Pipe Fittings

Water Reservoirs

Related Works

Regulation

INSTALLATION

Pipe Lines

Laying

2.2.2 Back Flow

2.2.3 Contamination

2.2.4 Underground Pipings

2.2.5 Concealed Piping

2.2.6 Jointing of Pipes

Cast Iron

Spigot and Socket Joints

Lead joint :

Flanged Joints :

Steel

G I Pipes

Asbestos Cement Pipes

Lead

Concrete

P. V. C.

Tyton Joint

Painting

Storage Tank - Pressed Steel Tank

G. I. Water Tank

Valve, Cocks, Taps

Protection

TESTING AND ACCEPTANCE

Inspection Before Installation

Testing of Mains After Laying

Testing of Service Pipes and Fittings

I.S. CODES

TECHNICAL SPECIFICATION
FOR
XXX) DRAINAGE AND SANITATION

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXX) DRAINAGE AND SANITATION

SCOPE

INSTALLATION

General

Rainwater Downcomers

Gutters

Soil and Drainage Pipes

Gradients

Relation with water supply pipe lines

Laying

2 Support and Protection on Pipelines

[illegible]

[illegible]

2[illegible] **Ducts**

[illegible]

[illegible] [illegible]

[illegible]

2[illegible] **Traps and Ventilating Pipes**

[illegible]

[illegible] [illegible]

[illegible]

[illegible] [illegible]

[illegible]

2[illegible] **Manhole and Inspection Chambers**

[illegible]

[illegible] [illegible]

[illegible]

[illegible] [illegible] 2[illegible]

[illegible]

[illegible] [illegible]

[illegible]

[illegible] [illegible]

[illegible]

2[illegible] **Cutting of Pipes**

[illegible]

[illegible] [illegible]

[illegible]

2 Jointing

a) Cast Iron Pipes :

b) Concrete Pipes

c) Glazed Stoneware Pipes

d) Vitrified clay pipes

2

e) Lead Pipes

f) PVC Pipes

g) Jointing Cast Iron Pipes with Stoneware Pipes

h) Jointing Stoneware with Cast Iron Pipes

[illegible]

[illegible]

[illegible]

2 Trenches and other excavations

[illegible]

[illegible] [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

2 Fixtures

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

2[illegible] **Water closet**

[illegible]

a) Raised type

[illegible]

[illegible]

[illegible]

b) Squatting type[illegible]

[illegible]

[illegible]

[illegible]

2[illegible]2[illegible] **Urinals**

[illegible]

[illegible]

[illegible]

2[illegible] **Wash basin**[illegible]

[illegible]

[illegible]

[illegible]

2 **Sink**

[illegible]

[illegible]

2 **Bathroom mirror**

[illegible]

[illegible]

2 **Glass shelves**

[illegible]

[illegible]

2 **Towel rail**

[illegible]

[illegible]

2 **Soap holder**

[illegible]

[illegible]

2 **Liquid soap dispenser**

[illegible]

[illegible]

2 **Toilet roll holder**

[illegible]

[illegible]

2 **Installation**

[illegible]

[illegible]

[illegible]

2 Septic tank & effluent disposal

2 Septic tank

2 2 2

2 2 Effluent Disposal

2 Soak pit

2 Open joined SW Pipe / dispersion trenches

2

2 Commissioning septic tank

TESTING AND ACCEPTANCE

Inspection before installation

Testing of Pipelines

General guidance for the tests are given below :

a) Smoke test

b) Water test

For pipes other than Cast Iron

Subsidence of test water may due to one or more of the following cases:

For cast iron pipes

c) For straightness

Testing Septic Tank

Fixtures etc.

CODES AND STANDARDS

TECHNICAL SPECIFICATION
FOR
XXXI) BOILER DRAIN DIVERSION

CONTENT

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	**ATTACHMENTS**
[illegible]	[illegible]
[illegible]	[illegible]

XXXI) BOILER DRAIN DIVERSION

1.00.00 SYSTEM DESCRIPTION

2.00.00 SCOPE OF WORK

3.00.00 DETAILED SPECIFICATION

A. Drain Channel :

B. Settling Tank :

C. Drain Pumps :

Material of Construction of Pumps :

D. Drain Piping :

TECHNICAL SPECIFICATION
FOR
XXXII) GEO-TEXTILE FABRIC

CONTENTS

CLAUSE NO. **DESCRIPTION**

2

TECHNICAL SPECIFICATION
FOR
XXXII) GEO-TEXTILE FABRIC

1.0 SCOPE

2.0 GENERAL

2.1 Work to be provided by the Contractor

2.2 Work to be provided by others

2.3 Conformity with Designs

2 Materials to be used

2 General

2.2 Geo-textile

Property	Test Method
Non-woven Geo-textile :	
Woven Geo-textile :	

EXECUTION

ACCEPTANCE CRITERIA

TECHNICAL SPECIFICATION
FOR
XXXIII) LANDSCAPING WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

TECHNICAL SPECIFICATION
FOR
XXXIII) LANDSCAPING WORK

1.0 SCOPE

1.1 The scope of work shall include supply of all materials, labour, tools, equipment, transportation, services and performance of all operations for landscaping work in accordance with the drawings, specifications and as directed by the Engineer-in-charge. The work shall include but not be limited to the following:

1.2 Development of green belt around the plant boundary, roads, buildings, open areas, etc. Plantation of trees, shrubs, creepers, grass, etc. Maintenance of the plantation for a period of one year after completion of the work.

1.3 Earthwork in excavation, filling, levelling, dressing, etc. Construction of retaining walls, pits, etc. Supply of soil, manure, fertilizers, etc.

1.4 Supply of plants, trees, shrubs, creepers, grass, etc. Planting, staking, guarding, watering, weeding, etc. Replacement of dead plants, trees, shrubs, creepers, grass, etc.

2.0 MATERIAL

2.1 (a) The soil shall be free from stones, bricks, concrete pieces, debris, etc. The soil shall be fertile and suitable for plantation. The soil shall be tested and approved by the Engineer-in-charge before use.

2.1 (b) The manure shall be well decomposed cattle dung or compost. The manure shall be free from weeds, seeds, etc. The manure shall be tested and approved by the Engineer-in-charge before use.

2.1 (c) The fertilizers shall be of approved quality and shall be used in accordance with the manufacturer's instructions.

2.1 (d) The plants, trees, shrubs, creepers, grass, etc. shall be of approved species and shall be healthy, vigorous and free from pests and diseases.

[illegible]

[illegible]

[illegible]

MAINTENANCE

ACCEPTANCE CRITERIA

I.S. CODE

VOLUME: IIG/3

TECHNICAL SPECIFICATION
FOR
CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

CONTENTS

VOLUME: IIG/3 : TECHNICAL SPECIFICATION FOR CIVIL, STRUCTURAL AND ARCHITECTURAL WORKS

TECHNICAL SPECIFICATION
FOR
I) LAND SURVEY AND ESTABLISHING REFERENCE GRIDS AND BENCH MARK PILLARS

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

I) LAND SURVEY AND ESTABLISHING REFERENCE GRIDS AND BENCH MARK PILLARS

SCOPE

2 GENERAL

2 Work to be Provided for by the Contractor

2

2 With Tender

2 After Award

INSTRUMENTS AND CONSTRUCTION MATERIALS

Instruments

Construction Materials for Reference Grid and Bench Mark Pillars

EXECUTION

Permanent Adjustments

2.0 Contour Intervals and Scale of Drawings

2.1 Contour Intervals

2.2 Scale of Drawings

Submission of Drawings and Documents

Time of Completion

Security Rules and Statutory Regulations

TECHNICAL SPECIFICATIONS

Establishing of Bench Marks

Establishing of Grid Pillars

Reference Grid Pillars and Bench Marks

Topographical Surveying and Mapping

Traversing and Ground Controls

Contouring

Route Survey

TECHNICAL SPECIFICATION
FOR
II) GEO TECHNICAL INVESTIGATION

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

II) GEOTECHNICAL INVESTIGATION

1.0 SCOPE

The scope of work for geotechnical investigation shall include collection of all relevant data for the design and construction of foundations for all the buildings and structures, roads, drainage, underground services, etc. The investigation shall also include the collection of data for the design of earthwork, slopes, embankments, etc. The investigation shall be carried out in accordance with the relevant Indian Standard Codes of Practice.

2.0 GENERAL

The geotechnical investigation shall be carried out by a reputed agency approved by the Owner. The Contractor shall submit the name of the agency for approval of the Owner. The Contractor shall submit the detailed investigation report for approval of the Owner. The report shall include the following:

2.1 Work to be provided for the Contractor

The Contractor shall provide the following:

a) Boring, sampling, testing and reporting in accordance with the relevant Indian Standard Codes of Practice. The number of boreholes, depth of boreholes, type of tests, etc. shall be as per the requirements of the Owner.

b) Laboratory testing of soil samples in accordance with the relevant Indian Standard Codes of Practice.

c) Preparation of detailed geotechnical investigation report including recommendations for foundations, earthwork, slopes, embankments, etc.

d) Submission of the report in triplicate to the Owner.

2.2 Work to be provided by others

The Owner shall provide the following:

a) Approval of the agency for geotechnical investigation.

b) Approval of the geotechnical investigation report.

2 Location and Levels

2 Codes and Standards

SOIL EXPLORATION

Test Boring

Stabilization of Boreholes

Open Trial Pits

Boring in River Bed

Rock Drilling

□

□ □□□□

2 Chunk Samples

Sampling in rock

Record of Boring

PENETRATION TESTS

Standard Penetration Test

Static Cone Penetration Test

Dynamic Cone Penetration Test

GROUNDWATER INVESTIGATION

Ground Water Level Observation

In-Situ Permeability Test

Pump-in Test

Constant Head Method (in borehole)

Falling Head Method (in borehole)

Percolation test (in trial pit)

Pump-Out Test

FIELD TESTS

Menard Pressure meter Test

Direct Load Tests on Soils

Vane shear Tests

Determination of Dry-Density of Soils

Sand Replacement Method

Core-cutter Method

Ring and Water Replacement Method

Rubber balloon Method

In-situ Block Shear/Wedge Shear Test

Test for Measurement of soil Resistivity

2

2

2

2

TESTS FOR DYNAMIC PROPERTIES

Block Vibration Test

2 Wave Propagation Test

Cyclic Plate Load Test

FIELD DETERMINATION OF CALIFORNIA BEARING RATIO

LABORATORY TESTS ON SOIL SAMPLES/ROCK CORES

REPORT ON SUB-SOIL INVESTIGATION

General

2.0 Data to be furnished

Geological information

Recommendations

Additional Recommendations

[illegible]

[illegible]

[illegible]

TECHNICAL SPECIFICATION
FOR
III) AREA GRADING AND SLOPE PROTECTION

CONTENTS

SECTIONS	DESCRIPTION
[illegible]	[illegible]
[illegible]	[illegible]

PART-A

TECHNICAL SPECIFICATION - GENERAL

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

PART-A

TECHNICAL SPECIFICATION - GENERAL

SCOPE OF WORK

2 DESCRIPTION AND FEATURES OF THE SITE

Location of Power Plant

Meteorological Data

SOIL CHARACTERISTICS

SPECIFICATIONS

DRAWINGS

Sl. No.	Drawing No.	Description

[illegible]

[illegible]

[illegible] **LAYOUT**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **WORKMANSHIP**

[illegible]

[illegible]

[illegible]

[illegible] **TEMPORARY WORK**

[illegible]

[illegible]

[illegible]

TENDER DRAWINGS (Refer Volume IIL of Specification)

PART-B

TECHNICAL SPECIFICATION
FOR
III) AREA GRADING AND SLOPE PROTECTION

CONTENTS

CLAUSE NO. **DESCRIPTION**

2

SECTION-II

TECHNICAL SPECIFICATION
FOR
A) AREA GRADING AND SLOPE PROTECTION

1.0 SCOPE

1.1 The scope of work under this specification shall include area grading, slope protection, construction of retaining walls, drainage channels, culverts, bridges, boundary wall, gates, approach roads, internal roads, pavements, parking areas, footpaths, kerbs, etc. complete in all respects as per the requirements of this specification and as shown on the drawings. The scope shall also include all temporary works, such as temporary drainage, temporary roads, etc. required for the execution of the work. The scope shall also include all earthwork in excavation and filling required for the above mentioned works.

2.0 GENERAL

2.1 Work to be provided for by the Contractor

2.1.1 The Contractor shall provide for all labour, materials, tools, plant, equipment, transport, supervision, etc. required for the execution of the work.

2.1.2 (a) The Contractor shall be responsible for the setting out of the works and shall be responsible for the correctness of the same. The Contractor shall provide all necessary survey instruments, equipment, etc. required for the setting out of the works.

2.1.3 (a) Before commencing the work, the Contractor shall submit to the Engineer-in-Charge for approval, a detailed programme for the execution of the work. The programme shall be prepared in such a manner that the work is completed in all respects within the time specified in the Contract.

2.1.4 (a) The Contractor shall be responsible for the safety of all workmen employed by him and shall provide adequate safety measures, such as safety nets, safety belts, etc. as required.

2.1.5 (a) The Contractor shall be responsible for the protection of the work executed by him and shall make good any damage to the work at his own cost.

2.2 Work to be provided for by others

2.2.1 (a) The Employer shall provide for the land required for the works. The Contractor shall be responsible for the acquisition of any additional land required by him for his temporary works, such as temporary roads, temporary drainage, etc.

2 Codes and Standards

2 Conformity with Designs

2 Materials to be used

2

2

2.2

2

2

2

2

Quality Control

2

2

2 Information regarding Site Conditions

EXECUTION

General

[illegible]

[illegible]

[illegible]

Classification

Classification

Classification

Classification

Classification

Classification

Earthwork in Excavation

[illegible]

[illegible]

[illegible]

2

- [illegible]

- [illegible]

- [illegible]

[illegible]

[illegible]

[

[illegible]

[illegible]

[illegible]

Where excavated material is mostly rock, the boulders shall be broken into pieces not longer than 150 mm size, mixed with properly graded fine material consisting of murum or earth to fill up the voids and the mixtures used for filling.

If any material rejected by the Engineer, Contractor shall remove the same forthwith from the site at no extra cost of the Owner. Surplus fill material shall be deposited/disposed of as directed by the Engineer after the fill work is completed.

No earthfill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by the Engineer.

Before commencement of area filling the existing top soil shall be removed upto a minimum depth of 200 mm or more, as directed by the Engineer in order to clear the surface of undesirable materials. After this the filling operation shall be performed with earth in layers not exceeding 250 mm, loose thickness. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as given below and got approved by the Engineer.

a) Each layer of earth of cohesive nature shall be compacted to 90% of proctors dry density unless otherwise permitted/directed by the Engineer.

b) Each layer of earth of non-cohesive nature shall be compacted to minimum 75% relative density unless otherwise permitted/directed by the Engineer.

Each shall be compacted with approved machine (mechanical plant) and usually manual compaction shall not be allowed unless specifically permitted by the Engineer. The original ground formation and each fill layer shall be compacted by rollers as described below with a maximum of six passes of 8/10 tonne roller.

i) When the optimum moisture content of soil is relatively high, a pneumatic tyred roller (type pressure 3.0 - 3.5 kg/sq.cm) shall be considered to give better performance for mechanical compaction.

ii) When the optimum moisture content of soil is relatively low, a vibrating roller shall be considered to give better performance for mechanical compaction.

Since the degree of compaction depends on the moisture content of the soil, a close watch shall be kept on this aspect and corrections done to optimise the moisture content. The adequacy of the compaction and moisture content of the soil shall be determined by performing field density tests and other tests as and when directed by the Engineer and shall conform to the stipulations laid down in IS:4701.

The cohesionless soil to be used for area filling, should be placed in fully saturated condition to obtain the maximum possible density. The saturation

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

TESTING AND ACCEPTANCE CRITERIA

Soil Testing

Acceptance Criteria

2.2 [illegible]

[illegible]

[illegible]

INFORMATION TO BE SUBMITTED

With Tender

[illegible]

a) [illegible]

b) [illegible]

c) [illegible]

After Award

[illegible]

a) [illegible]

b) [illegible]

TECHNICAL SPECIFICATION
FOR
IV) EARTHWORK IN EXCAVATION AND BACKFILLING

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

IV) EARTHWORK IN EXCAVATION AND BACKFILLING

SCOPE

GENERAL

Work to be provided for by the Contractor

Work to be provided for by others

Codes and Standards

IS 2720 :	Determination of Moisture Content (Part-II)	
IS 2720 :	Determination of Moisture content/Dry Relation (Part-VII) using Light Compaction.	
IS 2720 :	Determination of Density Index (Relative Density) (Part-xiv) of cohesionless soils.	
IS 2720 :	Determination of Dry Density, in place, by core (Part-xxix) cutter method.	
IS 2720 :	Determination of Dry Density of soils, in place, (xxviii)	(Part-by sand replacement methods.
IS:3764 :	Safety code for Excavation work.	
IS:4081 :	Blasting and Related Drilling Operations	
IS:4701 :	Earthwork on canals	

2.04.00 Conformity with Designs

The Contractor is to carry out the work as per the drawings issued to him and/or Contractor's drawings which are approved by the Engineer and/or the Engineer's instructions.

2.05.00 Materials to be used

2.05.01 General

All materials required for the work shall be of best commercial variety and approved by the Engineer.

2.05.02 Borrow Material

Borrow material required for back-filling shall be excavated from approved locations & levels and shall consist of material, approved by the Engineer free from roots & vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and clods. If specified, clean graded sand free from harmful and deleterious material from approved quarries shall be used as fill material.

2.06.00 Quality Control

The Contractor shall submit the Quality Assurance Plan (QAP) for total work to the Owner/Engineer for approval and follow the approved plan during work execution.

The Contractor shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. The quality control operation shall include but not be limited to the following items of work:

2 Information regarding site conditions

EXECUTION

Setting Out

2 Initial Levels

Clearing and Grubbing, etc.

Classification

Ordinary Soil

Hard Soil

Soft and Decomposed Rock

Hard Rock (requiring blasting)

[illegible]

Hard Rock (blasting prohibited)

[illegible]

Excavation for Foundations and Trenches

General

[illegible]

[illegible]

[illegible]

[illegible]

Blasting

General

Storage of Explosive

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **Carriage of Explosives**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **Use of Explosives**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Disposal

Disposal of Surplus

Protection

Dealing with Surface Water

Dewatering

Timber Shoring

Close Timbering

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **Open Timbering**

[illegible]

[illegible]

[illegible] **Treatment of Slips**

[illegible]

[illegible]

[illegible] **Back-filling**

[illegible]

[illegible] **General**

[illegible]

[illegible]

[illegible]

[illegible]

Filling and Compaction in Pits and Trenches around Structures

Plinth Filling

Filling in Trenches for Water Pipes and Drains

Filling in Disposal Area

Approaches and Fencing

Lighting

TESTING AND ACCEPTANCE CRITERIA

Excavation

2.2.2.2 Back-filling

INFORMATION TO BE SUBMITTED

With Tender

After Award

a) [illegible]

b) [illegible]

TECHNICAL SPECIFICATION
FOR
V) CEMENT CONCRETE – PLAIN AND REINFORCED

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

V) CEMENT CONCRETE - PLAIN AND REINFORCED

SCOPE

General

GENERAL

Work to be provided for by the Contractor

2.2 Work by Others

2.3 Information to be submitted by the Tenderer

2.3.1 With Tender

2.2.2 After Award

(a) Contractor shall submit to Employer for approval the Contract Performance Guarantee in the form and amount as specified in the Contract Agreement.

(b) Upon receipt of the Contract Performance Guarantee, Employer shall return the Bid Security to Contractor.

(c) (i) Contractor shall submit to Employer for approval the Contractor's Representative, Contractor's Key Personnel and Contractor's Equipment as specified in the Contract Agreement. Contractor shall not remove or replace any of the Contractor's Representative or Contractor's Key Personnel except as Employer may agree or direct. If any of the Contractor's Representative or Contractor's Key Personnel dies or is incapacitated, Contractor shall immediately appoint a replacement. If Employer requires the removal of any person, including the Contractor's Representative or Contractor's Key Personnel, Contractor shall appoint a replacement.

(d) (i) Contractor shall submit to Employer for approval the Contractor's Documents as specified in the Contract Agreement.

(e) (i) Contractor shall submit to Employer for approval the Program as specified in the Contract Agreement.

(f) (i) Contractor shall submit to Employer for approval the Health and Safety Manual as specified in the Contract Agreement.

(g) (i) Contractor shall submit to Employer for approval the Quality Plan as specified in the Contract Agreement.

(h) (i) Contractor shall submit to Employer for approval the Insurance policies as specified in the Contract Agreement.

(i) (i) Contractor shall submit to Employer for approval the Monthly Statements as specified in the Contract Agreement.

(j) (i) Contractor shall submit to Employer for approval the Contractor's Representative, Contractor's Key Personnel and Contractor's Equipment as specified in the Contract Agreement. Contractor shall not remove or replace any of the Contractor's Representative or Contractor's Key Personnel except as Employer may agree or direct. If any of the Contractor's Representative or Contractor's Key Personnel dies or is incapacitated, Contractor shall immediately appoint a replacement. If Employer requires the removal of any person, including the Contractor's Representative or Contractor's Key Personnel, Contractor shall appoint a replacement.

(k) (i) Contractor shall submit to Employer for approval the Contractor's Documents as specified in the Contract Agreement.

(l) (i) Contractor shall submit to Employer for approval the Program as specified in the Contract Agreement.

(m) (i) Contractor shall submit to Employer for approval the Health and Safety Manual as specified in the Contract Agreement.

(n) (i) Contractor shall submit to Employer for approval the Quality Plan as specified in the Contract Agreement.

(o) (i) Contractor shall submit to Employer for approval the Insurance policies as specified in the Contract Agreement.

(p) (i) Contractor shall submit to Employer for approval the Monthly Statements as specified in the Contract Agreement.

2 Conformity with Design

2 Materials to be used

2 General Requirement

2.2 Cement

2 Aggregates

2 Water

2 Admixture

2

Reinforcement

2 Storage of Materials

2 General

2

2 Cement

2

2

2 Aggregates

2

2

2 Reinforcement

2 Quality Control

INSTALLATION

Washing and Screening of Aggregates

2 Admixture

Grades of Concrete

Proportioning and Works Control

General

2 Mix Design Criteria

TABLE-I

STRENGTH REQUIREMENT OF CONCRETE

Note-1

Note-2

TABLE-II

MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE DIFFERENT DEGREES OF WORKABILITY WITH DIFFERENT VALUES OF WATER - CEMENT RATIO

(FOR GUIDANCE) CEMENT/TOTAL AGGREGATE RATIOS

Strength Requirements

Minimum Cement Content

Water-Cement Ratio

Strength Requirement

Durability Requirement

TABLE-IV

MAXIMUM PERMISSIBLE WATER/CEMENT RATIOS FROM DURABILITY CONSIDERATIONS FOR DIFFERENT TYPES OF STRUCTURES AND DEGREES OF EXPOSURE USING ORDINARY PORTLAND CEMENT

	Exposure Conditions	
	In Air	**In Air**

						Exposure Conditions

Workability

TABLE-V

LIMITS OF CONSISTENCY

Size of Coarse Aggregates

[illegible]

[illegible]

[illegible]

2 Placing and Compacting Concrete

2

Construction Joints and Cold Joints

Construction Joints

2

Cold Joint

[illegible]

[illegible] [illegible] [illegible] [

2 Finishing Unformed Surface

Protection and Curing of Concrete

Reinforcement

Bar Bending Schedules

Cleaning

Cutting & Bending of Reinforcement

Placing in Position

2

Welding

2

Control

2

Cold Weather Concreting

Hot Weather Concreting

Concreting under Water

2 Form Work

General

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Cleaning and Treatment of Forms

[illegible]

[illegible]

[illegible]

[illegible] Design

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Inspection of Forms

[illegible]

[illegible]

[illegible]

[illegible] Removal of Forms

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

TABLE-VI

SCHEDULE OF REMOVAL OF FORM

2.0 Tolerance

2.0 Re-use of Forms

2.0 Classification

2 Opening, Chases, Grooves, Rebates, Blockouts etc.

22 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and Other misc. Embedded Fixtures

2.0 Expansion and Isolation Joints

2.1 General

Expansion joints shall be provided in the floor slabs, walls, roofs, etc. at locations as shown in the drawings and as specified herein. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained. Expansion joints shall be provided in such a manner that the structural integrity of the building is maintained.

2.2 Bitumen Board/Expanded Polystyrene Board

Material

Bitumen board shall be provided in the expansion joints as shown in the drawings and as specified herein. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained.

Installation

Bitumen board shall be provided in the expansion joints as shown in the drawings and as specified herein. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained. Bitumen board shall be provided in such a manner that the structural integrity of the building is maintained.

2.3 Joint Sealing Strips

Joint sealing strips shall be provided in the expansion joints as shown in the drawings and as specified herein. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained. Joint sealing strips shall be provided in such a manner that the structural integrity of the building is maintained.

2 Grouting under Machinery or Structural Steel Bases

2

2

2 Precast Concrete

2

2

2

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Waterproofing of Concrete Structure

[illegible] General

[illegible]

[illegible]

[illegible]

[illegible] Water Bar/Seal/Special Treatment of Construction Joint

[illegible]

[illegible]

[illegible]

Method 1 :

Method 2 :

2 Waterproofing Admixtures

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Protective coating on Concrete Surface

On Foundation

Waterproofing by Pressure / Chemical Grouting

SAMPLING AND TESTING

General

Cement

Aggregates

Water

Admixture

Air Entraining Agents (A.E.A)

Other Admixtures

Concrete

ACCEPTANCE CRITERIA

Standard Deviation

Acceptance Criteria

Inspection and Core Tests

Load Test

LIST OF IS : CODES AND STANDARDS FOR REFERENCE

TECHNICAL SPECIFICATION
FOR
VI) DRIVEN PRECAST CONCRETE PILES

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

VI) DRIVEN PRECAST CONCRETE PILE

SCOPE

GENERAL

Work to be Provided by the Contractor

2.2 Work to be Provided by Others

2.3 Codes and Standards

[illegible]

[illegible] [illegible] [illegible] [

2 Storage of Materials

2 Quality Control

INSTALLATION

General

2 Casting and Curing

2

Storing and Handling

2

Driving

2

Stripping of Pile Heads

Lengthening of Piles

[illegible]

[illegible]

[illegible] **Risen Piles**

[illegible]

[illegible] **Defective Piles**

[illegible]

[illegible] **Idle Period**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **Test Pile**

[illegible]

[illegible]

TESTING AND ACCEPTANCE CRITERIA

General

Static Load Test on Working Piles

2

2

Acceptance Criteria

Recording Data

INFORMATION TO BE SUBMITTED

With Tender

Programme of Construction

After Award

Execution Plan

Detailed Construction Programme

Requirement of Materials, Tools and Plants and Equipment

Test Results

TECHNICAL SPECIFICATION
FOR
VII) DRIVEN CAST IN SITU CONCRETE PILES

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

VII) DRIVEN CAST-IN-SITU CONCRETE PILES

SCOPE

GENERAL

Work to be provided by the Contractor

[illegible]

2.2 Work to be provided by others

[illegible]

2. Codes and Standard

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

2 Steel

2 Structural steel conforming to IS 2062 or equivalent shall be used.

2 Storage of Materials

2 General

All steel materials shall be stored in a manner to prevent damage and deterioration. Materials shall be stored off the ground on platforms, skids or other supports. Materials shall be kept free from dirt, grease and other foreign matter. Storage shall be provided for all materials subject to damage by the weather. Long members shall be supported to prevent sagging. Materials shall be stored in such a manner as to facilitate inspection.

2 Cast Iron or Steel Shoes and Shells

Cast iron or steel shoes and shells shall be provided where indicated on the drawings. Shoes and shells shall be designed to distribute the load uniformly to the supporting structure. Shoes and shells shall be provided with anchor bolts and shall be grouted in place.

2 Quality Control

Quality control shall be maintained during all phases of work. Materials shall be inspected upon delivery and before erection. Defective materials shall be rejected and removed from the site. Erection tolerances shall be maintained within the limits specified. Alignment and plumbness of columns shall be checked before and after connections are made.

- Inspection of welds shall be carried out by visual and non-destructive methods.
- Bolted connections shall be checked for proper tightening.
- Records of inspection shall be maintained and submitted to the Engineer-in-Charge.
- Corrective action shall be taken for any non-conformance observed.
- Final inspection shall be carried out before acceptance.

2 Non-conformance

Any work or material that does not conform to the specifications shall be rejected. The Contractor shall remove and replace non-conforming work at his own expense. The Engineer-in-Charge shall be notified of all non-conformances. Corrective action shall be taken to prevent recurrence. Non-conformance reports shall be maintained and submitted with the final documentation.

INSTALLATION

General

Type of Pile

Identification of Piles

Sequence of Construction

Driving of Piles

Concrete in Pile

Trimming of Pile Heads

Lengthening of Piles

Reinforcement in Piles

2

Dowels

Inspection

Record for driving of Piles

[illegible]

[illegible]

[illegible] **Defective Piles**

[illegible]

[illegible]

[illegible] **Idle Period**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **Test Pile**

[illegible]

[illegible]

2

TESTING AND ACCEPTANCE CRITERIA

General

Components of R.C.C

Static Load Test on Working Piles

2

2

2

Acceptance Criteria

Lateral Load Tests/Pull out Tests

Non-destructive Dynamic Testing on Working Piles

"Low Strain" Method for Integrity Investigation of Concrete Piles

"High Strain" Method for Determination of Pile Capacity

Lateral Dynamic Load Test on Piles

INFORMATION TO BE SUBMITTED

With Tender

Design Data

2 Programme of Construction

After Award

Execution Plan

Detailed Construction Programme

Requirement of Materials, Tools and Plants and Equipment

Test Results

TECHNICAL SPECIFICATION
FOR
VIII) BORED CAST IN SITU CONCRETE PILES

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

VIII) BORED CAST IN SITU CONCRETE PILE

SCOPE

GENERAL

Work to be provided by the Contractor

2.2 Work to be provided by others

2.3 Codes and Standards

2 Conformity with Design

2 Materials

2 General

2 Casing

2 Concrete

2 **Reinforcement**

2 Reinforcement shall be as per approved drawings and shall be free from loose rust, scales, oil, paint, mud or any other coating which may reduce the bond between concrete and steel.

2 **Storage of Materials**

2 **General**

2 All cement, aggregates, reinforcement and admixtures shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter. Any material which has deteriorated or which has been contaminated shall not be used for concrete and shall be removed from the site of work. Cement shall be stored in dry and weather proof sheds with adequate provision for ventilation, drainage and inspection. Cement bags shall be stacked on platforms at least 150 mm above the ground level and shall be covered properly to protect from moisture. Cement bags shall be stacked in such a way that first bag to be used is the first bag received at site. Cement bags shall not be stacked more than 10 bags high. Cement which has been in storage for more than 3 months shall be tested before use. Aggregates shall be stored in such a manner as to prevent segregation and intrusion of foreign matter. Reinforcement shall be stored in such a way as to prevent deterioration by rusting or accumulation of dirt, oil or other coatings. Admixtures shall be stored in such a way as to protect them from deterioration or intrusion of foreign matter.

2 **Casing**

2 Casing shall be used for all concrete work except where the Engineer-in-Charge permits otherwise. Casing shall be of steel, timber or other suitable material. Casing shall be sufficiently rigid to prevent bulging during placing and compaction of concrete. Casing shall be removed without causing damage to the concrete.

2 **Quality Control**

2 Quality control tests for concrete shall be carried out in accordance with IS 456. Tests shall be carried out by an approved testing agency. The Contractor shall provide all facilities for sampling and testing of concrete.

2 (a) Slump test shall be carried out for every batch of concrete.

2 (b) Compressive strength test shall be carried out for every 50 cubic meters of concrete or part thereof. Three cubes shall be cast for each test and tested at 7 days and 28 days.

2 (c) Flexural strength test shall be carried out when required by the Engineer-in-Charge.

2 (d) Tensile strength test shall be carried out when required by the Engineer-in-Charge.

2 (e) Modulus of elasticity test shall be carried out when required by the Engineer-in-Charge.

2 (f) Durability tests shall be carried out when required by the Engineer-in-Charge.

2 (g) Any other test required by the Engineer-in-Charge.

2 [illegible]

[illegible]

[illegible]

[illegible] INSTALLATION [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] General [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] 2 [illegible] Design of Pile [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Identification of Piles

Sequence of Piling

Boring

With Casing

[illegible]

[illegible]

[illegible]

Concreting

Tremie Method of Concreting

2 Concreting in Cased Holes

Cut-off Level

Steel Pipe or Casing Tube

Trimming of Pile Heads

Lengthening of Piles

Removal of Spoil

Back-Filling of Abandoned Borings

Record for Installation of Piles

(iii) Details of pile load tests carried out in the past in the area, if any, should be furnished.

(iv) Pile load tests shall be carried out in accordance with IS 2911 (Part IV) and as per the direction of the Engineer-in-Charge.

(v) Pile load tests shall be carried out on working piles. The load shall be applied in increments of 20% of the working load. Each load increment shall be maintained till the rate of settlement does not exceed 0.1 mm in the last hour. The load shall be applied till the pile settles by 2.5 mm under the working load.

(vi) Pile load tests shall be carried out on working piles. The load shall be applied in increments of 20% of the working load. Each load increment shall be maintained till the rate of settlement does not exceed 0.1 mm in the last hour. The load shall be applied till the pile settles by 2.5 mm under the working load.

(vii) Pile load tests shall be carried out on working piles. The load shall be applied in increments of 20% of the working load. Each load increment shall be maintained till the rate of settlement does not exceed 0.1 mm in the last hour. The load shall be applied till the pile settles by 2.5 mm under the working load.

(viii) Pile load tests shall be carried out on working piles. The load shall be applied in increments of 20% of the working load. Each load increment shall be maintained till the rate of settlement does not exceed 0.1 mm in the last hour. The load shall be applied till the pile settles by 2.5 mm under the working load.

(ix) Pile load tests shall be carried out on working piles. The load shall be applied in increments of 20% of the working load. Each load increment shall be maintained till the rate of settlement does not exceed 0.1 mm in the last hour. The load shall be applied till the pile settles by 2.5 mm under the working load.

(x) Pile load tests shall be carried out on working piles. The load shall be applied in increments of 20% of the working load. Each load increment shall be maintained till the rate of settlement does not exceed 0.1 mm in the last hour. The load shall be applied till the pile settles by 2.5 mm under the working load.

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Test Pile

Offshore Piles

TESTING AND ACCEPTANCE CRITERIA

General

Components of RCC

Components of Steel

Load Tests

General

Vertical Load Test [as per IS : 2911 (Part-IV)]

Lateral Load Test

Pull-out Test

Non-destructive Dynamic Test on Working Piles

"Low Strain" Method for Integrity Investigation of Concrete Piles

"High Strain" Method for Determining of Pile Capacity

Acceptance Criteria

Lateral Dynamic Load Test on Piles

INFORMATION TO BE SUBMITTED

With Tender

Design Data

Programme of Construction

2.2.2 After Award

2.2.3 Execution Plan

2.2.4 Detailed Construction Programme

2.2.5 Requirement of Materials, Tools and Plants and Equipment

2.2.6 Test Results

TECHNICAL SPECIFICATION
FOR
IX) FABRICATION OF STRUCTURAL STEEL WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

IX) FABRICATION OF STRUCTURAL STEEL WORK

SCOPE

GENERAL

Work to be provided for by the Contractor

[illegible]

[illegible] [illegible]

[illegible]

2.2 Work by others

[illegible]

[illegible]

[illegible]

2. Codes and standards

[illegible]

[illegible]

[illegible]

List of IS Codes - Relevant to Fabrication of Structural Steel Work

[illegible]

IS Codes	Description
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Painting

2 Conformity with Designs

2 Materials to be used

2 General

2 2 Steel

[illegible]

2[illegible] Electrodes

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

2[illegible] Bolts and Nuts

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

2[illegible] Washers

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] Paints

[illegible]

[illegible] Storage of Material

[illegible] General

[illegible] Steel

[illegible] Electrodes

[illegible] Bolts, Nuts and Washers

2 Paints

2 Quality Control

2 Standard dimensions, forms and weights

2 Shop Drawings

WORKMANSHIP

Fabrication

General

Straightening Material

Cutting

[illegible]

[illegible] **Planning of edges**

[illegible]

[illegible]

[illegible] **Clearances**

[illegible]

[illegible]

[illegible] **Bolted construction**

[illegible]

[illegible] **Holes**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Assembly

Welded Construction

General

Preparation of Material

Assembling

Welding Sequence

Welding technique

Temperature

2

Peening

Equipment

Finish

2

Slab bases and caps

Lacing bars

Separators

Bearing Plates

Architectural Clearances

Shop connections

Castings

Shop erection

Shop painting

General

Painting on Structural Steel

Inaccessible parts

Contact surfaces

Finished surfaces

Surfaces adjacent to field welds

Galvanizing

General

2 Surface Preparation

Procedure

INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

Inspection

2.0 Testing and Acceptance Criteria

2.1 General

2.2 Steel

2.3 Testing Criteria for checking Lamination in raw steel plates

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Acceptance

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Delivery of materials

[illegible] General

[illegible]

[illegible] Marking

[illegible]

[illegible] Packing and Shipping

[illegible]

[illegible]

INFORMATION TO BE SUBMITTED

With Tender

2

TECHNICAL SPECIFICATION
FOR
X) ERECTION OF STRUCTURAL STEEL WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

X) ERECTION OF STRUCTURAL STEEL WORK

SCOPE

GENERAL

Work to be provided for by the Contractor

Work by others

Codes and Standards

Conformity with designs

2 Material

2 General

2

2 Storage of materials

2 General

2 Yard

sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved programme of work.

The Tenderer should visit the site prior to submission of his Tender to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc. all of which shall be carried out by the Contractor at his own cost as directed the Engineer.

2.06.03 Covered Store

All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in a properly covered store building to be built at the cost of the Contractor

2.07.00 Quality control

The contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Enginee to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the following items of work

a) Erection : Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.

b) Grouting : Cleaning and roughness of foundation quality of materials used for grouting, admixtures, consistency and strength of grout.

c) Painting : Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

2.08.00 Taking Delivery

The erection Contractor shall take delivery of fabricated structural steel and necessary connection materials supplied by the fabrication Contractor from railhead, trucks at site as may be necessary and as per terms & conditions of the contract or as directed by the Engineer. He shall check, unload, transpor the materials to his stores for proper storing at his own cost. The erection Contracto shall submit claims to insurance or other authorities and pursue the same in case of loss or damage during transit and handling and all loss thereof hall be borne by him.

The erection contractor shall also take all precautions against damage of the materials in his custody after taking delivery and till the same are erected in place and accepted.

WORKMANSHIP

Erection

Plant and equipment

Method and sequence of erection

Temporary bracing

Temporary floors for buildings

Setting out

Field bolting

TABLE-I

Field Welding

Holes, cutting and fitting

Drifting

Grouting of stanchion bases and bearings of beams and girders on stone, brick or concrete (Plain or reinforced)

Painting after erection

[illegible]

[illegible]

[illegible]

Stiffness Test

Strength Test

Structure of same design

[illegible]

[illegible]

[illegible]

Acceptance

INFORMATION TO BE SUBMITTED

Before Tender

Tentative Programme

Constructional Plant & Equipment, Tools, Temporary Works & Manpower

Erection yard

After award of the Contract

Fortnightly Progress Report

TECHNICAL SPECIFICATION
FOR
XI) ROADS AND DRAINAGE

PART-I : CONSTRUCTION OF ROADS & DRAINS

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XI) ROADS AND DRAINAGE

PART-I : CONSTRUCTION OF ROADS & DRAINS

SCOPE

GENERAL

Work to be Provided for by the Contractor

Work to be Provided for by Others

Codes and Standards

Conformity with Designs

Materials to be Used

General

Quality Control

TABLE-I

PERMITTED TOLERANCES OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sl. No.	Type of Construction	Longitudinal Profile with 3 m straight edge				Cross Profile
		Max. Permissible undulation.	Max. number of undulations permitted in any 300 metres length exceeding :			Max. permissible variation from specified profile under camber template
			mm	mm	mm	
			18	12	10	6	

Notes

2

EXECUTION

Shoulder Construction

Description

2 **Materials**

Construction Operations

Kerb

Material

Laying

Sub-base (Granular Sub-base)

Description

Materials

TABLE-II
GRADING FOR GRANULAR SUB-BASE MATERIALS

Sieve designation	Percent by weight passing the sieve		
	Grading 1	Grading 2	Grading 3

Note

Physical Requirements

Spreading and Compacting

Water Bound Macadam Sub-base/Base Course

Description

Materials

TABLE-III

PHYSICAL REQUIREMENTS OF COARSE AGGREGATES FOR WATER BOUND MACADAM

Sl. No.	Type of Construction	Test	Test method	Requirements

TABLE-IV

GRADING REQUIREMENTS OF COARSE AGGREGATES

Grading No.	Size range	Sieve designation	Percent by weight passing the sieve

TABLE-V

GRADINGS FOR SCREENINGS

Grading Classifi-cation	Size of screenings	Sieve designation	Percent by weight passing the sieve

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Bituminous Macadam Binder Course

Description

Materials

TABLE-VI

PHYSICAL REQUIREMENTS OF AGGREGATES FOR BITUMINOUS MACADAM

Sl. No.	Test	Test method	Requirements

TABLE-VII

AGGREGATES GRADING FOR 75 MM COMPACTED THICKNESS OF BITUMINOUS MACADAM

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
[illegible]	[illegible]	
[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]
2[illegible]	2[illegible]	[illegible]
2[illegible]	[illegible]	[illegible]
[illegible]2[illegible]	[illegible]2[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
2[illegible]	[illegible]	[illegible]2[illegible]
[illegible]	[illegible]	[illegible]

TABLE-VIII

AGGREGATE GRADING FOR 50 MM COMPACTED THICKNESS OF BITUMINOUS MACADAM

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
[illegible]	[illegible]	
[illegible]	[illegible]	
2[illegible]	[illegible]	[illegible]
2[illegible]	[illegible]	[illegible]
[illegible]2[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
2[illegible]	[illegible]	[illegible]2[illegible]
[illegible]	[illegible]	[illegible]

[illegible]2[illegible] [illegible]

[illegible]

[illegible]

[illegible]2[illegible] [illegible]

[illegible]

[illegible]

[illegible]

Construction Operations

Open-Graded Premix Carpet

Description

2

2 Materials

2.1 General

Materials and workmanship shall conform to the relevant Indian Standard Specifications, Codes of Practice and Standard Methods of Tests. Where Indian Standards are not available, the relevant British Standards shall be followed.

2.2 Earthwork

Earthwork shall be carried out in accordance with IS: 3764 and IS: 4081. Soil shall be free from organic matter, rubbish, boulders and stones larger than 75 mm in any dimension. Soil for embankment shall be compacted in layers not exceeding 200 mm loose thickness to achieve the specified dry density.

2.3 Aggregates

Aggregates for bituminous mixes shall conform to IS: 383. Coarse aggregates shall be crushed stone or crushed gravel. Fine aggregates shall be natural sand or crushed stone dust.

2.4 Bituminous Materials

Bituminous materials shall conform to IS: 73 for paving bitumen and IS: 8887 for bituminous emulsions.

TABLE-IX

QUANTITIES OF MATERIALS REQUIRED FOR 10 SQ.M OF ROAD SURFACE FOR 2 CM THICK OPEN-GRADED PREMIX CARPET

(a)	Quantity of premix required for 10 sq.m @ 2 cm thick			
	2 cm thick @ 10 sq.m per cubic metre	0.2 cubic metre	Nil	0.2 cubic metre
(b)	Quantity of binder required for premix @ 4.5 per cent			
	4.5 per cent of 0.2 cubic metre	0.009 cubic metre	Nil	0.009 cubic metre
	Total		0.009 cubic metre	0.209 cubic metre
	Add 10 per cent for wastage		0.0009 cubic metre	0.0209 cubic metre
	Total quantity of binder required		0.0099 cubic metre	0.2299 cubic metre
(c)	Quantity of aggregates required for premix @ 95.5 per cent			
	95.5 per cent of 0.2 cubic metre	0.191 cubic metre	Nil	0.191 cubic metre
	Add 10 per cent for wastage	0.0191 cubic metre	Nil	0.0191 cubic metre
	Total quantity of aggregates required	0.2101 cubic metre	Nil	0.2101 cubic metre

3 Construction Operation

3.1 Preparation of Base

The base shall be prepared to the required profile and cross-fall. All loose material, dust and debris shall be removed before the application of the prime coat.

3.2 Application of Prime Coat

The prime coat shall be applied uniformly at the rate specified by the Engineer-in-Charge. The surface shall be allowed to cure for a minimum period of 24 hours before the application of the premix carpet.

2

DEVELOPMENT CONSULTANTS **Page: V2/G3/XI/Part-I/17**
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[illegible]

[illegible] [illegible] [illegible] [

Construction Operations

Opening to Traffic

Repair of Existing Water Bound Macadam Surface

Road Side Drains

Formation of Drains

Culverts

Pipe Culverts and Drainage Pipes

Materials

Laying of Pipes

2 Relation with Water Supply Pipeline

Manholes and Inspection Chambers

Masonry

Brick Masonry

2 Stone Masonry

Pointing to Masonry

Plaster to Masonry and Concrete

Finish

Cement Concrete (Plain and Reinforced)

General

22

Materials

Storage of Materials

Workmanship

TESTING AND ACCEPTANCE CRITERIA

Roads

Masonry and Plastering

Cement Concrete

INTERLOCKING PAVING BLOCKS

PART-II
TECHNICAL SPECIFICATION FOR
CONSTRUCTION OF WET MIX MACADUM ROAD

WET MIX MACADAM

Description

Materials

Aggregates - General Requirements

Table-1

Physical Requirements of Aggregates for Wet-Mix Macadam

Sl. No.	Type of Construction	Test Method	Test	Requirement

Note :

2.2 Crushed Stone/Gravel

Crushed stone/gravel shall be obtained from approved quarries. Stone shall be hard, durable, clean and free from soft, friable, thin, elongated or laminated pieces, dirt and other extraneous matter.

2.3 Crushed Slag

Crushed slag shall be obtained from approved sources. Slag shall be hard, durable, clean and free from soft, friable, thin, elongated or laminated pieces, dirt and other extraneous matter. Slag shall be free from unburnt coal or other combustible matter and shall not contain more than 2 percent of sulphates and sulphides calculated as magnesium sulphate when tested in accordance with IS:1622. Slag shall not be used unless it has been stored in the stockpiles for a period of at least 2 months.

2.4 Aggregates - Grading Requirements

The composition of the mixed aggregates shall be determined by the Engineer-in-Charge to suit the requirements of the grading given in Table-2 and shall be such that when applied to the road in the required quantity, it shall form a dense mass with the minimum practicable percentage of voids after adequate rolling.

Table-2

Grading Requirements of Aggregates for Wet-Mix Macadam

Sieve Designation (IS:460)	Percent by Weight Passing the Sieve Grading 1 Max. Nominal Size 40 mm	 Grading 2 Max. Nominal Size 20 mm
90 mm	100	
63 mm	90 to 100	
45 mm	25 to 60	100
22.4 mm	0 to 15	90 to 100
11.2 mm	0 to 5	40 to 80
5.6 mm		0 to 15
2.8 mm		0 to 5
Water Bound Macadam	Screenings	22 mm	Screenings
Grouted Macadam	Screenings	45 mm	22.4 mm

Aggregates shall be tested in accordance with IS:2386 (Part-I) and shall satisfy the requirements of Table-1 of IS:1609.

[illegible]

[illegible]

2 Quantity of Aggregates

[illegible]

[illegible]

Construction Operations

[illegible]

Preparation of Foundation for Receiving the Wet-Mix Macadam Courses

[illegible]

[illegible]

[illegible]

[illegible]

2 Provision of Lateral Confinement of Aggregates

[illegible]

[illegible]

Mixing of Aggregates with Water

[illegible]

[illegible]

[illegible]

Spreading of Aggregates

Rolling

Opening of Traffic

Surface Evenness of Wet-Mix Macadam Course

Rectification of Defective Construction

TECHNICAL SPECIFICATION
FOR
XI) ROADS AND DRAINAGE

PART-III : CONSTRUCTION OF RCC ROAD WITHIN PLANT

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XI) ROADS AND DRAINAGE

PART-III : CONSTRUCTION OF REINFORCED CEMENT CONCRETE ROAD WITHIN PLANT

SCOPE

GENERAL

Work to be provided for by the Contractor

Work to be provided for by Others

Codes and Standards

[illegible]

2[illegible] Conformity with Designs[illegible]

[illegible]

2[illegible] Materials to be Used[illegible]

[illegible]

2[illegible] General

[illegible]

2[illegible] Quality Control[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

TABLE- : 600-2. Texture Depth

EXECUTION

TESTING AND ACCEPTANCE CRITERIA

TECHNICAL SPECIFICATION
FOR
XII) REINFORCED CONCRETE CHIMNEY

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

I) REINFORCED CONCRETE CHIMNEY

SCOPE

GENERAL

Work to be provided for by the Contractor

2.2 Work by others

2.3 Codes and Standards

[illegible]

[illegible]

[illegible]

maximum utilisation of the available sizes and shapes for metal components.

2.05.00 Materials to be used

2.05.01 General Requirement

All materials, whether to be incorporated in the work or to be used temporarily for the construction, shall conform to the relevant IS specifications unless stated otherwise and shall be of the quality approved by the Engineer.

2.05.02 Cement

Generally, cement shall be 43 grade / 53 grade ordinary Portland Cement conforming to IS-8112 / IS 12269. In special cases any of the following type of cement may be permitted or directed to be used with prior approval by the Engineer :

a) 33 Grade ordinary Portland Cement conforming to IS 269.

b) Rapid hardening Portland Cement conforming to IS-8041.

c) Portland slag cement conforming to IS-455.

d) Portland Pozzolona Cement (fly ash based) Conforming to IS-1489 (Part-1).

e) Portland pozzolona Cement (calcined clay based) conforming to IS-1489 (Part 2).

f) Hydrophobic Cement conforming to IS-8043.

g) Low heat Portland Cement conforming to IS-12600.

h) Sulphate Resisting Portland Cement conforming to IS-12330.

2.05.03 Coarse Aggregate

Coarse aggregate shall be graded crushed or broken stone from approved sources, free from impurities and shall be screened free of dust and other deleterious matter. It shall conform to IS:383 or IS:515 and shall be washed clean, if necessary. The max. size of coarse aggregate for chimneys shall be 20 mm. down graded, unless otherwise stated (vide serial 5(b) of clause 3.3.6). Grading for a particular size shall conform to relevant IS Codes and shall be such as to produce a dense concrete of specified proportion and strength and shall be of consistency that will work readily into position without segregation.

2.05.04 Fine Aggregate

Fine aggregate shall be river or pit sand, free from any clay, earth, vegetable matters, salt or other impurities and shall be clean and fit for use, to the satisfaction of the Engineer. Sand acceptable for the work shall normally have a grading falling within the limits of one of the three grades, mentioned

2 Water

2 Reinforcement

2 Structural Steel

2 Paints

2 Fire Bricks, Acid Resistant Bricks and Castable Refractories

2 Storage of Materials

2 General

2.2.2 Cement

Aggregate

Reinforcement

Steel, Metal and Fittings

Paints

Bricks

Insulation Material

Electrical Items

2 Quality Control

EXECUTION

Concrete

Trial Mix, Grades of Concrete

TABLE-II

MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE DIFFERENT DEGREES OF WORKABILITY WITH DIFFERENT VALUES OF WATER - CEMENT RATIO (FOR GUIDANCE)

CEMENT/TOTAL AGGREGATE RATIOS

WORKABILITY	WATER/ CEMENT RATIO	RATIO BY WEIGHT OF CEMENT TO GRAVEL AGGREGATE		RATIO BY WEIGHT OF CEMENT TO CRUSHED STONE AGGREGATE [1]	
		20 mm to 10 mm	40 mm to 20 mm	20 mm to 10 mm	40 mm to 20 mm
Very low (Pressed concrete)	0.45	0.34	0.36	0.32	0.34
	0.50	0.32	0.34	0.30	0.32
	0.55	0.30	0.32	0.28	0.30
	0.60	0.28	0.30	0.26	0.28
Low (Vibrated concrete)	0.45	0.32	0.34	0.30	0.32
	0.50	0.30	0.32	0.28	0.30
	0.55	0.28	0.30	0.26	0.28
	0.60	0.26	0.28	0.24	0.26
Medium (Vibrated concrete)	0.45	0.30	0.32	0.28	0.30
	0.50	0.28	0.30	0.26	0.28
	0.55	0.26	0.28	0.24	0.26
	0.60	0.24	0.26	0.22	0.24
High (Concrete for trowelling)	0.45	0.28	0.30	0.26	0.28
	0.50	0.26	0.28	0.24	0.26
	0.55	0.24	0.26	0.22	0.24
	0.60	0.22	0.24	0.20	0.22

Note: 1 The proportion of sand to be taken as 35 percent of the total aggregate by absolute volume. The total aggregate may be taken as the sum of the quantities of gravel and crushed stone in the proportion in which they are actually used.

Note: 2

Batching of concrete

Mixing of Concrete

Workability of Concrete

LIMITS OF CONSISTENCY

Degree of workability	Slump in mm. with standard concrete		Use for which concrete is suitable
	Min.	Max.	

Note :

Placing and Compaction of Concrete

[illegible]

[illegible]

[illegible]

2.2.2.4 Reinforcement

2.2.2.4.1 Bending of Reinforcement

All reinforcement bars shall be bent cold to the shapes and dimensions shown on the drawings or as required by the Engineer-in-Charge. Bars shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the drawings shall not be used, unless specifically permitted by the Engineer-in-Charge. Bars shall be bent in accordance with IS 2502.

2.2.2.4.2 Placing

Reinforcement shall be placed in accordance with the drawings and as directed by the Engineer-in-Charge. Before placing, all reinforcement shall be cleaned of loose mill scale, loose rust, mud, oil or other coatings which may destroy or reduce the bond. Reinforcement shall be placed and maintained in position during the placing of concrete by means of approved supports, spacers, chairs or ties. The minimum clear cover to reinforcement shall be as shown on the drawings or as specified in the relevant clauses of IS 456.

Reinforcement shall not be displaced beyond the tolerances specified in IS 456 before or during the placing of concrete. Bars projecting from previous concrete work shall be carefully cleaned and straightened before new concrete is placed around them.

2.2.2.4.3 Fixing of Reinforcement

All reinforcement shall be fixed rigidly and securely tied at all intersections with annealed black iron wire of not less than 16 gauge. The ends of the wire shall be turned inwards away from the face of the concrete. Welding of reinforcement shall not be permitted except where specifically shown on the drawings or approved by the Engineer-in-Charge.

2.2.2.5 Forms

2.2.2.5.1 Design and Material of formwork

Forms shall be designed and constructed to withstand the pressure of the concrete and all other loads, vibration and construction operations without deflection or movement beyond the tolerances specified. They shall be of such material as will not affect the concrete surface adversely. Steel forms shall be used wherever practicable.

Forms shall be so constructed that they can be removed without damaging the concrete. They shall be removed in such manner as to ensure the complete safety of the structure. Forms shall not be removed without the approval of the Engineer-in-Charge.

2 Installation of Formwork

Tolerance

Stripping of formwork

Re-use of formwork

Construction by slip-form Method

Chimney Steel and Metal Work

General

Fabrication

Assembly

Painting

Galvanizing

[illegible]

[illegible]

[illegible]

[illegible] **Erection**

[illegible]

[illegible]

[illegible] **Cast Iron Chimney Cap**

[illegible]

[illegible]

[illegible]

[illegible] **Insulation and Protective Treatment**

[illegible]

[illegible] **Acid and Heat Resistant Paint**

[illegible]

[illegible]

[illegible]

[illegible]

2 Cement Paint

Acid Resistant Brick Lining

Fire Brick Lining

Insulation and Packing

Asbestos Rope

Slag or mineral wool

Slag or mineral wool insulation shall be used for insulation of hot surfaces of equipment and piping operating at temperatures above 200°C. The insulation shall be manufactured from slag or mineral wool fibres bonded with suitable binders. The insulation shall be supplied in the form of mattresses, slabs, sections or loose wool as required. The density of the insulation shall be not less than 120 kg/m3 for mattresses and slabs. The thermal conductivity of the insulation shall be not more than 0.045 W/m°C at 100°C mean temperature. The insulation shall be non-combustible and shall not support combustion. The insulation shall be resistant to moisture and shall not absorb more than 2% moisture by weight when exposed to atmosphere for 24 hours. The insulation shall be resistant to vermin and shall not support their growth. The insulation shall be supplied with suitable wire mesh or metal bands for holding the insulation in place.

Vermiculite Concrete

Vermiculite concrete insulation shall be used for insulation of hot surfaces of equipment and piping operating at temperatures above 200°C. The insulation shall be manufactured from vermiculite aggregate bonded with suitable binders. The insulation shall be supplied in the form of blocks or slabs as required. The density of the insulation shall be not less than 400 kg/m3. The thermal conductivity of the insulation shall be not more than 0.12 W/m°C at 100°C mean temperature. The insulation shall be non-combustible and shall not support combustion. The insulation shall be resistant to moisture and shall not absorb more than 5% moisture by weight when exposed to atmosphere for 24 hours. The insulation shall be resistant to vermin and shall not support their growth. The insulation shall be supplied with suitable wire mesh or metal bands for holding the insulation in place.

Asbestos Mill Board

Asbestos mill board insulation shall be used for insulation of hot surfaces of equipment and piping operating at temperatures above 200°C. The insulation shall be manufactured from asbestos fibres bonded with suitable binders. The insulation shall be supplied in the form of boards or sheets as required. The density of the insulation shall be not less than 1000 kg/m3. The thermal conductivity of the insulation shall be not more than 0.16 W/m°C at 100°C mean temperature. The insulation shall be non-combustible and shall not support combustion. The insulation shall be resistant to moisture and shall not absorb more than 5% moisture by weight when exposed to atmosphere for 24 hours. The insulation shall be resistant to vermin and shall not support their growth. The insulation shall be supplied with suitable wire mesh or metal bands for holding the insulation in place.

Lightning Protection System

The lightning protection system shall be provided for the protection of the power plant buildings and structures against lightning strikes. The system shall consist of air terminations, down conductors, earth electrodes and bonding conductors. The air terminations shall be provided on the roof of the buildings and structures at suitable intervals. The down conductors shall be provided from the air terminations to the earth electrodes. The earth electrodes shall be provided at suitable locations around the buildings and structures. The bonding conductors shall be provided for bonding the metallic parts of the buildings and structures to the earth electrodes. The system shall be designed in accordance with IS 2309.

Air Terminations

Air terminations shall be provided on the roof of the buildings and structures at suitable intervals. The air terminations shall be made of copper or aluminium rods or tapes. The air terminations shall be supported on suitable supports.

Down Conductors

Down conductors shall be provided from the air terminations to the earth electrodes. The down conductors shall be made of copper or aluminium rods or tapes. The down conductors shall be supported on suitable supports.

Earth Electrodes

Earth electrodes shall be provided at suitable locations around the buildings and structures. The earth electrodes shall be made of copper or galvanized iron rods or plates. The earth electrodes shall be buried in the ground at suitable depths.

Bonding Conductors

Bonding conductors shall be provided for bonding the metallic parts of the buildings and structures to the earth electrodes. The bonding conductors shall be made of copper or aluminium rods or tapes. The bonding conductors shall be supported on suitable supports.

Aviation Obstruction Lighting System

The aviation obstruction lighting system shall be provided for the protection of aircraft flying in the vicinity of the power plant. The system shall consist of obstruction lights, control panel and power supply. The obstruction lights shall be provided on the top of the chimney and other tall structures. The control panel shall be provided for controlling the operation of the obstruction lights. The power supply shall be provided for supplying power to the obstruction lights and control panel. The system shall be designed in accordance with ICAO Annex 14.

Obstruction Lights

Obstruction lights shall be provided on the top of the chimney and other tall structures. The obstruction lights shall be red in colour and shall be visible from a distance of at least 5 km. The obstruction lights shall be provided with suitable lenses and reflectors.

Control Panel

Control panel shall be provided for controlling the operation of the obstruction lights. The control panel shall be provided with suitable switches and indicators. The control panel shall be provided with suitable protection devices.

Sampling Port

22

MS insert plates for mounting of instruments for the measurement of amplitude of vibration and wind speed

TESTING AND ACCEPTANCE CRITERIA

General

Cement

Aggregate

Water

Concrete

INFORMATION TO BE SUBMITTED

With Tender

[illegible]

[illegible] [illegible]

[illegible]

[illegible] **After Award**

[illegible]

[illegible]

[illegible]

[illegible] **Programme of execution and requirement of materials**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **Samples**

[illegible]

[illegible]

[illegible]

[illegible] **Design Mix**

[illegible]

[illegible]

[illegible]

[illegible] **Detail Drawings**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

TECHNICAL SPECIFICATION
FOR
XIII) PROPERTIES, STORAGE AND HANDLING OF COMMON BUILDING MATERIAL

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]

XIII) PROPERTIES, STORAGE AND HANDLING OF COMMON BUILDING MATERIAL

SCOPE

MATERIALS

Bricks

Stone

Lime

Cement

Coarse Aggregates

Sand

Water

Reinforcement

STORAGE AND HANDLING OF MATERIALS

Bricks

Stones

Lime

Cement

Coarse and Fine Aggregates

Reinforcement

TECHNICAL SPECIFICATION
FOR
XIV) ANTI-TERMITE TREATMENT

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XIV) ANTI-TERMITE TREATMENT

SCOPE

EXECUTION

General

Chemicals and Rate of Application

Chemicals	Concentration by Weight, Percentage

Treatment of Column Pits, Wall Trenches and Basement Excavations

2.2.2.2 Treatment of Top Surface of Plinth Filling

2.2.2.3 Treatment of Soil Surrounding Pipes, Wastes and Conduits

2.2.2.4 Treatment of Expansion Joints

2.2.2.5 Treatment at Junction of the Wall and the Floor

2.3.0.0 ACCEPTANCE CRITERIA

2.4.0.0 I.S. CODE

TECHNICAL SPECIFICATION
FOR
XV) MASONRY AND ALLIED WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]

XV) MASONRY AND ALLIED WORK

SCOPE

INSTALLATION

Soling

Brick Soling

Stone Soling

Brick Edging

Masonry

General

Mortar

[illegible]

[illegible] [illegible] [illegible] [

2 Reinforced Brickworks

2 Stone Masonry (Not Used)

2 Exposed Stonework (Not Used)

2 Hollow and Solid concrete block Masonry (Not Used)

[illegible]

2[illegible] Composite Masonry (Not Used)

[illegible]

2[illegible] Expansion & Separation Joints

[illegible]

2[illegible] Moldings, Cornices, Drip Course

[illegible]

2[illegible]2[illegible] Curing

[illegible]

2[illegible] Embedding of fixtures

[illegible]

2[illegible] Encasing of Structural Steel

[illegible]

[illegible]

2[illegible] **Damp Proof Course**

[illegible]

[illegible]2[illegible]

2[illegible]

2[illegible] **Damp Proof Membrane**

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] **I.S. CODES**

[illegible]

[illegible]

[illegible]2[illegible]

[illegible]2[illegible]

[illegible]

[illegible]

[illegible]

[illegible]22[illegible]2[illegible]

[illegible]22[illegible]

[illegible]

[illegible]

[illegible]

TECHNICAL SPECIFICATION
FOR
XVI) FINISH TO MASONRY AND CONCRETE

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XVI) FINISH TO MASONRY AND CONCRETE

SCOPE

INSTALLATION

Preparation of Surface

Plastering

Mortar

[illegible]

[illegible]

2.2.2 Application of Plaster

[illegible]

[illegible]

[illegible]

Neat Cement Finish

Coloured Plaster Finish (Not Applicable)

2.02.01

2

Pebble-dash Finish (Not Applicable)

2.02.01

2

2

Rough-Cast Finish (Not Applicable)

2

Scraped Finish (Not Applicable)

2.02.01

Textured Finish (Not Applicable)

2.02.01

Textured Finish with Granules

2.02.02 Curing

2.02.03 Pointing to Masonry (Not applicable)

2.02.04 Plaster with Metal Lath

[illegible]

[illegible]

[illegible]

2[illegible] Lime Punning (Not Applicable)

[illegible]

[illegible]

[illegible]

2[illegible] Plaster of Paris Punning (Not Applicable)

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] Wall Putty Finish to interior & Exterior Surfaces.

[illegible]

[illegible]

[illegible]

[illegible]

2[illegible] Stone Facing

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

ACCEPTANCE CRITERIA

I.S. CODE

TECHNICAL SPECIFICATION
FOR
XVII) SINGLE SHEET / SANDWICH / DOUBLE SKIN METAL CLADDING

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XVII) SINGLE SHEET / SANDWICH / DOUBLE SKIN METAL CLADDING

GENERAL

Description

Applicable Codes and Standards

Submittals

[illegible]

[illegible]

[illegible]

2 □

□

2 □ □

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DOUBLE SKIN INSULATED METAL CLADDING

General

EXECUTION

Inspection

2.0 Installation

Clean-Up

TECHNICAL SPECIFICATION
FOR
XVIII) CARPENTRY AND JOINERY

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XVIII) CARPENTRY AND JOINERY

SCOPE

INSTALLATION

Materials

Timber

Plywood

Decorative Laminated Plastic Sheets

Flush Doors

Panel Doors

Fixtures

Workmanship

General

Finish

Surface Treatment

ACCEPTANCE CRITERIA

Door and Window Frames

Door and Window Shutters

Partitions, Paneling, Pelmets, Furniture, etc.

General

Partition

Pelmets

Cupboard Shutters

Drawers

Loose Furniture

IS CODES

TECHNICAL SPECIFICATION
FOR
XIX) METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XIX) METAL DOORS, WINDOWS, VENTILATORS, LOUVRES, ETC.

SCOPE

INSTALLATION

Materials

2.2 Fabrication

2.2.1 Steel Doors, Windows, Ventilators, Louvres, etc.

a) Door Frames

b) Double Plate Flush Door Shutters

Single Sheet Door Shutters

2

Sliding Doors

2

Fire Proof Door

2

Door Threshold

Steel Windows, Sashes, and Ventilators etc.

[illegible]

[illegible] [illegible]

[illegible] [illegible] [illegible]

[illegible] **M.S grill**

[illegible] [illegible] [illegible]

[illegible] **Aluminium Door, Windows and Frames**

[illegible]

[illegible]

[illegible] [illegible]

[illegible] **Shop Coat or Paint**

[illegible]

[illegible]

[illegible] [illegible]

[illegible]

2 Handling & Storage of Fabricated Material

2 Assembly & Erection at Site

ACCEPTANCE CRITERIA

For Fabricated Items

For Installed Items

INFORMATION TO BE SUBMITTED

With Tender

After Award

I.S. CODES

TECHNICAL SPECIFICATION
FOR
XX) ALUMINIUM FRAMED GLAZED CURTAIN WALLS AND STRUCTURAL GLAZING

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XX) ALUMINIUM FRAMED GLAZED CURTAIN WALLS AND STRUCTURAL GLAZED WALL

SCOPE

INSTALLATION

System and Materials

- **Stick wall system**

- **Ladder or semi-unitized system**

- **Unitized system**

Structural glazing

[illegible]

[illegible]

[illegible]

[illegible]

INFORMATION TO BE SUBMITTED BY CONTRACTOR

[illegible]

After award of contract

[illegible]

[illegible]

[illegible]

[illegible]

I.S. Code

2

TECHNICAL SPECIFICATION
FOR
XXI) ROLLING STEEL SHUTTERS AND GRILLS

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXI) ROLLING STEEL SHUTTERS AND GRILLS

SCOPE

INSTALLATION

Components

Materials

Fabrication

Finishing

Installation

[illegible]

[illegible]

[illegible]

ACCEPTANCE CRITERIA

Shop Inspection

Field Inspection

Guarantee

I.S. CODE

TECHNICAL SPECIFICATION
FOR
XXII) GLASS AND GLAZING

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXII) GLASS AND GLAZING

SCOPE

INSTALLATION

General

Materials

2.2 Glazing, Setting and Finish

ACCEPTANCE CRITERIA

I. S. CODES

TECHNICAL SPECIFICATION
FOR
XXIII) FLOOR FINISHED AND ALLIED WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXIII) FLOOR FINISHED AND ALLIED WORK

SCOPE

In Situ Finishes

Tiled Finishes

Base

2.2.4 Sequence

[illegible]

2.3 INSTALLATION

2.3.1 Special Materials

[illegible]

[illegible]

2.3.2 Workmanship

[illegible]

2.3.3 Preparation of the Base Surface

[illegible]

[illegible]

[illegible]

[illegible]

In Situ Finishes

Integral Finish to Concrete Base

Red Oxide of iron finish (Not Applicable)

Thickness

Mix

Underbed

Topping

Laying

d) Polishing

Terrazo Finish : In Situ (Not Applicable)

Thickness

Mix

Underbed

Topping

Laying

[illegible]

[illegible]

[illegible]

2 Granolithic Finish

Thickness

Mix

Laying of Monolithic Topping

Laying of Topping Separately on Hardened Base

Curing

Grinding

2

Finishing

Patent Stone

Thickness

Mix

Underbed

2

Topping

Laying

2

2 Metallic Hardener Like “Ironite” Finish

Thickness

Material

Mix

Laying

2 Non Metallic Hardener Like SIKA' Chapdur' Finish

2 Mastic Asphalt Finish (Not used)

Thickness

Materials

Composition

Laying

Chemical Resistant in Situ Finish (Not used)

Tiled Finish

Terrazzo Tile Finish

Thickness

Tiles : Terrazzo

Mix : Underbed

Laying

Grinding and Polishing

Heavy duty Cement Concrete (Carborundum) tile

[illegible]

[illegible]

[illegible]

Tiles : Glazed/ mat finish Ceramic tiles

Mix : Underbed

Laying

Finishing

2.2 Vitrified tiles

2.2 Tesserae Finish (Mosaic etc.) (Not Used))

Thickness

Tesserae Finish

Mix : Underbed

Laying

Chemical Resistant Tiled Finish

Tiles

Laying

Rubber, Vinyl or Vinyl Asbestos Tiles Finish

Thickness

Tiles

Mix : Underbed

Laying

Finishing

Store Slab Finish : Marble, Stone and Similar Fine Grained Stone

Thickness

Stone Slab

Mix : Underbed

Laying

Polishing, Finishing

Stone Slab Finish : Sand Stone & Similar Coarse Grained Stone Finish

Base and Sub base for Flooring

ACCEPTANCE CRITERIA

I.S. CODES

TECHNICAL SPECIFICATION
FOR
XXIV) FALSE FLOORING

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXIV) FALSE FLOORING

SCOPE

FALSE FLOORING SYSTEM

Base

Supporting Structure

Floor Panel

Strength

Surface Finish

Skirting

Installation

ACCEPTANCE CRITERIA

TECHNICAL SPECIFICATION
FOR
XXV) PAINTING, WHITE WASHING AND POLISHING ETC.

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXV) PAINTING, WHITE WASHING AND POLISHING ETC.

SCOPE

INSTALLATION

Materials

White Washing (Not Used)

Dry Distemper (Not Used)

Oil Bound Washable Distemper (Not Used)

Waterproof Cement Paint

Acrylic Emulsion Paint internal and external use.

Acrylic Washable distemper.

e)

Synthetic Enamel Paint

Aluminium Paint

French Polish (Not Used)

Storage

Preparation of Surface

Wood

2.2.2 Masonry, Concrete and Plastered Surface

2.2.2.1 Mildew

2.2.3 Metal

2.3 Application

2.3.1 General

[illegible]

[illegible]

[illegible]

2 Waterproof Cement Paint

2 Acrylic Emulsion Paint

2 Synthetic Enamel Paint

2 Aluminium Paint

2 Clear Synthetic Varnish * Not Used)

2 French Polish (Not Used)

2 Chemical Resistant Paint

2 Epoxy coating/painting

Protection

Cleaning up

ACCEPTANCE CRITERIA

I.S. CODE

TECHNICAL SPECIFICATION
FOR
XXVI) SUSPENDED CEILING

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXVI) SUSPENDED CEILING

SCOPE

INSTALLATION

Suspension System

General

Metal Grid Suspension System

[illegible]

2[illegible] Timber Grid Suspension System (Not used)

[illegible]

2[illegible]2[illegible] Ceiling Panels

2[illegible]2[illegible] Materials

[illegible]

[illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible] [illegible]2[illegible]

[illegible]

[illegible]

2[illegible]2[illegible]2[illegible] Installation of Ceiling Panels[illegible]

[illegible]

[illegible]

[illegible]

[illegible]2[illegible]

[illegible]

[illegible]

ACCEPTANCE CRITERIA

I. S. CODES

TECHNICAL SPECIFICATION
FOR
XXVII) SHEET WORK IN ROOF AND SIDING

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

SHEET WORK IN ROOF AND SIDING

SCOPE

INSTALLATION

Storage of Materials

Workmanship

Asbestos Sheeting

C.G.I. Sheeting and Aluminium Sheeting

2.2.2.2 Fibre Glass Reinforced Plastic Sheeting

2.2.2.2.1 [illegible]

2.2.2.2.2 [illegible]

2.2.2.2.3 [illegible]

2.2.2.2.4 [illegible]

2.2.2.3 Poly Carbonate Roofing vault etc.

2.2.2.3.1 [illegible]

2.2.2.3.2 [illegible]

ACCEPTANCE CRITERIA

IS CODES

TECHNICAL SPECIFICATION
FOR
XXVIII) ROOF WATER PROOFING, INSULATION AND ALLIED WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXVIII) ROOF WATER PROOFING, INSULATION AND ALLIED WORK

SCOPE

INSTALLATION

Grading Underbed

Concrete

2 Insulation

2 Foam Concrete (Not Used)

2 Expanded Polystyrene Blocks

2 **Fillets**

2 Fillets shall be provided at the junction of floor and wall, wall and wall, wall and ceiling, wall and beam, beam and ceiling, beam and beam, beam and column, column and floor, column and column, column and ceiling, floor and ceiling, floor and floor, floor and beam, ceiling and ceiling, ceiling and column, ceiling and floor, ceiling and beam, beam and floor, beam and ceiling, beam and column, column and floor, column and ceiling, column and beam, floor and column, floor and beam, floor and ceiling, ceiling and column, ceiling and beam, ceiling and floor, beam and column, beam and floor, beam and ceiling, column and beam, column and floor, column and ceiling

[illegible]

[illegible]

[illegible]

2 Flashing

2 Elastromeric Membrane

2 Primer Coat

2 Finishing Coats

Water Proof Membrane

Surface Finish

ACCEPTANCE CRITERIA

I.S. CODES AND STANDARDS

XXIX) WATER SUPPLY

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXIX) WATER SUPPLY

SCOPE

Materials

Pipes and Pipe Fittings

Water Reservoirs

Related Works

Regulation

INSTALLATION

Pipe Lines

Laying

2.2.2 Back Flow

2.2.3 Contamination

2.2.4 Underground Pipings

2.2.5 Concealed Piping

2.2.6 Jointing of Pipes

Cast Iron

Spigot and Socket Joints

Lead joint :

Flanged Joints :

Steel

G I Pipes

Asbestos Cement Pipes

Lead

Concrete

P. V. C.

Tyton Joint

Painting

Storage Tank - Pressed Steel Tank

G. I. Water Tank

Valve, Cocks, Taps

Protection

TESTING AND ACCEPTANCE

Inspection Before Installation

Testing of Mains After Laying

Testing of Service Pipes and Fittings

I.S. CODES

TECHNICAL SPECIFICATION
FOR
XXX) DRAINAGE AND SANITATION

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

XXX) DRAINAGE AND SANITATION

SCOPE

INSTALLATION

General

Rainwater Downcomers

Gutters

Soil and Drainage Pipes

Gradients

Relation with water supply pipe lines

Laying

2 Support and Protection on Pipelines

[illegible]

[illegible]

2[illegible] **Ducts**

[illegible]

[illegible] [illegible]

[illegible]

2[illegible] **Traps and Ventilating Pipes**

[illegible]

[illegible] [illegible]

[illegible]

[illegible] [illegible]

[illegible]

2[illegible] **Manhole and Inspection Chambers**

[illegible]

[illegible] [illegible]

[illegible]

[illegible] [illegible] 2[illegible]

[illegible]

[illegible] [illegible]

[illegible]

[illegible] [illegible]

[illegible]

2[illegible] **Cutting of Pipes**

[illegible]

[illegible] [illegible]

[illegible]

2 Jointing

a) Cast Iron Pipes :

b) Concrete Pipes

c) Glazed Stoneware Pipes

d) Vitrified clay pipes

2

e) Lead Pipes

f) PVC Pipes

g) Jointing Cast Iron Pipes with Stoneware Pipes

h) Jointing Stoneware with Cast Iron Pipes

[illegible]

[illegible]

[illegible]

2 Trenches and other excavations

[illegible]

[illegible] [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

2 Fixtures

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

2[illegible] **Water closet**

[illegible]

a) Raised type

[illegible]

[illegible]

[illegible]

b) Squatting type[illegible]

[illegible]

[illegible]

[illegible]

2[illegible]2[illegible] **Urinals**

[illegible]

[illegible]

[illegible]

2[illegible] **Wash basin**[illegible]

[illegible]

[illegible]

[illegible]

2 **Sink**

[illegible]

[illegible]

2 **Bathroom mirror**

[illegible]

[illegible]

2 **Glass shelves**

[illegible]

[illegible]

2 **Towel rail**

[illegible]

[illegible]

2 **Soap holder**

[illegible]

[illegible]

2 **Liquid soap dispenser**

[illegible]

[illegible]

2 **Toilet roll holder**

[illegible]

[illegible]

2 **Installation**

[illegible]

[illegible]

[illegible]

2 Septic tank & effluent disposal

2 Septic tank

2 2 2

2 2 Effluent Disposal

2 Soak pit

2 Open joined SW Pipe / dispersion trenches

2

2 Commissioning septic tank

TESTING AND ACCEPTANCE

Inspection before installation

Testing of Pipelines

General guidance for the tests are given below :

a) Smoke test

b) Water test

For pipes other than Cast Iron

Subsidence of test water may due to one or more of the following cases:

For cast iron pipes

c) For straightness

Testing Septic Tank

Fixtures etc.

CODES AND STANDARDS

TECHNICAL SPECIFICATION
FOR
XXXI) BOILER DRAIN DIVERSION

CONTENT

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	**ATTACHMENTS**
[illegible]	[illegible]
[illegible]	[illegible]

XXXI) BOILER DRAIN DIVERSION

1.00.00 SYSTEM DESCRIPTION

2.00.00 SCOPE OF WORK

3.00.00 DETAILED SPECIFICATION

A. Drain Channel :

B. Settling Tank :

C. Drain Pumps :

Material of Construction of Pumps :

D. Drain Piping :

TECHNICAL SPECIFICATION
FOR
XXXII) GEO-TEXTILE FABRIC

CONTENTS

CLAUSE NO. **DESCRIPTION**

2

TECHNICAL SPECIFICATION
FOR
XXXII) GEO-TEXTILE FABRIC

1.0 SCOPE

2.0 GENERAL

2.1 Work to be provided by the Contractor

2.2 Work to be provided by others

2.3 Conformity with Designs

2 Materials to be used

2 General

2.2 Geo-textile

Property	Test Method
Non-woven Geo-textile :	
Woven Geo-textile :	

EXECUTION

ACCEPTANCE CRITERIA

TECHNICAL SPECIFICATION
FOR
XXXIII) LANDSCAPING WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
[illegible]	[illegible]
2 [illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

TECHNICAL SPECIFICATION
FOR
XXXIII) LANDSCAPING WORK

1.0 SCOPE

1.1 The scope of work shall include supply of all materials, labour, tools, equipment, transportation, services and performance of all operations for landscaping work in accordance with the drawings, specifications and as directed by the Engineer-in-charge. The work shall include but not be limited to the following:

1.2 Development of green belt around the plant boundary, roads, buildings, open areas, etc. Plantation of trees, shrubs, creepers, grass, etc. Maintenance of the plantation for a period of one year after completion of the work.

1.3 Earthwork in excavation, filling, levelling, dressing, etc. Construction of retaining walls, pits, etc. Supply of soil, manure, fertilizers, etc.

1.4 Supply of plants, trees, shrubs, creepers, grass, etc. Planting, staking, guarding, watering, weeding, etc. Replacement of dead plants, trees, shrubs, creepers, grass, etc.

2.0 MATERIAL

2.1 (a) The soil shall be free from stones, bricks, concrete pieces, debris, etc. The soil shall be fertile and suitable for plantation. The soil shall be tested and approved by the Engineer-in-charge before use.

2.1 (b) The manure shall be well decomposed cattle dung or compost. The manure shall be free from weeds, seeds, etc. The manure shall be tested and approved by the Engineer-in-charge before use.

2.1 (c) The fertilizers shall be of approved quality and shall be used in accordance with the manufacturer's instructions.

2.1 (d) The plants, trees, shrubs, creepers, grass, etc. shall be of approved species and shall be healthy, vigorous and free from pests and diseases.

[illegible]

[illegible]

[illegible]

MAINTENANCE

ACCEPTANCE CRITERIA

I.S. CODE

GUJARAT STATE ELECTRICITY CORPORATION LTD.

1x800 MW SUPERCRITICAL THERMAL POWER PROJECT WANAKBORI, GUJARAT

TECHNICALSPECIFICATION
(SECTION D)

DOCUMENT NO. PE-TS-J57-600-C001
REVISION 00

BHARAT HEAVY ELECTRICALS LIMITED
PROJECT ENGINEERING MANAGEMENT
PPEI BUILDING, POWER SECTOR,
PLOT NO. 25, SECTOR-16A,
NOIDA -201031

Project Title	1x800 MW WANAKBORI SUPERCRITICAL TPS
Job no.	J57
Document No.	PE-TS-J57-600-C001
Subject	SECTION A, B, C & D

Rev No.	Particulars	Prepared by	Checked by	Approved by	Remarks
	Name	KN	AB	AKS	
00	Sign	-sd-	-sd-	-sd-	
	Date	15/09/2014	16/09/2014	16/09/2014	

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1. General 4

2. Section D 5

GENERAL

Section C & Section D of this specification cover design, preparation of general arrangement drawings, construction and fabrication drawings, supply of materials and construction of all civil, structural and architectural works.

Section-C covers specific technical & functional requirements of contract and should be read in conjunction with BOQ, Section-D and other sections of the contract. In case of any conflict between the contents of BOQ and Section-C, BOQ will prevail over Section-C. In case of any conflict between Section-C and Section-D, Section-C will prevail over Section-D. Further contract document and clarifications given by BHEL to Bidder will prevail over Section C and D in case of any conflict. During the detailed engineering if there is some change in requirements, which is agreed by customer, consultant and BHEL, the same shall prevail over all.

SECTION D

STANDARD SPECIFICATION

SECTION - D
(PART I)

SUB-SECTION – D I

EARTHWORK IN EXCAVATION AND BACKFILLING

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	CODES AND STANDARDS
3.00.00	EXECUTION
4.00.00	TESTING AND ACCEPTANCE CRITERIA
5.00.00	RATES AND MEASUREMENTS
6.00.0	INFORMATION TO BE SUBMITTED BY THE BIDDER

STANDARD TECHNICAL SPECIFICATION FOR EARTHWORK IN EXCAVATION AND BACKFILLING

1.00.00 SCOPE

This specification covers earth work excavation in all types of soil, soft rock and hard rock including setting out, clearing and grubbing, shoring, dewatering, back filling around foundations/pipelines to grade, watering, compaction of fills, testing, approaches, disposal of surplus earth, protective fencing, lighting etc relevant to the structures and locations covered under this contract.

1.01.00 Work To Be Provided By The Contractor

The work to be provided for by the contractor unless specified otherwise shall include but not be limited to the following.

a) Supplying and providing all labour, supervision services including as required under statutory labour regulations, materials, scaffolding, equipments, tools and plants, transportation etc required for the work.

b) Preparation and submission of working drawings showing the approaches, slopes, berms, shoring, sumps for dewatering including drainage, space for temporary stacking of soils, disposal area, fencing etc and all other details as may be required by the engineer.

c) Carrying out sampling and testing on fill materials/fills to assess the quality/moisture content/degree of compaction and submission of the test results whenever required by the engineer.

d) Design, construction and maintenance of Magazine of proper capacity for storage of explosives for blasting work and removal of the same after completion of the work etc.

1.02.00 Work to be provided by others

No work under this specification will be provided by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

2.00.00 Codes and Standards

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes

unless specified otherwise.

IS-1200	Method of measurement of building and civil engineering works, Part-I: Earthwork
IS-2720	Method of test for soils (Relevent parts)
IS-3764	Excavation work - Code of safety
IS-4081	Safety code for blasting and related drilling operations
IS-4701	Indian Standard Code of Practice for earthwork on Canals
IS:6922	Criteria for safety and design of structures subject to underground blasts

In case of conflict between this specification and those (IS Codes) referred to herein, the former shall prevail. In case any particular aspect of work is not covered specifically by this specification/IS Codes, any other standard practice as may be specified by the engineer shall be followed.

2.01.00 Conformity with Designs

The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer.

2.02.00 Materials

2.02.01 General

All materials required for the work shall be of the best commercial variety and approved by the engineer.

2.02.02 Material for Excavation

For the purpose of identifying the various strata encountered during the course of excavation, the following classification are to be followed.

a) Soil

It include all type of soil including laterite and moorum etc with/without any percentage of kankars which can be excavated by normal means such as shovel, pick axe, crow bar, spade etc and those which do not fall under clause 2.02.02 (b) and (c) etc.

b) Soft Rock

It include the rocks (including weathered rock) which are removable by splitting with the help of crow bar, pick axe, wedges, pavement breakers, pneumatic tools, hammers

or such implements etc and not requiring blasting (for excavation) in the opinion of the engineer.

c) Hard Rock

It include the rocks which require blasting for excavation in the opinion of the engineer. Where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other method as approved by the engineer. The mere fact that the contractor resorts to blasting shall not classify the soft rock under hard rock.

However, the engineer's decision on the type of strata encountered during excavation shall be the final and binding on the contractor.

2.02.03 Material for Filling

Material to be used for back filling shall be free from vegetations, roots, salts, rubbish, lumps, organic matter and any other harmful chemicals etc and shall be got approved by the engineer. Normally excavated earth shall be used for back filling. In case such earth contains deleterious salts, the same shall not be used. All clods of earth shall be broken or removed. Where the excavated material is mostly rock and if filling with the same is permitted by the engineer in writing, then the filling with rock shall be done in the following manner. The boulders shall be broken into pieces not exceeding 150mm size in any direction and mixed with fine materials consisting of decomposed rock, moorum or any approved earth to fill the voids as for as possible and the mixture shall then be used for filling.

In case the earth required for backfilling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc shall be borne by him. The selected earth from the borrow areas shall be got approved by the engineer. The borrowed material shall be free from roots, vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and clods etc. The contractor shall obtain and submit necessary clearances/permissions from the concerned authorities for the borrow areas/materials acquired to the engineer.

If specified, the back filling shall be done with clean well graded sand from approved quarries free from harmful and deleterious materials.

2.03.00 Quality Control

All works shall confirm to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor

shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

Sl. No.	Activity	Check
1	Lines, levels & grades	a) By periodic surveys b) By establishing markers, boards etc
2	Back filling	(a) On quality of fill material (b) On moisture content of back fill (c) On degree of compaction achieved

3.00.00 EXECUTION

The contractor shall prepare and submit the detailed drawings/schemes for excavation and back filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of slopes, shoring, approaches, dewatering, drainage, berms and compaction etc within 15 days of award of the contract to the engineer for approval.

3.01.00 Setting out

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the same shall be rectified by the contractor at his own risk and cost.

3.02.00 Clearing and Grubbing

The area to be excavated shall be cleared out of fences, trees, logs, stumps, bushes, vegetation, rubbish, slush etc. Trees upto 300mm girth shall be uprooted. Trees above 300mm girth to be cut shall be approved by the engineer and marked. Cutting of trees shall include removing roots as well. After the tree is cut and roots taken out, the pot holes formed shall be filled with good earth in 250mm layers and compacted unless directed otherwise by the engineer. The trees shall be cut in to suitable pieces as

instructed by the engineer. Before earthwork is started, all the spoils, unserviceable materials and rubbish shall be burnt or removed and disposed to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timber, fire woods etc shall be the property of the owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

3.03.00 Excavation for Foundations and Trenches

3.03.01 General

All excavation shall be done to the minimum dimensions as required for the safety and working facility. In each individual case, the contractor shall obtain prior approval of the engineer for the method he proposes to adopt for the excavation including dimensions, side slopes, shoring, dewatering, drainage and disposal etc. This approval however shall not in any way make the engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. All excavation in open cuts shall be made true to the line, slopes and grades as shown on the drawings and/or as directed by the engineer. No material shall project within the dimension of minimum excavation lines marked. Boulders (if any) projecting out of the excavated surfaces shall be removed if they are likely to be a hindrance to the work/workers in the opinion of the engineer.

Method of excavation shall in every case be subject to the approval of the engineer. The contractor shall ensure the stability and safety of the excavation, adjacent structures, services and works etc including the safety of the workmen. If any slip occurs, the contractor shall remove all the slipped materials from the excavated pit without any extra cost to the engineer/owner. All loose boulders and semi detached rocks which are not inside but so close to the area to be excavated and may liable to fall or otherwise endanger the workmen, equipment of the work etc during excavation in the opinion of the engineer shall be stripped off and removed away from the area of excavation. The method to be used for removal shall be such that it should not shatter or render unstable or unsafe the portion which was originally sound and safe. In case any material not required to be removed initially but later to become loose or unstable in the opinion of the engineer shall also be promptly and satisfactorily removed.

The rough excavation may be carried out upto a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up as instructed by the engineer. If the excavation (in all types of soil and rock) is done to a depth greater than that shown on the drawing or as directed by the engineer, the excess depth up to the required level shall be filled with cement concrete not leaner than 1:4:8 or richer as directed by the engineer at the own risk and cost of the contractor. In case where excavation in soil, soft rock (including weathered rock) and hard rock are involved, the excavation in each stratum

shall be carried out separately with the approved methodology and as per the instructions of the engineer.

All excavated materials such as rock, boulders, bricks, dismantled concrete blocks etc shall be the property of the owner and shall be stacked separately as directed by the engineer. All gold, silver, oil, minerals, archeological and other findings of importance, trees cut or other materials of any description and all precious stones, coins, treasures, relics, antiquities and other similar things which may be found in or upon the site shall be the property of the owner and the contractor shall duly preserve the same to the satisfaction of the engineer/owner. The contractor shall deliver the same to such person or persons as may be authorized or appointed from time to time by the owner to receive the same.

Prior to starting the excavation, the ground level at the location shall be checked jointly with the engineer.

3.03.02 Excavation in All Type of Soil and in Soft Rock

The excavation in all type of soil, soft rock including decomposed rock etc shall be carried out as per the approved proposal and as directed by the engineer. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to any other activities in the area. Foundation pits shall not be excavated to the full depth unless construction is imminent. The last 150mm depth shall be excavated once concreting work is imminent. At the discretion of the engineer, the full depth may be excavated and the bed be covered with lean concrete as specified after watering and compacting the bed. As the excavation reaches the required dimensions, lines, levels and grades etc, the work shall be got checked and approved by the engineer. In cases where detoriation of the ground, upheaval, slips etc are expected, the engineer may order to suspend the work at any stage and instruct the contractor to carry out the protection works before the excavation will be restarted.

3.03.03 Excavation in Hard Rock

Hard rocks shall normally be excavated by means of blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. Where the excavated surface is not stable against sliding, necessary supports such as props, bracings or bulkheads shall be provided and maintained during the period of construction. Where the danger of falling loose rock/boulder from the excavated surfaces deeper than 2m exist, steel mesh anchored to the lower edge of the excavation and extending over and above the rock face adequate to retain the dislodged material shall be provided and maintained.

3.03.04 Blasting

a) General

Storage, handing and use of explosives shall be governed by the current explosive rules/regulations laid down by the Central and the State Governments. The contractor shall ensure that these rules/regulations are strictly adhere to. The following instructions are also to be strictly followed and the instructions wherever found in variance with the above said rules/regulations, the former (instructions) shall be superseded with the later (above said rules/regulations).

No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. The contractor shall obtain licence from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per Explosives Rules, 1940 corrected upto date. The contractor shall purchase the explosives, fuses, detonators etc only from a licensed dealer and shall be responsible for the safe custody and proper accounting of the explosive materials. The engineer or his authorized representative shall have the access to check the contractor's store of explosives and his accounts at any time. It is the full responsibility of the contractor to transport the explosives as and when required for the work in a safe manner to the work spot.

Further, the engineer may issue modifications, alterations and new instructions to the contractor from time to time. The contractor shall comply with the same without these being made a cause for any extra claim.

b) Materials

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of the engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and shall be not less than 4 seconds per inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected. Moist, damaged or broken ones shall be discarded. When the fuses are in stock for long, the rate of burning of fuses shall be tested before use. The detonators shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded.

c) Storage of Explosives

The current Explosive Rules shall govern the storage of explosives. Explosives shall be stored in a clean, dry and well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400m of the actual work site or any source of fire. The space surrounding the magazine shall be fenced and the ground inside shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be through a single gate only and no person shall be allowed without the permission of the officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be well drained. Two lightning conductors, one at each end shall be provided to the magazine. The lightning conductors shall be tested once in every year.

Explosives, fuses and detonators shall each be separately stored. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care shall be taken to keep the floor free from any grains of explosives. Cases containing explosives shall not be opened inside the magazine and the explosives in open cases shall not be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine but must be removed without delay to a safe distance and be destroyed.

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine. Illumination shall be obtained from an electric storage battery lantern. No smoking shall be allowed within 100m distance from any magazine.

Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be provided at the magazine for this purpose and should be careful

* not to put their feet on the clean floor unless the magazine shoes on.

* not to touch the magazine shoes on ground outside the clean floor.

* not to allow any dirt or grit to fall on the clean floor.

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.

The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside

the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

d) Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicle conveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

e) Use of Explosives

The contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his responsibilities.

Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting.

The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the blast area and inspect carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot firer shall be present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc shall be taken during blasting operations.

f) Restrictions in Blasting

a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted.
b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted.
c) Progressive blasting shall be limited to two third of the total remaining depth of excavation.

d) No large scale blasting operations will be resorted to when the excavation reaches the last one metre and only small charge preferably black powder may be allowed so as not to shatter the parent rock.
e) The last blast shall not be more than 0.50 m in depth.
f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiselling or any other suitable method as approved by the engineer.

3.03.05 Disposal

The excavated spoils shall be disposed of in any (or all) of the following manner as directed by the engineer.

a) By using it straightway for backfilling.

b) By stacking it temporarily to use for backfilling at a later date during execution of the contract.

c) i) By either spreading
or
ii) By spreading and compacting at designated disposal areas.

d) By selecting the useful material and stacking it neatly in designated areas as indicated by the engineer for use in backfilling by some other agency.

3.03.06 Disposal of Surplus Materials

All surplus material from excavation shall be removed and disposed of from the excavation site to the designated disposal area indicated by the engineer. All good and sound rocks obtained from excavations and all assorted materials of dismantled structures are the property of the owner and if the contractor wants to use it, he shall have to obtain it from the engineer at a mutually agreed rate. All sound rocks and other assorted materials like excavated bricks etc shall be stacked separately.

3.03.07 Protection

The contractor shall notify the engineer as soon as the excavation is expected to be completed within a day so that he shall inspect it at the earliest. Immediately after approval of the engineer, the excavation must be covered up in a shortest possible time. But in no case the excavation shall be covered up or worked on before approval by the engineer. Excavated material shall be placed 1.5m or half the depth (of excavation) whichever is more from the edge of the excavation or further away if directed by the engineer. Excavation shall not be carried out below the foundation level of the structure close by until the required precautions are taken. Adequate fencing is to be made enclosing the excavation. The contractor shall protect all the

underground services exposed during excavation. All existing surface drains in the work area shall be suitably diverted by the contractor before taking up excavation to maintain the working area neat and clean.

3.03.08 Dewatering

All excavation shall be kept free of water and slush. Grading in the vicinity shall be controlled to prevent the surface water running into the excavations. The contractor shall remove any water inclusive of rain water and subsoil water etc accumulated in the excavation by pumping or other means as approved by the engineer and keep the excavations dewatered and/or lower the subsoil water level to 300mm below the founding level until the construction of foundation and backfilling are completed in all respects.

Sumps made for dewatering must be kept clear of the foundations. The engineer's prior approval on the method of pumping to be adopted shall be taken; but in any case, the pumping arrangement shall be such that there shall be no movement or blowing in of subsoil due to the differential head of water during pumping.

3.03.09 Timber Shoring

Close or open type timber shoring as approved by the engineer depending on the nature of sub-soil, depth of pit or trench and the type of timbering shall be adopted. Timbers made out of approved quality shall only be used. It shall be the responsibility of the contractor to take all necessary steps to prevent the sides of trenches and pits from collapsing.

a) Close Timbering

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called "polling boards". These shall be of 250mm wide(min.) and 40mm thick(min.) sections as directed by the engineer. The boards shall generally be placed vertically in pairs, one on each side of the cut and shall be kept apart (maximum spacing is limited to 1.20m) by horizontal walers of strong wood cross strutted with wooden struts or as directed by the engineer. The length of wooden struts shall depend on the width of the trench or pit.

In case where the soil is very soft and loose, the boards shall be placed horizontally against the sides of excavation and supported by vertical walers which shall be strutted to similar timber pieces on the opposite face of the trench or pit. The lowest board supporting the sides shall be taken into the ground. No portion of the vertical side of the trench or pit shall remain exposed to avoid any slipping out of earth.

The withdrawal of the timber shall be done very carefully to prevent the collapse of

the pit or trench. It shall be started from one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried.

b) Open Timbering

In case of open timbering, vertical board of 250mm wide(min.) and 40mm thick(min.) shall be spaced sufficiently apart to leave unsupported strips of maximum 500mm average width. The detailed arrangement, size of timber and the spacing etc shall be subjected to the approval of the engineer. In all other respects, the specification for close timbering shall apply to open timbering as well.

3.03.10 Treatment of Slips

The contractor shall take all precautions to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides of the excavations. These precautions along with proper slopes, berms, shoring and control of ground water should cause no slips to occur. If however slips still occur, the same shall be removed by the contractor with his own risk and cost.

3.04.00 Backfilling

3.04.01 General

The material to be used for backfilling shall be approved by the engineer which shall be obtained directly from the excavation, from the nearby areas where excavation work by the same agency is in progress, from the temporary stacks of excavated spoils or from the borrow pits as directed by the engineer. The material shall be free from lumps and clods, roots and vegetations, harmful salts and chemicals, organic materials etc.

In locations where sand filling is required, the sand used should be clean, well graded and be of the quality normally acceptable for use in concrete.

3.04.02 Filling and Compaction in Pits and Trenches all Around the Structures

As soon as the work in foundation has been accepted, the spaces around the foundation in pits and trenches shall be cleared of all debris, brick bats, mortar droppings etc and filled with approved earth in layers not exceeding 250mm (in loose thickness). Each layer(loose) shall be watered, rammed and properly compacted to the required degree to the satisfaction of the engineer. Earth shall be compacted with approved mechanized compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the engineer. The moisture content of the fill material

during compaction shall be controlled near to its optimum moisture content so as to obtain the required degree of compaction. The final surface shall be trimmed and levelled to proper profile as desired by the engineer.

3.04.03 Plinth Filling

The plinth shall be filled with earth in layers not exceeding 250mm (in loose thickness) and each layer shall be watered and compacted to the required degree with approved compaction machine or manually if specifically permitted by the engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted in order to avoid any settlement at a later stage. The finished surface of fill shall be trimmed to the slope intended to be provided for the floor.

3.04.04 Filling in Trenches for Water Pipes and Drains

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150mm, watered, rammed and compacted taking care that no damage is caused to the pipe below.

In case of trenches excavated in rock, the filling upto a height of 300mm or the diameter of the pipe whichever is more above the crown of the pipe or barrel shall be done with fine material such as earth, moorum, disintegrated rock or ash as per the availability at site and shall be filled in compacted layers not exceeding 150mm. The remaining filling shall be done in layers with the mixture of boulders (of size not exceeding 150mm) and fine material as specified elsewhere in the specification. Each layer shall be watered, rammed and compacted to the required degree and to the satisfaction of the engineer.

3.04.05 Filling in Disposal Area

Surplus materials from excavation which are not required for backfilling shall be disposed of in the designated disposal areas. The spoils shall not be dumped haphazardly but should be spread in layers approximately 250mm thick when loose, watered and compacted with the help of a compacting equipment as per the directions of the engineer. In wide areas, rollers shall be employed and compaction shall be done to the satisfaction of the engineer at the optimum moisture content which shall be checked and controlled by the contractor. In certain cases the engineer may direct the contractor to dispose the surplus materials without compaction which can be done by tipping the spoils from a high bench neatly maintaining a proper level and grade of the bench.

3.05.00 Approaches and Fencing

The contractor should provide and maintain proper approaches for the workmen and inspection. The roads and approaches around the excavation should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the project. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as around the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.

3.06.00 Lighting

Full scale area lighting is to be provided if night work is permitted or directed by the engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the fill.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 Excavation

On completion of excavation, the dimension of the pits will be checked as per the drawings after the pits are completely dewatered. The work will be accepted after all undercuts have been set right and all over excavations are filled back to the required lines, levels and grades by placing ordinary cement concrete of 1:4:8 proportion and/or richer and/or by compacted earth as directed by the engineer. The choice of the grade of concrete will be a matter of unfettered discretion of the engineer. Over excavation of the sides shall be made good by the contractor while carrying out the backfilling. The excavation work will be accepted after the above requirements are fulfilled and all the temporary approaches encroaching inside the excavation have been removed.

4.02.00 Backfilling

The degree of compaction required will be as per the stipulation laid down in IS:4701 and the actual method of measuring the degree of compaction will be as decided by the engineer. The work of back filling will be accepted after the engineer is satisfied with the degree of compaction achieved.

5.00.00 RATES AND MEASUREMENTS

5.01.00 Rates

a) The item of work in the schedule of quantities describe the work very briefly. The various items of the schedule of quantities shall be read in conjunction with the corresponding section in the technical specification including amendments and additions if any. For each item in the schedule of quantities, the bidder's rate shall

include all the activities covered in the description of the items as well as for all necessary operations in detail as described in the technical specification.

b) No claims shall be entertained if the details shown on the released for construction drawings differ in any way from those shown on the tender drawings.

c) The unit rate quoted shall include minor details which are obviously and fairly intended and which may not have been included in these documents but are essential for the satisfactory completion of the work.

d) The bidder's quoted rate shall be inclusive of supplying and providing all labour, men, materials, equipments, tools and plants, supervision, services, approaches, schemes etc.

e) In case blasting in hard rock is envisaged, the unit rate quoted for earth work shall include the cost of storage and safety arrangements for the materials required for blasting. No separate payment will be made on this account.

5.02.00 Measurements

Method of measurements are specified in the proceeding sections. Where not so specified, the latest version of IS:1200, Part-1 shall be applicable.

a) The length, breadth and depth shall be measured correct to the nearest centimetre if measurements are taken by tape. Rounding of numerical shall be as per relevant IS Codes. If the measurements are taken with staff and level, the levels shall be recorded correct to 5mm. The area and volume shall be worked out in square meter and cubic meter respectively correct to the nearest of two decimal places.

b) For earth work in excavation, the ground levels shall be taken before and after completion of the work in the actually excavated area. The quantity of earth work in excavation shall be computed from these levels in cubic meter.

c) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation, then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed.

d) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall

be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rock so arrived shall be taken as soil.

6.00.00 INFORMATION TO BE SUBMITTED BY THE BIDDER

6.01.00 With Tender

Detail of equipments and machineries proposed to be used for excavation, backfilling and compaction shall be submitted along with the tender.

6.02.00 After Award

After award of the contract the successful bidder shall submit the following for approval.

a) Within 30 days of the award of contract, the contractor shall submit a detailed programme of the work as proposed to be executed giving completion dates of excavation for the various foundations and the time required for backfilling and compaction after completion of foundation for the structures. The earthwork programme shall be planned in accordance with the foundation programme. The programme should also show how the excavation and backfilling quantities will be balanced minimizing the temporary stacking of spoils. It is to be noted that the engineer even after initial approval of the programme may instruct the contractor to enhance or to retard the progress of work during the actual execution in order to match with the progress of foundations. The initial programme being submitted by the contractor should have sufficient flexibility to take care of such reasonable variations.

b) Within 15 days of the award of contract, the contractor shall submit the drawings for earth work in excavation and backfilling showing detail of slopes, shoring, approaches, sump pits, dewatering lines, fencing etc for the approval of the engineer.

SECTION D
SUB-SECTION D II

CEMENT CONCRETE(PLAIN & REINFORCED)

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	GENERAL
3.00.00	INSTALLATION
4.00.00	SAMPLING AND TESTING
5.00.00	ACCEPTANCE CRITERIA
6.00.00	RATES AND MEASUREMENTS
7.00.00	LIST OF I.S.: CODES AND STANDARDS FOR REFERENCE

SUB-SECTION – D II

CEMENT CONCRETE (PLAIN & REINFORCED)

1.00.00 SCOPE

1.01.00 General

This specification covers all the requirements, described hereinafter for general use of Plain and Reinforced Cement Concrete work in Structures and locations, cast-in-situ or precast, and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work. Special requirements for structures such as reinforced concrete chimney, cooling towers, etc. have been covered under the respective specifications. Those specifications shall be used in conjunction with this specification.

1.02.00 ACI:318 shall form a part of this specification and shall be complied with unless permitted otherwise. For any particular aspect not covered by this Code, appropriate Code, specifications and/or replacement by any International code of practice as may be specified by the Engineer shall be followed. All codes and Standards shall conform to its latest revisions. A list of IS codes and Standards is enclosed hereinafter for reference. However, should the list be not exhaustive and does not cover any aspect of the work, then relevant Indian and, in its absence, relevant International code shall apply.

2.00.00 General

2.01.00 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified shall include but not be limited to the following

a) Furnish all labour, supervision, services including facilities as may be required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plants, transportations, etc. required for the work.

b) Prepare Bar bending Schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.

c) Prepare working drawings of formworks, scaffolds, supports, etc.

d) Prepare shop drawings for various inserts, anchors, anchor bolts, pipe sleeves, embedments, hangers, openings, frames etc.
e) Prepare detailed drawings of supports, templates, hangers, etc. required for installation of various embedments like inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc.

As decided by the Engineer some or all of the drawings & schedules prepared under item (b) to (e) above will have to be submitted for approval.

f) Submit for approval detailed schemes of all operations required for executing the work, e.g. material handling, Concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc.

g) Design and submit for approval concrete mix designs required to be adopted on the job.

h) Furnish samples and submit for approval results of tests of various properties of the following:

i) The various ingredients of concrete

ii) Concrete

iii) Embedments

iv) Joint seals

i) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings and specifications.

j) For supply of certain materials normally manufactured by specialist firms, the Contractor may have to produce, if directed by the Engineer, a guarantee in approved Performa for satisfactory performance for a reasonable period as may be specified, binding both the manufacturers and the Contractor, jointly and severally.

2.02.00 Work by others

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.03.00 Information to be submitted by the Tenderer

2.03.01 With Tender

The following technical information's are required with the tender:

a) Source and arrangement of processing of aggregates proposed to be adopted.

b) Type of batching plant and equipments to be used for batching, transportation, compaction, ice handling, testing at site & laboratory.

c) Names of firms with which association is sought for to execute the special items of work in the contract.

d) Types of formwork proposed to be used.

2.03.02 After Award

The Contractor shall submit the following information and data including samples where necessary, progressively during the execution of the contract.

a) Programme of Execution

Within 30 days of the award of contract, the Contractor will submit a Master Programme for completion of the work.

This Master Programme may have to be reviewed and updated by the Contractor, quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work.

Detailed day-to-day Programme of every month is to be submitted by the Contractor before the end of the previous month.

b) Samples

Samples of the following materials and any other materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities free of cost, for approval. The Engineer for future reference will preserve approved samples. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying materials of specified qualities:

i) Coarse and fine aggregates, cement (if supplied by contractor).

ii) Admixtures.

iii) Plywood for Formwork.

iv) Embedded and anchorage materials as may be desired by the Engineer.

v) Joint sealing strips and other*waterproofing materials.

vi) Joint filling compounds.

vii) Foundation quality Rubber Pads.

c) Design Mix

Design mix as per specification giving proportions of the ingredients, sources of aggregates and cement, along with test results of trial mixes as per relevant I.S 10262 (latest), is to be submitted to the Engineer for his approval before it can be used on the works.

d) Bar Bending Schedules

Bar Sending Schedules in accordance with Clause 2.01.00 (b) and 3.16.01 of this specification.

e) Detailed Drawings and Designs of Formworks to be used

Detailed design data and drawings of standard formworks to be used as per clause 2.01.00 (c).

f) Detailed Drawings for Templates & Temporary Supports for embedment As per Clause 2.01.00 (e).

g) Mill Test Reports for Cement & Reinforcing Steel.

h) Inspection Reports

The Engineer in accordance with Clause 2.04.00 of this specification may desire inspection Reports in respect of Formwork and Reinforcement and any other item of work as.

i) Test Reports

Reports of tests of various materials and concrete as required under

Clause 4.0: SAMPLING & TESTING of this specification or as directed by the Engineer.

j) Any other data, which may be required as per this specification or as directed by the Engineer.

2.04.00 Conformity with Design

The Contractor will prepare checklists in approved Performa, which will be called "Pour Cards". These Pour Cards will list out all items of work involved. The Contractor will inform the Engineer, sufficiently in advance, whenever any particular pour is ready for concreting. He shall accord all necessary help and assistance to the Engineer for all checking required in the pour. On satisfying himself that all details are in accordance to the drawings and specifications, the engineer will give written permission on the same Pour Cards allowing the contractor to commence placement of concrete. Details of all instructions issued by the Engineer and the records of compliance by the Contractor, deviations allowed by the Engineer and any other relevant information will be written on accompanying sheets attached to the Pour Cards. The Pour Cards along with accompaniments will be handed over to the Engineer before starting placement of concrete. One of the mix designs developed by the Contractor as per the I.S. Specifications and established to the satisfaction of the Engineer by trial mixes shall be permitted to be used by the Engineer, the choice being dictated by the requirements of designs and workability. The methods of mixing, conveyance, placement, vibration, finishing, curing, protection and testing of concrete will be as approved or directed by the Engineer.

2.05.00 Materials to be used

2.05.01 General Requirement

All materials whether to be incorporated in the work or used temporarily for the construction shall conform to the relevant IS Specifications unless-stated otherwise and be of best approved quality.

2.05.02 Cement

Ordinary Portland cement of grade-43 as per IS:8112/fly ash based Portland puzzolona cement conforming to IS:1489 (Part-1) shall preferably be used in reinforced/plain cement concrete works for all areas other than for the critical structures identified below. However, other types of cement such as ordinary Portland cement conforming to IS:269, Portland slag cement conforming to

IS:455 respectively can be used under special circumstances. Cement used in all concrete mixes shall be in general of grade 33/43 unless design requires a higher grade. Ordinary Portland cement shall be used for following structure.

a) TG foundation top deck and sub structures including raft.

b) Spring Supporting decks of all machine foundations.

c) Structures requiring grade of concrete of M30 and above.

In special cases, Rapid Hardening Portland Cement, Low Heat Cement, Sulphate resistant cement, high strength Ordinary Portland Cement etc. may be permitted or directed to be used by the Engineer.
For Brickwork, plaster, flooring and other finishing works, ordinary Portland cement of 33/43 grade shall be used.

2.05.03 Coarse Aggregate

Aggregate of sizes ranging between 4.75 mm and 150 mm will be termed as Coarse Aggregate. Coarse aggregate for concrete shall be chemically inert, hard, strong durable against weathering, of limited porosity, and free from deleterious materials. It shall be properly graded. Coarse aggregates shall be either crushed gravel or stone. All aggregates shall meet the requirement of IS:383:1970. Only Coarse Aggregate from, approved quarries and conforming to IS-383 will be allowed to be used on the works. Petrographic test shall be carried out by the contractor free of cost for checking the quality of rock from quarry. This test shall be repeated by the Contractor free of cost for change in quarry or as directed by the Engineer. The results shall be checked for reactivity of silica in aggregate with alkalis of cement.

2.05.04 Fine Aggregate

Aggregate smaller than 4.75 mm and within the grading limits and other requirements set in IS: 383 are termed as Fine Aggregate or Sand. Only Fine Aggregate from approved sources and conforming to the above IS Specification will be allowed to be used in works. Sand shall be hard, durable, clean and free from adherent coatings or organic matter and clay balls or pellets. Sand when used as fine aggregate in concrete shall conform to IS:383. For plaster, it shall conform to IS:1542 and for masonry work to IS:2116.

2.05.05 Water

Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts, or other impurities. Generally, IS: 3550 will

be followed for routine tests. Acceptance of water shall be as per IS: 456.

2.05.06 Admixture

Only admixtures of approved quality will be used when directed or permitted by the Engineer. The different types of admixtures, which may be necessary to satisfy the concrete mix and the design requirement, shall be as per IS-9103 and may be one of the followings:

a) Accelerating admixture

b) Retarding admixture

c) Water reducing admixture

d) Air entraining admixture

The contractor shall inform the Engineer about the type of admixture which he is planning to use in different areas within the scope of work for the approval of the Engineer. The admixture shall be of proven make and from a reputed manufacturer. It should not have any adverse effect on strength, durability of concrete and reinforcement. Super plasticizers conforming to IS: 9103 or ASTMC-494 shall only be used as admixture having the above properties either individually or in a combination as per the direction of the Engineer.

2.05.07 Reinforcement

Reinforcement shall be as per relevant IS Specification as mentioned in the Contract/Drawing/Instructions. All bars above 10 mm dia. shall be of tested quality.

2.06.00 Storage of Materials

2.06.01 General

All materials shall be so stored as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged or is otherwise considered defective by the Engineer, shall not be used for concrete and shall be removed from site immediately, failing which, the Engineer shall be at liberty to get the materials removed and the cost incurred thereof shall be realised from the Contractor's dues. The Contractor shall maintain upto-date accounts of receipt, issue and balance (stack wise) of all materials. Storage of materials shall conform to IS: 4082.

2.06.02 Cement

Sufficient space for storage, with open passages between stacks, shall be arranged by the Contractor to the satisfaction of the Engineer.

Cement shall be stored off the ground in dry, leak proof, well-ventilated warehouses at the works in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter.

Cement shall be stored in easily countable stacks with consignment identification marks. Consignments shall be used in the order of their receipts at site. Sub-standard or partly set cement shall not be used and shall be removed from the site, with the knowledge of the Engineer, as soon as it is detected.

2.06.03 Aggregates

Aggregates shall be stored on raised surface constructed by providing planks or steel plates or on concrete or brick masonry pavement. Each size shall be kept separated with wooden or steel or concrete or masonry bulkheads or in separate stacks and sufficient care shall be taken to prevent the material at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart with proper arrangement of drainage. The aggregates shall be stored in easily measurable stacks of suitable depths as may be directed by the Engineer.

2.06.04 Reinforcement

Reinforcing steel shall be stored consignment-wise and size-wise off the ground and under cover, if desired by the Engineer. It shall be protected from rusting, oil, grease, and distortions.

If necessary, the reinforcing steel may be coated with cement wash before stacking to prevent scale and rust at no extra cost to the Owner. The stacks shall be easily measurable. Steel needed for immediate use shall only be removed from storage.

2.07.00 Quality Control

Contractor shall establish and maintain quality control for different items of work and materials as may be directed by the Engineer to assure compliance with contract requirements and maintain and submit to the Engineer records of the same. The quality control operation shall include but not be limited to the following items of work:

a) Admixture: Type, quantity, physical, and chemical properties that affects strength, workability, and durability of concrete.

For air entraining admixtures, dosage to be adjusted to maintain air contents within desirable limits.

b) Aggregate: Physical, chemical and mineralogical qualities. Grading, moisture content and impurities.

c) Water: Impurities tests.

d) Cement: Tests to satisfy relevant IS Specifications.

e) Formwork: Material, shapes, dimensions, lines, elevations, surface finish, adequacy of form, ties, bracing and shoring and coating.

f) Reinforcement: Shapes, dimensions, length of splices, clearances, ties and supports. Quality and requirement of welded splices.

Material tests or Certificates to satisfy relevant IS Specification.

g) Grades of Concrete: Usage and mix design, testing of all properties.

h) Batching & Mixing: Types and capacity of plant, concrete mixers and transportation equipment.

i) Joints: Locations of joints, water stops and filler materials. Dimension of joints, quality, and shape of joint material and splices.

j) Embedded and Anchorage Items: Material, shape, location, setting.

k) Placing: Preparation, rate of pouring, weather limitations, time intervals between mixing and placing and between two successive lifts, covering over dry or wet surfaces, cleaning and preparation of surfaces on which concrete is to be placed, application of mortar/slurry for proper bond, prevention of cold joint, types of chutes or conveyors.

l) Compaction: Number of vibrators, their prime mover, frequency and amplitude of vibration, diameter and weight of vibrators, duration of vibration, hand-spreading, rodding and tamping.

m) Setting of base &

Bearing plates: Lines, elevations, and bedding mortar.

n) Concrete Finishes:Repairs of surface defects, screening, floating, steel trowelling and brooming, special finishes.

o) Curing: Methods and length of time.

Copies of records and tests for the items noted above, as well as, records of corrective action taken shall be submitted to the Engineer for approval as may be desired.

3.00.00 INSTALLATION

All installation requirements shall be in accordance with IS: 456 and as supplemented or modified herein or by other best possible standards where the specific requirements mentioned in this section of the specification do not cover all the aspects to the full satisfaction of the Engineer.

3.01.00 Washing and Screening of Aggregates

Washing and screening of coarse and fine aggregates to remove fines, dirt, or other deleterious materials shall be carried out by approved means as desired by the Engineer.

3.02.00 Admixture

All concrete shall be designed for normal rate of setting and hardening at normal temperature. Variations in temperature and humidity under different climatic conditions will affect the rate of setting and hardening, which will, in turn, affect the workability and quality of the concrete. Admixtures including plasticisers of approved make may be used with the Engineer's approval in accordance with IS-456 to modify the rate of hardening, to improve workability or as an aid to control concrete quality. The Engineer reserves the right to require laboratory test or use test data, or owner satisfactory reference before granting approval. The admixture shall be used strictly in accordance with the manufacturer's directions and/or as directed by the Engineer.

3.03.00 Grades of Concrete

Concrete shall be in one of the grades designated in IS: 456. Grade of concrete to be used in different parts of work shall be as shown on the drawing. In case of liquid retaining structures, IS: 3370 will be followed. Minimum cement content shall be as per IS: 456.

3.04.00 Proportioning and Works Control

3.04.01 General

"Design Mix Concrete" and "Nominal Mix Design" is defined as follows for use in this specification:

a) Proportioning of ingredients of concrete made with preliminary tests by designing the concrete mix. Such concrete shall be called "Design Mix Concrete".

Proportioning of ingredients of concrete made without preliminary tests adopting nominal concrete mix. Such concrete shall be called "Nominal Mix Concrete".

As far as possible, design mix concrete shall be used on all concrete works. Nominal mix concrete, in grades M-15 or lower only may be used if shown on drawings or approved by the Engineer. In all cases the Proportioning of ingredients and works control shall be in accordance with IS: 456 and shall be adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.

3.04.02 Mix Design Criteria

Concrete mixes will be designed by the Contractor to achieve the strength, durability, and workability necessary for the job, by the most economical use of the various ingredients. In general, the design will keep in view the following considerations

a) Consistent with the various other requirements of the mix, the quantity of water should be kept at the lowest possible level.

b) The nominal maximum size of coarse aggregate shall be as large as possible within the limits specified.

The various fractions of coarse and fine aggregates should be mixed in such a proportion as to produce the best possible combined internal grading giving the densest and most workable mix.

The finished concrete should have adequate durability in all condition, to withstand satisfactorily the weather and other destruction agencies, which it is expected to be subjected to in actual service.

The mix design shall have required workability and characteristic strength as

per IS: 456. The quantity of cement, aggregates, and admixtures shall be determined by mass.

The requirement of adequate structural strength is catered for by the choice of proper grade of concrete in structural design. The Contractor will strictly abide by the same in his design of concrete mix installation. Various trials shall be given by the contractor with specific cement content on each trial. In some cases, plasticizers and other admixtures may be necessary to achieve the desired results.

3.05.00 Strength Requirements

The strength requirements of both design mix and nominal mix concrete where ordinary Portland Cement or Portland Blast furnace slag cement is used, shall be as per IS: 456. All other relevant clauses of IS: 456 shall also apply.

3.06.00 Minimum Cement Content

The minimum cement content for each grade of concrete shall be as per IS: 456. Contractor has to consider actual environmental exposure condition at site. Based on various tests results and as per Engineer, the environment condition shall be adopted for which minimum cement content shall be considered. No extra payment shall be made on account of any variation in environment condition.

a) Sufficient number of trial mixes (to be decided by the Engineer) will be taken at the laboratory for the various designs and graphs of w/c ratio Vs crushing strengths at various ages will be plotted.

b) All tests will be done in presence of the Engineer who shall be the final authority to decide upon the adoption of any revised minimum cement content. The Contractor will always be responsible to produce quality concrete of the required grade as per the acceptance criteria of IS: 456.

c) The Engineer will always have the unquestionable right to revise the minimum cement content as decided above, if, in his opinion, there is any chance of deterioration of quality on account of use of lower cement content or any other reason.

3.07.00 Water-Cement Ratio

The choice of water-cement ratio in designing a concrete mix will depend on:-

a) The requirement of strength.

b) The requirement of durability.

3.07.01 Strength Requirement

In case of "Design Mix Concrete" the water-cement ratio of such value as to give acceptable test results as per IS: 456, will be selected by trial and error. The values of water-cement ratios for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary tests in the laboratory to the satisfaction of the Engineer. Frequent checks on test will have to be carried out and the water-cement ratios will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above the Contractor's responsibility to produce satisfactory test results and to bear all the consequences in case of default remains unaltered.

In case of nominal mix concrete, the maximum water-cement ratio for different grades of concrete is specified in Table-5 of IS: 456 and no tests are necessary. The acceptance test criterion for nominal mix concrete shall be as per IS: 456.

3.07.02 Durability Requirement

Tables 4 & 5 of IS: 456 give the maximum water-cement ratio permissible from the point of view of durability of concrete subjected to adverse exposure to weather, sulphate attacks, and contact with harmful chemicals. Impermeability may also be an important consideration.

Whenever the water-cement ratio dictated by Durability consideration is lower than that required from strength criteria, the former should be adopted.

In general the water cement ratio between 0.4 and 0.45 will be desirable to satisfy the durability requirement and from the consideration of impermeability of concrete. The contractor may propose lower water cement ratio as mentioned above by addition of a suitable plasticizer/super-plasticizer. Trial mix shall be carried out accordingly. However, the contractor has to propose specifically along with field trials in the event of lower cement content if found suitable along with a plasticizer.

3.08.00 Workability

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments and to give the required surface finish shall depend*on the type and nature of structure and shall be based on experience

and tests. The usual limits of consistency for various types of structures are given below:

TABLE-V

LIMITS OF CONSISTENCY

Degree of workability	Slump in mm with Standard Cone as per IS: 1199		Use for which concrete is suitable
	Min.	Max.	
Very low	0	25	Large Mass concrete structure with heavy compaction equipments, roads
Low	25	50	Uncongested wide and shallow R.C.C. structures
Medium	50	100	Deep but wide R.C.C. structures with congestion of reinforcement and inserts
High	100	150	Very narrow and deep R.C.C. structures with congestion due to reinforcement and inserts.

Note: Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer.

With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. No extra payment will be made for this additional cement.

The workability of concrete shall be checked at frequent intervals by slump tests.

3.09.00 Size of coarse Aggregates

The maximum size of coarse aggregates for different locations shall be as

follows unless otherwise directed by the Engineer

Very narrow space	- 12 mm
Reinforced concrete Except foundation	- 20 mm
Ordinary Plain concrete and Reinforced concrete foundations	- 40 mm
Mass concrete	- 80 mm
Lean concrete	- 40 mm

Grading of coarse aggregates for a particular size shall conform to relevant I.S. Codes and shall also be such as to produce a dense concrete of the specified proportions, strength and consistency that will work readily into position without segregation.

Coarse aggregate will normally be separated into the following sizes and stacked separately in properly designed stockpiles

80 mm to 40 mm, 40 mm to 20 mm and 20 mm to 5 mm. In certain cases it may be necessary to further split the 20 mm to 5 mm fraction into 20 mm to 10 mm and 10 mm to 5 mm fractions.

This separation of aggregates in different size fractions is necessary so that they may be remixed in the desired proportion to arrive at a correct internal grading to produce the best mix.

3.09.01 Temperature control of concrete in top decks of machine foundations (i.e. of TGs, BFPs, Fans and Mills):

The temperature of fresh concrete shall not exceed 25°C when placed. A suitable measuring device for measuring the temperature of concrete as approved by the Engineer shall be used. For maintaining the limiting temperature of the 25°C, crushed ice shall be used as mixing water. The ice shall be formed of water conforming IS: 456. The Contractor shall establish the quantity of crushed ice to be mixed in order to achieve the limiting temperature of 25°C.

3.09.02 Base raft of Turbo Generator foundations and top decks of all machine foundations shall be cast in a continuous operation without any construction joint.

3.10.00 Mixing of Concrete

Ingredients of the concrete mix shall be measured by weight. Concrete shall always be mixed in mechanical mixer. Water shall not normally be charged into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency, but in no case shall mixing be done for less than 2 (two) minutes and at least 40 (forty) revolutions after all the materials and water are in the drum. When absorbent Aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.

The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time the work stops, the mixer shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement at no extra cost to the Owner to allow for loss in the drum.

Regular checks on mixer efficiency shall be carried out as directed by the Engineer as per IS: 4634 on all mixers employed at site only those mixers whose efficiencies are within the tolerances specified in IS: 1791 will be allowed to be employed.

Batching Plant shall conform to IS: 4925. The measuring gauges of batching plant shall be periodically calibrated for which the contractor shall provide standard weights. The accuracy of all gauges shall be within limits prescribed by the Engineer.

When hand mixing is permitted by the Engineer, for unimportant out of the way locations in small quantities, it shall be carried out on a water-tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand-mixing, 10% extra cement shall be added to each batch at no extra cost to the owner.

3.11.00 Conveying Concrete

Concrete shall be handled and conveyed from the place of mixing to the place of laying as rapidly as practicable by approved means and placed and compacted in the final position before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation or

loss of any of the ingredients. For long distance haulage, agitator cars of approved design will be used. If, in-spite of all precautions, segregations does occur during transport, the concrete shall be properly re-mixed before placement. During very hot or cold weather, if directed by the Engineer, concrete shall be transported in deep containers, which will reduce the rate of loss of water, by evaporation or loss of heat. If necessary, the container may have to be covered and insulated. Conveying equipments for concrete shall be well maintained and thoroughly cleaned before, commencement of concrete mixing. Such equipments shall be kept free from set concrete.

3.12.00 Placing and Compacting Concrete

Where specifically covered, the relevant I.S. Code will be followed for the procedure of surface preparation, placement, consolidation, curing, finishes, repairs and maintenance of concrete. If, however, there is no specific provision in relevant I.S. code for any particular aspect of work, any other standard code of practice, as may be specified by the Engineer, will be adopted. Concrete may have to be placed against the following types of surfaces:

Earth foundation

b) Rock foundation

Formwork

d) Construction joint in concrete or masonry

The surface on or against which concrete is to be placed has to be cleaned thoroughly. Rock or old construction joint has to be roughened by wire brushing, chipping, sand blasting or any other approved means for proper bond. All cuttings, dirt, oil, foreign and deleterious material, laitance, etc. are to be removed by air water jetting or water at high pressure. Earth foundation on which direct placement of concrete is allowed, will be consolidated as directed by the Engineer such that it does not crumble and get mixed up with the concrete during or after placement, before it has sufficiently set and hardened.

Formwork, reinforcement, preparation of surface, embedments, joint seals etc., shall be approved in writing by the Engineer before concrete is placed. As far as possible, concrete shall be placed in the formwork by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 1500 mm shall have to be approved by the Engineer.

Rock foundation or construction joint will be kept moist for at least 72 hours prior to placement. Concrete will be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the Engineer will have to be adopted.

Formwork will be cleaned thoroughly and smeared lightly with form oil or grease of approved quality just prior to placement.

A layer of mortar of thickness 12 mm of the same or less w/c ratio and the same proportion as that of the concrete being placed or cement slurry will be spread thoroughly on the rock Foundation or construction joint just prior to placement of concrete.

After concrete has been placed, it shall be spread, if necessary & thoroughly compacted by approved mechanical vibration to maximum, subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced workmen and the work carried out as per relevant IS Code of Practice: In thin members with heavy congestion of reinforcement or other embedments, where effective use of internal vibrator is, in the opinion of the Engineer, doubtful, in addition to immersion vibrators the contractor may have to employ form vibrators conforming to IS: 4656. For slabs and other similar structures, the contractor will additionally employ screed vibrator as per IS: 2506. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures, reinforcement, and formwork are not displaced or distorted during placing & consolidation of concrete.

The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green Concrete, which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete.

Slabs, beams, and similar members shall be poured in one operation, unless otherwise instructed by the Engineer. Mouldings, throating, drip course, etc., shall be poured as shown on the drawings or as directed by the Engineer.

Holes shall be provided and bolts, sleeves, anchors, fastenings, or other fixtures shall be embedded in concrete as shown on the drawings or as directed by the Engineer. Any deviation there from shall be set right by the Contractor at his own expense as instructed by the Engineer.

In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Engineer may direct to remove the portion and reconstruct or repair the same -at the Contractor's expense.

The Engineer shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement.

Once the concrete is deposited, consolidated and finished in its final position, it shall not be distributed.

3.13.00 Construction Joints and Cold Joints

3.13.01 Construction Joints

It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete certain predetermined stages. These joints will be formed in a manner specified in the drawings/Instruction.

Vertical construction joints will be made with rigid stop-board forms having slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint as per clause 3.12.

Where the location of the joints are not specified, it will be in accordance with the following:

a) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it.

b) Concrete in a beam shall preferably be placed without a joint, but if Provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span.

c) A joint in a suspended floor slab shall be vertical and at the middle of the span and at right angles to the principal reinforcement.

d) Feather-edges in concrete shall be avoided while forming a joint.

e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress.

f) In case the Contractor proposes to have a construction joint anywhere to facilitate his work, the proposal should be submitted well in advance to the Engineer for study and approval without which no construction joint will be allowed.

3.13.02 Cold Joint

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The Contractor should always remain vigilant to avoid cold joints.

If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it:

a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated.

b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 mm in thickness, will be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.

c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not raise inspite of extensive vibration, the joint, will be left to harden for at least 12 - 24 hrs. It Will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under clause 3.12.

3.14.00 Repairs, Finishes, and Treatment of Concrete surfaces

3.14.01 Adequate and sound concrete surfaces, whether formed or unformed, can be obtained by employing a concrete mix of proper design, competent formwork, appropriate methods of handling, placing, and consolidation by experienced workmen.

Unsound concrete resulting from improper mix design, incompetent methods, equipment and formwork, poor workmanship and protection will not be accepted and will have to be dismantled, removed and replaced by sound concrete at the Contractor's cost. The Engineer may, at his sole discretion, allow to retain concrete with minor defects provided the Contractor is able to repair it by approved methods at no extra cost to the Owner, All concrete work shall be inspected by the Contractor immediately after the forms are removed & he will promptly report occurrence of any defects to the Engineer. All repair works will be carried out as per the instructions and in the presence of the Engineer or his representative. Generally, repair work will consist of any or all of the following operations:

a) Sack rubbing with mortar and stoning with carborundum stone.

b) Cutting away the defective concrete to the required depth shape.

c) Cleaning of reinforcement & embedments. It may be necessary to provide an anti-corrosive coating on the reinforcement.

d) Roughening by sand blasting or chipping.

e) Installing additional reinforcement/welded mesh fabric.

f) Dry packing with stiff mortar.

9) Plastering, guniting, shotcreting etc.

h) Placing and compacting concrete in the void left by cutting out defective concrete.

i) Grouting with cement sand slurry of 1:1 mix.

j) Repairing with a suitable mortar either cement or resin modified mortars.

k) Polymer modified patching and adhesive repair& mortar for beams & columns.

3.14.02 Finishing unformed Surface

The contractor shall provide normal finishes in unformed surfaces which can be achieved by screeding, floating, trowelling etc. A few typical and common

cases of treatment of concrete surface are cited below

a) Floor

Whenever a non-integral floor finish is indicated, the surface of reinforced concrete slab shall be struck off at the specified levels and slopes and shall be finished with a wooden float fairly smooth removing all laitance. No over trowelling, to obtain a very smooth surface, shall be done, as it will prevent adequate bond with the subsequent finish. If desired by the Engineer, the surface shall be scored and marked to provide better bond.

Where monolithic finish is specified or required, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type and then floated with a wooden float. Steel trowelling is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done will flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes, ripples, and trowel marks.

A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water can be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface.

To provide a better grip the Engineer may instruct marking the floor in a regular geometric pattern after initial trowelling.

b) Beans, Columns & Walls

If on such or any other concrete structure it is intended to apply plaster or such concrete surfaces against which brickwork or other allied works are to be built, the Contractor shall hack the surface adequately as soon as the form is stripped off so that proper bond can develop. Pattern, adequacy, and details of such hacking shall meet with the approval of the Engineer, who shall be informed to inspect such surfaces before they are covered up.

3.15.00 Protection and Curing of concrete

Newly placed concrete shall be protected by approved means from rain, sun, and wind. Concrete placed below the ground level shall be protected against contamination from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be protected from contact with

such ground, or with water draining from such ground, during placing of concrete and for a period of at least three days, or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pumping out or other adequate means of drainage to prevent floatation or flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage by debris, excessive 'Loadings, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently, it shall be covered either with sand, hessian, canvas, or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water will be allowed if the Engineer is satisfied with the adequacy of the arrangements made by the Contractor. Quality of water for curing shall be as per IS: 456.

If permitted by the Engineer, liquid curing compound may be used for prevention of premature water loss in concrete and thereby effecting curing of concrete. This type of curing compound shall be sprayed on newly laid concrete surfaces to form a thin film barrier against premature water loss without disturbances to normal setting action. The curing compound shall be emulsified paraffin based and shall comply with ASTM requirements for acceptance.

The curing compound shall be applied following the final finishing operation and immediately after disappearance of water from concrete surface. It is important not to apply the curing compound when standing water is still present on concrete.

The contractor shall arrange for the manufacturer's supervision at no extra cost.

The Contractor shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. The Engineer's decision regarding the adequacy of curing is final. In case the Engineer notices any lapse on the part of the Contractor, he will inform the Contractor or his supervisor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the Contractor within 3 (three) hours of issuance of such instruction, the Engineer will be at liberty either to employ sufficient means through any agency to make good the deficiency and recover the cost thereof from the Contractor, or deduct certain amount from contractor's payment for the part where inadequate curing was noticed entirely at the discretion of the Engineer.

3.16.00 Reinforcement

Mild steel round bars, TMT bars, Hot rolled deformed bars or cold twisted deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc, will be used as reinforcement as per drawings and directions. In an aggressive environment an anti-corrosive coating on the reinforcement may be provided as per IS: 9077, as shown on the drawing or as directed by the Engineer.

3.16.01 Bar Bending Schedules

The Contractor shall prepare Bar Bending Schedules showing clearly the arrangements proposed by the Contractor to match available stock of reinforcing steel, progressively, starting within one week of receipt of approval on corresponding design of RCC structure. As decided by the Engineer, some or all the detailed drawings and schedules will have to be submitted for approval. Approval of such detailed drawings by the Engineer shall not relieve the Contractor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the contract. The contractor for record and distribution shall submit six prints of the final drawings & schedules with one reproducible print.

3.16.02 Cleaning

All steel for reinforcement shall be free from loose scales, oil, grease, paint or other harmful matters immediately before placing the concrete.

3.16.03 Bending

Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in IS: 2502 or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions corresponding with the final Bar Bending Schedules. Bar Bending Schedules shall be rechecked by the Contractor before any cutting, bending is done.

No reinforcement shall be bent when already in position in the work, without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Rebending can be done only if approved by the Engineer. Reinforcing bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat (not exceeding 845°C) may be allowed under very exceptional circumstances except for bars whose strength depends on cold working. Bars bent hot shall not be cooled by quenching.

3.16.04 Placing in Position

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings by such approved and adequate means like mild steel chairs and/or concrete spacer blocks. Bars intended to be in contact at crossing points, shall be securely tied together at all such points by No. 20 G annealed soft iron wire or by tack welding in case of Bar larger than 25 mm dia., as may be directed by the Engineer. Binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be spaced such that the main bars do not sag perceptibly between adjacent spacers. Before actual placing, the Contractor shall study the drawings thoroughly and inform the Engineer in case he feels that placement of certain bars is not possible due to congestion. In such cases he should not start placing any bar before obtaining clearance from the Engineer.

3.16.05 Welding

Lapping shall normally do splicing of reinforcement. For M.S. reinforcement bars, butt-welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards for welding of mild steel bars used in reinforced concrete construction as per IS: 2751 and IS: 456. Welded mesh fabrics conforming to IS: 1566 may also be used if specified in the Drawings. Welding of cold twisted High yield strength deformed bar shall not be allowed.

3.16.06 Control

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS: 456, unless otherwise specified. The laps shall be staggered as far as practicable and as directed by the Engineer. Arrangements for placing concrete shall be such that reinforcement in position does not have to bear extra load and get disturbed. The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Engineer. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar not leaner than 1 (one) part cement to 2 (two) parts sand by –volume and cured in a pond for at least 14 (fourteen) days. The type, shape, size and location of the concrete blocks shall be as approved by

the Engineer.

3.17.00 Cold Weather Concreting

When conditions are such that the ambient temperature may be expected to be 5°C or below during the placing and curing period, the work shall conform to the requirement of IS: 456 and IS: 7861.

3.18.00 Hot Weather Concreting

When depositing concrete in very hot weather, the Contractor shall take all precautions as per IS: 7861 and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 38°C while placing. Positive temperature control by precooling, post cooling or any other method, if required, will have to be done by the contractor at no extra cost.

3.19.00 Concreting under water

When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of IS: 456.

3.20.00 Form Work

3.20.01 General

If it is so desired by the Engineer, the contractor shall prepare, before commencement of actual work, designs and working drawings for formwork and centring and get them approved by the Engineer. The formwork shall conform to the shape, grade, lines, levels and dimensions as shown on the drawings.

Materials used for the formwork inclusive of the supports and centring shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Engineer.

The centring shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Rakers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight and horizontal pressure of the concrete as a liquid as well as the working load. In case the contractor wishes to adopt any other design criteria, he has to convince the Engineer about its

acceptability before adopting it. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel and concrete of adequate strength shall be used. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified as directed by him.

For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion-resistant devices. Rigid care shall be exercised in ensuring that all column forms are in true plumb and thoroughly cross-braced to keep them so. All floor and beam centring shall be crowned not less than 8 mm in all directions for every 5 metres span. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed when required, during pouring operations without leaving any mark on the concrete.

3.20.02 Cleaning and Treatment of Forms

All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, sawdust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil or other compound before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be

allowed to accumulate at the bottom of the formwork. The oiling of the formwork will be inspected just prior to placement of concrete and redone wherever necessary.

3.20.03 Design

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns, and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork.

Removing any props or repropping shall not be done except with the specific approval of the Engineer. If formwork for column is erected for the full height of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.

3.20.04 Inspection of Forms

Casting of' Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained.

3.20.05 Removal of Forms

Formwork shall be kept in position after casting of concrete for a minimum period as mentioned in IS: 456, however the period of retaining form in position can be extended as per drawing, instruction of Engineer or as required for satisfactory completion of work without any extra cost. Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if the Engineer so desires.

The Contractor shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed there from and have this record checked and countersigned by the Engineer regularly. The Contractor shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him without any extra cost to the Owner, The Engineer may, however, instruct to postpone the removal of formwork if he

considers it necessary.

If any other type of cement other than ordinary Portland cement and Rapid hardening cement is used, the time of removal of forms shall be revised such that the strength of this cement at the time of removal of forms match with strength of Portland cement at the time of removal of form.

3.20.06 Tolerance

The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances unless otherwise specified in this specification or drawings or directed by the Engineer:-

For - a) Sectional dimension - ± 5 mm
b) Plumb - 1 in 1000 of height
c) Levels - ± 3 mm before any deflection has taken place

The tolerance given above are specified for local aberrations in .the finished concrete surface & should not be taken as tolerances for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Any error, within the above tolerance limits or any other as may be specially set up by the Engineer, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

3.20.07 Re-use of Forms

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as specified hereinbefore. Formwork shall not be used/re-used if declared unfit or unserviceable by the Engineer.

3.20.08 Classification

Generally, the "ordinary" class formwork shall be used unless otherwise specified.

a) **Ordinary:** These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality partially seasoned timber.

b) **Plywood:** These shall be used in exposed surfaces, where specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilization of used plywood for the "ordinary" class, if it is still in good condition.

c) **Ornamental:** These shall be used where ornamental and curved surface are required and shall be made of selected best quality well seasoned timbers or of plywood, which can be shaped correctly.

3.21.00 Opening, Chases, Grooves, Rebates, Blockouts etc.

The Contractor shall leave all openings, grooves, chases, etc. in concrete work as shown on the drawings or as specified by the Engineer.

3.22.00 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and other misc. Embedded Fixtures

The Contractor shall build into concrete work all the items noted below and shall embed them partly or fully as shown on drawings and secure the same as may be required. The materials shall be as specified and be of best quality available according to relevant Indian Standards of approved manufacture and to the satisfaction of the Engineer. Exposed surfaces of embedded materials are to paint with one coat of approved anti- corrosive paint and/or bituminous paint without any extra cost to the Owner. If welding is to be done subsequently on the exposed surface of embedded material, the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, jigs, fixtures, supports etc. shall be used as may be required or directed by the Engineer.

Items to be embedded

a) Inserts, hangers, anchors, frame around openings, manhole covers, frames, floor clips, sleeves conduits and pipes.

b) Anchor bolts and plates for machinery, equipment and for structural steel work.

c) Steel structurals to be left embedded for future extension, special connection etc.

d) Dowel bars, etc. for concrete work falling under the scope of other contractors.

e) Lugs or plugs for door and window frames occurring in concrete work.

f) Flashing and jointing in concrete work.

g) Any misc. embedments and fixture as may be required.

Correct location and alignment, as per drawings/instruction of all these embedded items shall be entirely the responsibility of the Contractor.

3.23.00 Expansion and Isolation Joints

3.23.01 General

Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified hereinafter. In case of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufacturers and must have the approval of the Engineer. Where it is the responsibility of the Contractor to supply the material, the Engineer may demand test certificates for the materials and/or instruct the Contractor to get them tested in an approved laboratory free of cost to the Owner. Joints shall be formed true to line, level, shape, dimension, and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the Engineer before starting the work.

3.23.02 Bitumen Board/ Expanded Polystyrene Board

a) Bitumen Board

Bitumen impregnated fibreboard of approved manufacturer as per IS: 1838 may be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the joint and not prepared by cutting to size smaller pieces from larger boards at site. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer.

The sealing compound and the primer shall be applied as specified by the manufacturer.

b) Expanded Polystyrene Boards

If required, commercial quality of expanded polystyrene products commonly used for thermal insulations may also be used as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installations will be similar to that recommended by the manufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board against which concrete will be placed.

3.23.03 Joint sealing strips

Joint sealing strips may be provided at the construction, expansion, and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure. The sealing strips will be either metallic like G.I., Aluminums, or Copper, or non-metallic like rubber or P.V.C.

Sealing strips will not have any longitudinal joint and will be procured and installed in largest practicable lengths having a minimum number of transverse joints. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of joint strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Engineer. The Contractor is to supply all labour and material for installation -including the material and tools required for jointing, testing, protection, etc. If desired by the Engineer, joints in rubber seals may have to be vulcanized.

a) Metal Sealing Strips

Metal sealing strips shall be either G.I., Aluminium or Copper and formed straight, U shaped, Z shaped or any other shape and of thickness as indicated in the drawing. The transverse joints will be gas welded using brass rods and approved flux and will be tested by an approved method to establish that it is leak proof. If required, longer lap lengths and different method of brazing which will render it leak proof, will be adopted by the Contractor. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

i) G.I. Strips

G.I. strips shall be minimum 1.5 mm thick and 150 mm in width unless specified otherwise. The standard of Galvanizing shall be as per relevant Indian Standards for heavy-duty work. At the joints, the overlapping should be for a minimum length of 50 mm.

ii) Aluminium Strips

Aluminium strips shall be minimum 18 SWG thick and 300 mm wide unless specified otherwise and shall conform to IS: 737 of 19000 grades or 31000 grade (Designation as per IS: 6051). A minimum lap of 50 mm length is required at the joints.

iii) Copper Strips

The Copper strips shall be minimum 18 SWC in thickness and 300 mm width unless specified otherwise and shall conform to the relevant Indian Standards. It should be cleaned thoroughly before use to expose fresh surface, without any reduction in gauge. A minimum lap of 50 mm in length is required at the joints.

b) Non-metallic Sealing Strips

These will be normally in Rubber or P.V.C. Rubber or P.V.C. joint seals can be of shape having any combination of the following features:

i) Plain

ii) Central bulb

iii) Dumb-bell or flattened ends

iv) Ribbed and Corrugated Wings

v) V shaped

As these types of seals can be easily handled in very large lengths unlike metal strips, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer. The method of forming these joints, laps etc. shall be as specified by the Manufacturer and/or as approved by the Engineer taking particular care to match the central bulbs & the edges accurately.

c) Rubber Sealing Strips

The minimum thickness of Rubber sealing strips shall be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion, and tear and also to attacks from the acids, alkalis and chemicals normally encountered in service. The physical properties will be generally as follows. The actual requirements may be slightly different as decided by the Engineer:

Specific Gravity	:	1.1 to 1.15
Shore Hardness	:	65A to 75A
Tensile Strength	:	25 - 30 N/Sq.mm
Maximum Safe Continuous Temperature	:	75°C
Ultimate Elongation	:	Not less than 350%

b) P.V.C., Sealing Strips

The minimum thickness of P.V.C. sealing strips will be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion, and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows. The actual requirements, which will be directed by the Engineer, may vary slightly

Specific Gravity	:	1.3 to 1.35
Shore Hardness	:	60A to SOA
Tensile Strength	:	10 - 15 N/Sq.mm
Maximum Safe Continuous Temperature	:	70 Deg.C
Ultimate Elongation	:	Not less than 275%

3.23.04 Bitumen Compound

When shown in drawing or directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS: 1834.

3.23.05 Isolation Joints

Strong and tough alkathene sheet or equivalent, about 1 mm in thickness and as approved by the Engineer shall be used in isolation joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set concrete to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

3.23.06 Pad

Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings. The rubber shall have a unit weight of 1500 Kg/Cu.m, a shore hardness - 65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.

3.24.00 Grouting under Machinery or Structural Steel Bases

If required, grouting under base plates of machines or structural steel etc. shall be carried out by the Contractor. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6 mm down stone chips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If specified on drawings, admixtures like Aluminium powder, "Ironite" etc. may have to be added with the grout in required proportions. Premixed non-shrink grout of approved manufacture having proper strength shall be used with Engineer's approval for important machineries.

3.25.00 Precast Concrete

The Specification for precast concrete will be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose. This yard shall be dry, properly levelled and having a hard and even surface. If the ground is to be used as a soffit

former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer, casting will have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 7 (seven) days of curing and can be removed for erection after 28 (twenty-eight) days of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal. The yard shall preferably be fenced.

Lifting hooks, where necessary or as directed by the Engineer, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection.

Precast concrete units, when ready, shall be transported to site by suitable means approved by the Engineer. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, leveling, and plumbing shall be done as per instructions of the Engineer. The Contractor shall render all help with instruments, materials, and men to the Engineer for checking the proper erection of the precast units.

After erection and alignment, the joints shall be filled with grout or concrete as per drawings. If centrings have to be used for supporting the precast units, they shall not be removed until the joints have attained sufficient strength and in no case before 14 (fourteen) days. The joint between precast roof planks shall be pointed with 1:2 cement: sand mortar where called for in the drawings.

3.26.00 Waterproofing of Concrete Structure

3.26.01 General

Where required, waterproofing of concrete structures shall be ensured internally by suitable design of the concrete mix, addition of suitable admixtures in the concrete or mortar at the time of mixing and/or installing water bars at the joints. In addition to the above measures, the structures shall be made watertight by adopting "structural waterproofing" as per specification. The design, material, and workmanship shall conform to the relevant I.S. Codes where applicable. The Engineer's approval of the materials shall be obtained by the Contractor before procurement. If desired by the Engineer, test certificates for the materials and samples shall be submitted by the Contractor free of charge. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

3.26.02 Water Bar/Seal/Special Treatment of Construction Joint

Water bearing structures and underground structures may have water bar/seals installed at the joints. They may be metallic, rubber, or P.V.C. The materials and installation will be as described under Clause 3.23.3. Construction joint shall be provided as per clause 3.13.1 with or without water bar/seal as shown on the drawing. In case of water bars being used at the construction joint, fixing of the same has to be done carefully, so that the water bar is not disturbed during concreting. The construction joint shall also be treated by any one of the following methods.

Method 1: A surface retarder in the form of a thixotropic gel shall be applied on the joint surface of the previous pour in case of joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm just before pouring the next stage of concreting. In case of walls, the above bonding agent will be mixed with water, which will be used for making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer's specification. In case of floor joint, however, after washing of retarder a solvent free two-component epoxy resin-bonding agent will be used at the joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days

Compressive strength - 55 to 60 N/Sq.mm

Flexural strength - 5 to 30 N/sq.mm

Tensile strength - 15 N/Sq.mm (approx.)

Bonding strength to concrete - 3 N/Sq.mm (approx.)

Bonding strength to steel - 20 N/Sq.m (approx.)

The whole operation shall be done as per manufacturers specification. The contractor shall provide manufacturer's supervision at no extra cost to the owner.

Method 2: One row of threaded nozzles at regular intervals not exceeding l.5 m centre to centre shall be placed in concrete along the construction joint during casting. Injection of cement water together with a suitable waterproof expanding grouting admixture of approved quality shall be done through the nozzles after the concrete has set to seal the voids in concrete near the construction joint in walls

and slabs. The injection shall be done under pressure of approximately 2 to 4 kg/sq.cm. The nozzles shall be sealed off with suitable admixture after the injection is over. The whole operation shall be carried out as per manufacturer's specification and supervision. The cost of such manufacturer's supervision shall be borne by the contractor.

3.26.03 Waterproofing Admixtures

The waterproofing admixture for concrete and cement mortar/plaster shall conform to IS: 2645. The admixture shall not cause decrease of strength of concrete/plaster at any stage and it shall be free from chlorides and sulphates. The admixture shall not affect the setting time by more than 5%. The maximum permissible dosage of admixture will be 3% (three percent) by weight of cement, but a lower dosage will always be preferred. The product shall be stored in strong moisture proof packings. However, in case of important structures where M25 or higher grade concrete is specified, the use of melamine based, high range water reducing concrete admixture shall be used to provide a waterproof concrete, For achieving high strength concrete having cement content around 400 kg/cu.m. a melamine based super plasiticizer will be preferable.

a) In concrete: The admixtures shall be procured from reliable and reputed manufacturers and approved by the Engineer. The method of application and other details shall conform to the manufacturer's specification and/or as instructed by the Engineer. The Contractor shall have the services of the manufacturer's supervisor at no extra cost to supervise the work, if desired by the Engineer.

b) In Plaster: The concrete surface, to be plastered, shall be hacked to Engineer’s satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture and laid in appropriate thickness and in layers not exceeding 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. If desired by the Engineer, the Contractor shall have the work supervised by the manufacturer's supervisor at no extra cost. On completion, the Plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

3.26.04 Structural waterproofing

a) Nozzles spaced as required after the concrete is completed shall be drilled into surfaces to be rendered watertight. Non-shrink cement grout with waterproofing compound as per manufacturers specifications shall be injected under pressure to seal all voids. Special care shall be taken at joints by providing additional nozzles. The pressure grouting shall be done on the internal surface.

b) External Treatment

Two layers of (1 : 4) plaster of 12 mm thick each with waterproofing compound as per manufacturer's specification shall be provided on outer surface of concrete underground structures.

3.26.05 Protective coating on Inside Surface.

Two coats of cement based two components polymer modified flexible protective and waterproofing slurry having 1 mm thick for each coat shall be applied on the walls/floor after proper surface preparation as mentioned above. The slurry shall be applied by brush.

3.26.06 Bitumen Felt: Application for Tanking

This specification shall cover laying the waterproof course on the outside and inside of the walls and bases of structures.

The materials shall conform to IS: 1322, and the workmanship to IS: 1609. The bitumen felt should be hessian base and/or fibre base as specified in Drawing. If required by the Engineer, tests as specified in relevant IS Codes shall be arranged by the Contractor without charging any extra to the Owner.

The Contractor shall execute this work in direct collaboration with one of the well known specialized firm approved by the Engineer.

Cleaning the surface, keeping it dry, providing, necessary corner fillets and cement rendering and cutting chases, etc. shall be done as per drawings and/or instructions. If any protective brickwork on/against concrete sub-bases or walls are required, the same shall be provided. A twenty (20) years guarantee for satisfactory performances shall be given by the Contractor as well as his specialist sub-contractor jointly and severally, for this work. Free rectification of any defects noted in the work within this guarantee period will be carried out by the Contractor even if it is beyond the specified maintenance period of the contract as a whole.

3.26.07 Polyethylene Films: Application in Walls or base of structures

Waterproof treatment shall be applied as outlined and as per sequence given hereunder

i) the concrete surface shall be made smooth with 12 mm cement plaster 1:6.

ii) apply hot bitumen 80/100 grade (IS: 73-1961) at the rate of 1.0 Kg/Sq.m

minimum

iii) lay black polyethylene film 250-micron (IS: 2508-1977) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed, taking care not to puncture the film.

Alternatively, the overlaps shall be heat sealed by an electric iron having three parallel sealing bars. A long piece of plywood is to be placed below the polyethylene film to be heat-sealed. On the plywood a rubber gasket is to be laid to provide a cushion for better welding of the film. On the rubber padding, a cellophane tape is to be spread and on this the LDPE film, with 100 mm overlap, is to be stretched. On the overlapped film another cellophane tape is to be placed to prevent the heat sealer from sticking to the LDPE film. After this, the electric iron is to be pressed on the overlap joint for sufficient time so as to allow perfect welding. The operation is to be repeated for subsequent lengths of joints. After heat-sealing, the cellophane tape is to be removed and the joints are to be tested for leaks.

iv) Lay 100 gm brown craft paper laminated with a layer of straight run bitumen,

v) Lay hot bitumen 80/100 grade (IS: 73-1961) at 1.0 Kg/Sq.m minimum.

vi) Lay 250-micron polyethylene film as second layer similar to

vii) above.

viii) Lay second layer of 100 gm. brown craft paper laminated similar to (iv) above.

ix) Apply hot bitumen (straight run grade) to IS: 73-1961 at 1.0 Kg/Sq.m dusted with fine sand.

x) Protecting with a layer of 75 mm plain cement concrete M-10, or a layer of brick laid in cement mortar 1:6 in case of wall apply a 12 mm thick plaster as shown on the drawing or a protective brick wall in 1:6 cement mortar as shown on the drawing.

3.27.00 Protective Coating on Concrete Surface

3.27.01 On Foundation

The outside faces of foundation of important structures will be protected from adverse effect of soil/underground water, if shown on drawing by using rubber/bitumen emulsion protective coating of approved manufacturer.

4.00.00 SAMPLING AND TESTING

4.01.00 General

The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost unless otherwise specified in this specification. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the teat results in triplicate within 3 (three) days after completion of the test.

4.02.00 Cement

Representative samples will be taken from each consignment of cement received from the manufacturer/supplier for carrying out the tests for fineness (by hand sieving), setting time and compressive strengths as per guidelines of IS: 269. Soundness Tests may also be required to be carried out if required by the Engineer. The Contractor shall carry out the tests without any expense to BHEL. No cement from a particular consignment/batch will be used on the works unless satisfactory 3 (three) days and 7 (seven) days test results for compressive strength are known. The Engineer and Contractor will jointly associate themselves with the tests irrespective of whether they are carried out by the BHEL or the Contractor. These tests are of great importance, as their results will have a bearing on the acceptance of concrete or otherwise as per the terms and conditions of the Contract.

4.03.00 Aggregates

The contractor shall carry out any or all the tests on aggregates as may be required by the Engineer in accordance with IS: 2386 PARTS-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant Indian Standards.

4.04.00 Water

Sampling and Testing of water being used for concrete works as per IS: 3550 will be carried out by the Contractor at regular intervals and whenever directed by the Engineer. The acceptance criteria will be as per IS: 456.

4.05.00 Admixture

4.05.01 Air Entraining Agents

Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cylinder cube crushing strength vis-a-vis quantity of A.E.A. used for all types of concrete will be established by the Contractor by carrying out sufficiently large number of tests. After that, at regular intervals and whenever directed by the Engineer, the Contractor will check up the actual percentages of air entrained and corresponding crushing strengths to correlate with the earlier test results.

4.05.02 Other Admixtures

Tests for establishing the various properties of any other admixtures, which may be required to be added, shall be carried out by the Contractor.

4.06.00 Concrete

The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be in accordance with IS: 516 and IS: 1199, the size of specimen being 15 cm cubes. Normally, only compression tests shall be performed but under special circumstances the Engineer may require other tests to be performed in accordance with IS: 516. Sampling procedure, frequency of sampling and test specimen shall conform to IS: 456. To control the consistency of concrete from every mixing plant, slump tests shall be carried out by the Contractor every two hours or as directed by the Engineer. Slumps corresponding to the test specimens shall be recorded for reference. The acceptance criteria of concrete shall be in accordance with IS: 456. Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the Contractor at his own cost. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good, free of charge by the Contractor, to the satisfaction of the Engineer.

5.01.00 Standard Deviation

Standard deviation shall be based on test results and determination of Standard deviation shall conform to IS: 456.

5.02.00 Acceptance Criteria

The strength requirements and acceptance criteria shall conform to IS: 456.

5.03.00 Inspection and Core Tests

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to IS: 456.

5.04.00 Load Test

Load tests of structural members as per IS:456 may be required by the Engineer, when the strength of test specimen results falls below the required strength.
If the member shows evident failure, the Contractor shall make the structure adequately strong free of cost to BHEL.

The entire cost of load testing shall be borne by the Contractor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification. The entire cost of dismantling and replacement and restoration of the site being borne by the Contractor.

If, in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same will be made good, free of charge by the Contractor to the satisfaction of the Engineer.

6.00.00 RATES AND MEASUREMENTS

6.01.00 Cast-in-situ Concrete

6.01.01 Rates

a) The unit rates shall include the cost of labour, materials, equipment, handling, transporting, botching, mixing, placing in position, vibrating, compacting, finishing, curing, testing, etc. at all elevations. This shall also include the cost of using curing compound, whenever used.

b) The unit rates shall include for all working conditions including in or under water, liquid, mud, in or under foul positions, under tides, and extreme weather conditions.

c) The unit rates for exposed concrete works (including machine foundations) shall include all incidentals, rendering, smoothening with carborandum stone, finishing with a paste of cement sand mortar, curing, etc.

d) The unit rates shall include for maintaining stability of structure during execution.

e) Nothing extra shall be payable for the handling/mixing of extra cement on account of any reason or pouring of second stage concrete.

f) Nothing shall be payable to the Contractor on account of facilities and arrangement provided by him for conducting ultrasonic pulse velocity tests or other relevant tests to ascertain grade and quality, etc. of the concrete, if required. In case of any defects,

the Contractor shall rectify the same by cement/epoxy grout at his own cost.

g) The unit rates for controlling of the temperature of concrete shall include storing and mixing of ice, water, cooling of aggregate etc.

h) The quoted rate shall include the cost of making additional trial mixes, using the super plasticizer and mixing in concrete etc.

6.01.02 Measurements

a) Actual volume of concrete work as executed or as per drawings issued, whichever is less shall be measured in cubic metres.

b) No deductions shall be made for the following:

i) Opening upto 0.1 sq.m.

ii) Volume occupied by reinforcement, sleeves, anchor bolts, and similar items.

iii) Volume occupied by pipes, conduits, sheathing, etc. not exceeding 100 sq.cm. each in cross sectional area.

c) The concrete works of different grades; below and above ground floor finished level shall be measured separately, unless otherwise specified in the schedule of items. Accordingly rates shall be applied for concrete in foundation for concrete below ground floor finished level and concrete in superstructure for concrete above ground floor finished level.

d) For temperature control measures, measurement shall be done in terms of quantity of concrete in cum. in concreting of which the ice have been used or cooling of aggregates has been done to keep the temperature of freshly laid concrete to less than 250C.

6.02.00 Reinforcement

6.02.01 Rates

a) The unit rates shall include for cover block, providing binding wire, welding, separator pieces between two or more layers of reinforcement required for keeping the steel in position, etc. at all elevations.

b) No extra will be paid for transportation from stores, cleaning, straightening of steel, cutting, bending, binding with annealed wire, welding, tack welding, placing the reinforcement modification of already embedded reinforcement, if

required, due to faulty fabrication or placement and other cost of tools and plants, materials, labours, return of unused steel to the store, etc.

c) No extra shall be paid for preparing and getting approved bar bending schedules (including all revisions).

d) Generally members are straight and have straight edges. However, for bending, binding, placing of reinforcement in any curved member in length or cross section or both, no extra payment shall be made.

6.02.02 Measurements

a) Bar or any other type of reinforcement used like hard drawn steel wire fabric etc. for reinforced concrete shall be measured by weight in tonnes. The weight shall be arrived at by multiplying the actual or theoretical length measured alongwith standard hooks, cranks, bends, authorized laps, etc. whichever is less by the sectional weights. Claims for payment for this item shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS Section weight. Nothing extra will be payable to the Contractor on account of, difference in weight, if any, due to different methods adopted for issue and measurement.

b) Standard hooks, cranks, bends, authorised laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tonnes.

6.03.00 Formwork and Staging

6.03.01 Rates

a) The unit rates shall be inclusive of all staging, scaffolding, making the formwork watertight, etc. for all elevations and in all types of works.

b) No separate payment shall be made for providing fillets, for rounding or chamfering at junctions, comers, etc.

c) The unit rates shall include the cost of labour, materials etc. and the extra time, which shall be required for the removal of shuttering/ support for satisfactory completion of work.

d) No extra payment shall be made on account of difficulty, wastage etc. for placement/removal of formwork between the network of closely placed steel beams or for the lacing/bracing portions and ribbed slab constructions.

Payment for curved shuttering shall be made for curved members/wall whose centerline radius in plan is less than 6m.

If the contact surface area in pockets is less than or equal to 0.1 sq.m. in each case, payment shall be done under item for providing formwork in pockets.\

6.03.02 Measurements

a) Formwork for different classes (types) shall be measured separately as the actual surface in contact with the concrete and paid on area basis unless included in the rate for concrete. The unit of measurement shall be in sq.m.

b) Openings upto 0.1 sq.m or boxing left for inserts etc. for facility of Contractor's work, shall be neglected as if nonexistent for the purpose of formwork measurement of surface in which the openings occur.

For suspended floor, no deduction shall be made for flange area of secondary steel beams.

c) No measurement shall be taken for the formwork in pockets, openings, chases, blockouts, etc. in concrete, the contact surface area is less than or equal to 0.1 sq.m. in each case.
d) For pockets, if the contact surface area is less than or equal to 0.1 sq.m. in each case, measurement shall be done under item for providing formwork in pockets.
e) Formwork, if required, for joints shown on drawing or instructed by the Engineer, shall be paid for the 'leading side' only.

6.04.00 Embedded Parts

6.04.01 Rates

a) The unit rate for erection of embedded steel parts, supplied by Engineer shall include transportation from Owner's store to the place of work, erection & installation including setting material in concrete, etc. complete.

b) The unit rate for MS pipe embedments and PVC pipe embedments shall include cutting, welding, fabrication, erection, embedding, and transportation to site. Unit rate shall also include the cost of the pipes.

c) Rate for expansion fasteners shall include cost of fasteners, installation, and fixing including cost of washers and nuts.

6.04.02 Measurements

a) The measurement of the embedded steel parts fabricated and installed by the Contractor shall be based on the calculated weight of steel sections in tonne corrected to second place of decimal.

b) Embedded steel parts supplied by Owner and installed by Contractor Measurement shall be done for the net weight of the embedments installed in tonnes correct to second place of decimal.

c) For PVC pipes/conduits, measurements shall be in quintals correct to second place of decimal for the net weight.

d) For mild steel pipes, measurement shall be in quintals, correct to second place of decimal, for the net weight of the steel pipe supplied, fabricated, and installed.

e) The lugs shall be measured in Kg. correct to second place decimal for the net weight.

f) The expansion fasteners shall be measured in number according to tension capacity.

g) The rails shall not be treated as embedded steel part and the track shall be measured in running metres along the centre line and paid for under separate item of work as specified in schedule of items. Other related civil items associated with the laying of track shall be measured separately and paid under respective items of works.

6.05.00 Groutings

6.05.01 Rates

Rate shall include the cost of surface preparation, admixtures, and curing.

6.05.02 Measurements:

a) Measurement shall be in cubic decimeters.

b) Measurement for grouting shall be by volume of the block out, pockets or bolt hole upto the top surface of foundation concrete and shall be calculated from the dimensions shown on the drawings.

c) Measurement for underpinning shall be by volume between the top surface of the foundation concrete and the underside of the base plate, the plan dimensions being as indicated on the drawings.

d) No deduction shall be made for shims, bolts, shear keys and such other embedments.

6.06.00 Joints

6.06.01 Rates

The unit rate shall include all the activities described in the schedule of items.

6.06.02 Measurements

a) Bitumen Board/Expanded polystyrene.

The measurement for bitumen board shall be based on actual finished surface area in square meters nearest to second decimal, for the specified thickness.

b) Water Stops

The measurement for water stops shall be in running metres of actual length of the joint covered, for specified thickness, width, and shapes. No separate measurement shall be made for laps/splices for cross-joints and mitered joints.

c) Metal Cover Strips

The measurement for Metal Cover Strips shall be based on actual finished surface area in square metres for the specified thickness.

d) Vibration Damping Resilient Pads

The measurement for this item shall be in square metres for the specified thickness, measured correct to the second place of decimal, of the actual finished surface area.

6.07.00 Dismantling/Demolishing Work – RCC and PCC and Chipping of Concrete

6.07.01 Rates

The unit rates shall include the cost of all necessary propping, shoring, underpinning scaffolding, safety measures, temporary enclosures, disposal/ stacking of serviceable/unserviceable materials, etc. for all types of work and for all grades of concrete.

In the case of dismantling/demolishing work, the cutting of reinforcement shall also be included in the rate.

In the case of chipping work, the cutting of reinforcement shall be paid separately.

6.07.02 Measurements

a) Dismantling of PCC and RCC work shall be measured in cu.m separately. Measurement of all work, except hidden work shall be taken before execution of work and no allowance for increase in bulk shall be allowed. Specifications for deductions of voids, openings etc, shall be on the same basis as that employed for construction work.

b) Chipping of concrete, making holes/pockets etc. shall be measured in cubic decimeters (i.e. 0.001 cu.m.).

c) Cutting of reinforcement in chipping work for making of pockets and openings shall be measured in sq. cm. of cross-sectional area.

6.08.00 Precast Concrete

This clause shall be read in conjunction with relevant provisions specified elsewhere for cast in-situ Concrete.

6.08.01 Rates

a) The unit rate shall include cost of preparation of casting yard, formwork, concrete and its casting, finishing as specified, setting filling of gaps between adjacent pre-cast concrete units with concrete, or cement mortar, curing, handling, erection, grouting, welding, preparation of supporting surface, etc.

6.08.02 Measurements

The measurement of pre-cast concrete members shall be on the basis of volume of concrete in cubic metres nearest to second place of decimal. No deduction shall be made for volume occupied by reinforcement/inserts/sleeves and for openings up to 0.1 sq.m. The setting of element with cement mortar shall not be measured separately The filling of concrete cement mortar between the gaps of adjacent precast units shall be considered while computing the volume of pre-cast concrete work and shall be paid for under this item itself.

7.00.00 LIST OF IS CODES AND STANDARDS FOR REFERENCE

All work under this specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard

Specifications and Codes of Practice. In case any particular aspect of work is not specifically covered by Indian standard Specifications, any other standard practice, as may be specified by the Engineer, shall be followed:-

IS: 73 - Indian Standard Specification for Paving Bitumen

IS: 216 - Indian Standard Specification for Coal Tar Pitch

IS: 383 - Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete

IS: 432 - Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement

IS: 455 - Indian Standard Specification for Slag Cement

IS: 456 - Indian Standard Code of Practice for Plain and Reinforced Concrete

IS: 457 - Indian Standard Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive Structures

IS: 516 - Indian Standard Specification for Methods of Test for Strength of Concrete

IS: 702 - Indian Standard specification for industrial bitumen.

IS: 1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete

IS: 1322 - Indian Standard Specification for Bitumen Felts for Waterproofing and Damp-proofing

IS: 1489 - Indian Standard Specification for Portland Pozzolona Cement

IS: 1566 - Indian Standard Specification for hard drawn steel wire fabric for concrete reinforcement.

IS: 1609 - Code of Practice for Laying Damp-proof Treatment using Bitumen Felt

IS: 1786 - Indian Standard Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement.

IS: 1791 - Indian Standard Specification for Batch Type Concrete Mixers.

IS: 1838 - Indian Standard Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type.

IS: 2185 - Indian Standard Specification for Hollow Cement Concrete Blocks

IS: 2210 - Indian Standard Specification for Design of Reinforced Concrete shell Structures and Folded Plates

IS: 2386 - Indian Standard Specification for Methods of Test for Aggregates for Concrete - Part-I to VIII

IS: 2502 - Indian Standard Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement

IS: 2505 - Indian Standard Specification for Concrete Vibrators, Immersion Type

IS: 2506 - Indian Standard Specification for Screed Board Concrete Vibrators

IS: 2514 - Indian Standard Specification for Concrete Vibrating Tables

IS: 2571 - Code of practice for laying in-situ cement concrete floors.

IS: 2645 - Integral cement water proofing compound

IS: 2722 - Indian Standard Specification for Portable Swing Weigh Batchers for Concrete (Single and Double Bucket type)

IS: 2750 - Indian Standard Specification for steel scaffoldings.

IS: 2751 - Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction

IS: 2770 - Indian Standard Specification for Method of Testing Bond in Reinforced Concrete

IS: 3025 - Indian Standard specification for Methods of Sampling and Test (Physical and Chemical) for Water used in Industry

IS: 3067 - Code of practice for general design details and preparatory work for damp proofing and water proofing of building.

IS: 3201 - Indian Standard Specification for Design and Construction of Precast Concrete Trusses

IS: 3370 - Indian Standard Specification for Code of Practice for Concrete Structures for Storage of Liquids

IS: 3414 - Code of practice for design and installation of joints in buildings.

IS: 3550 - Indian Standard Specification for Method of Test for Routine Control for Water used in Industry

IS: 3558 - Code of Practice for use of Immersion vibrators for Consolidating Concrete

IS: 3696 - Safety Code for Scaffolding and Ladders

IS: 3812 - Indian Standard Specification for Fly Ash for Use as Admixture for Concrete

IS: 4014 - Code of practice for steel tubular scaffolding.

IS: 4031 - Indian Standard Specification for Method of Tests for Hydraulic Cement

IS: 4082 - Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials at site

IS: 4090 - Indian Standard Specification for Design of Reinforced Concrete Arches

IS: 4634 - Indian Standard Specification for Method of Testing Performance of Batch-type Concrete Mixes

IS: 4656 - Indian Standard Specification for Form Vibrators for Concrete

IS: 4925 - Indian Standard Specification for Concrete Batching and Mixing Plant

IS: 4926 - Indian Standard Specification for Ready Mixed Concrete

IS: 4990 - Indian Standard Specification for Plywood for Concrete Shuttering work

IS: 4991 - Indian Standard Specification for Blast Resistant Design of structure for Explosion above ground

IS: 4995 - Indian Standard Specification for Design of Reinforced Part-I & II Reinforced Concrete Bins for the Storage of Granular and Powdery Materials

IS: 4998 - Indian Standard Specification for Design of Reinforced Concrete Chimneys.

IS: 5256 - Code of practice for sealing joints in concrete lining on canals.

IS: 5512 - Indian Standard Specification for Flow Table for use in Tests of Cement and Pozzolanic materials

IS: 5513 - Indian Standard Specification for vacate Apparatus.

IS: 5515 - Indian Standard Specification for Compaction Factor Apparatus.

IS: 5525 - Recommendation for detailing of reinforcement in reinforced concrete works.

IS: 5624 - Indian Standard Specification for foundation bolts.

IS: 5751 - Indian Standard Specification for Precast Concrete Coping Blocks.

IS: 5816 - Indian Standard Specification for Method of Test for Splitting Tensile strength of Concrete Cylinders.

IS: 5891 - Indian Standard Specification for Hand operated Concrete Mixers.

IS: 5892 - Indian Standard Specification for transit mixer and agitators.

IS: 6452 - Indian Standard Specification for High Alumina Cement for Structural Use

IS: 6909 - Indian Standard Specification for Super sulphated Cement

IS: 6923 - Indian Standard Specification for Method of Test for Performance of Screed Board Concrete Vibrators.

IS: 6925 - Indian Standard Specification for Method of Test for Determination of Water Soluble Chloride in Concrete Admixtures.

IS: 7242 - Indian Standard Specification for Concrete Spreaders.

IS: 7246 - Indian Standard Specification for Table Vibrators for Consolidating Concrete.

IS: 7251 - Indian Standard Specification for Concrete Finishers.

IS: 7293 - Safety code for working with construction machinery.

IS: 7320 - Indian Standard Specification for Concrete Slump Test Apparatus.

IS: 7861 - Indian Standard Specification for Recommended Practice Part-I&II for Extreme Weather Concreting.

IS: 7969 - Safety Code for Storage and Handling of Building Materials.

IS: 8041 - Indian Standard Specification for Rapid Hardening Portland cement.

IS: 8112 - Indian Standard Specification for high strength Ordinary Portland Cement.

IS: 8142 - Indian Standard Specification for Determining Setting time of concrete by Penetration Resistance.

IS: 8989 - Safety Code for Erection of Concrete Framed Structures.

IS: 9012 - Recommended method for shortcreting.

IS: 9013 - Indian Standard Specification for Method of Making, Curing, and determining compressive Strength of Accelerated-cured Concrete Test Specimens.

IS: 9077 - Code of Practice for Corrosion Protection of Steel Reinforcement in RB and RCC Construction.

IS: 9103 - Indian Standard Specification for Admixtures for Concrete.

IS: 10262 - Recommended Guidelines for Concrete Mix Design.

IS: 13311 - Non-destructive testing of concrete.

SP: 34 - Handbook of concrete, reinforcement and detailing.

SECTION - D

SUB-SECTION – D3

CARPENTRY AND JOINERY

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	INSTALLATION
3.00.00	ACCEPTANCE CRITERIA
4.00.00	I.S. CODES
5.00.00	RATES AND MEASUREMENTS

CARPENTRY AND JOINERY

1.00.00 SCOPE

This section covers supply, fitting and fixing of timber frames to doors and windows with M S holdfasts, flush doors, panelled, shutters, partitions, wall panelling, pelmets, shelves, furniture, etc. as shown in drawings, including a prime coat of approved paint, varnish, or fixing of decorative plastic laminate where called for. This shall also include the supply and fixing of all hardware and fixtures shown in drawing or specified.

2.00.00 INSTALLATION

2.00.01 Materials

a) Timber

Unless otherwise specified, all timber shall be best quality well seasoned CP teakwood free from large or loose knots, cracks or any other defects. All timber shall be treated with approved wood preservative before use, unless specified otherwise. The rough timber shall be approved by the Engineer before incorporating in the works and starting the carpenter's work.

b) Plywood

Plywood shall be of commercial quality or with decorative surface veneer. Unless specifically permitted otherwise, the adhesive used in plywood shall be phenol formaldehyde synthetic resin of BWP grade conforming to IS: 848.

c) Decorative Laminated Plastic Sheets

The colour, pattern, finish and texture shall be approved by the Engineer. The bulk supply shall be procured in full sheet sizes which will ensure the least number or joints in one surface.

d) Flush Doors

Flush doors shall be solid core doors with commercial or decorative faces and hardwood edges conforming to IS: 2202 (Part-1). The core for solid core doors shall be of block board or wood particle board. Manufacturer's literature and test certificates shall be submitted for the approval of the Engineer. The Contractor shall give a guarantee that the adhesive used is

BWP grade phenol formaldehyde synthetic resin conforming to IS: 848. The thickness shall be as specified.

e) Panel Doors

Panel door shall be of teakwood shutter frame, unless otherwise noted and panels with teakwood/commercial ply/teakwood particle board. Other considerations shall be as mentioned in item (d) above.

f) Windows, Ventilators

Windows and ventilators shall made of teakwood shutter frame, unless specified otherwise and glazing of specified thickness shall be fixed with wooden beadings.

g) Fixtures

Fixtures for doors, windows, furniture etc. shall be as shown on drawing or specified.

2.02.00 Workmanship

2.02.01 General

The work shall be done by skilled carpenters as per details shown on drawing or instructed by the Engineer.

Framing timber and other work shall be close - fitting with proper wood joinery, accurately set to required lines or levels and rigidly secured in place. The surface of frames etc., which will come in contact with masonry after fixing, shall be given two coats of approved paint before fixing. Mastic caulking shall be done after fixing external door and window frames. Special care shall be taken to match the grain of timber or plywood, which will be subsequently polished. Screwing or nailing will not be permitted to the edge of plywood and particle board. The edge of all plywood, blackboard and particle board shall be finished with teakwood lipping unless otherwise shown on drawings.

Fixing to frames and partitions shall generally be with 40 mm x 6 mm x 300 mm long M S holdfasts bifurcated at end and grouted with 1:2:4 cement concrete. The gap between masonry and external door and window frame shall be caulked with polysulphide mastic. M.S. grills or guard bars shall be provided to windows where called for in the drawings.

2.02.02 Finish

All carpentry work after finishing shall be sand papered smooth. A prime coat paint shall be given after inspection of the Engineer to all surfaces other than those, which shall be subsequently polished or covered with laminated plastic sheet.

2.02.03 Surface Treatment

When shown on drawings or called for, decorative ply or laminated plastic sheets shall be bonded under pressure to the surface to be finished. The adhesive used shall be of brand and brought to site in sealed containers. The rate of application and the length of time for which the pressure is to be applied shall be as per the manufacturer's instructions. The edge of sheets shall be protected by teak lipping or bevelled as shown on drawings.

3.00.00 ACCEPTANCE CRITERIA

3.00.01 Door and Window Frames

All frames shall be square and flat at the time of delivery and shall be checked for dimensions and corner angles. After fixing they shall be on a fine vertical plane. All external door and window frames shall be caulked with mastic.

3.02.00 Door and Window Shutters

All doors and window shutters shall be of proper size, shape, and design and free of warp. When fixed to frames, these shall operate smoothly without jamming and all latching or locking devices shall engage properly without undue pressure.

3.03.00 Partitions, Paneling, Pelmets, Furniture, etc.

3.03.01 General

These shall conform to drawings in all details. No unsightly nail marks etc. shall be permitted. Plywood grains shall be matched to give a uniform and pleasing appearance.

3.03.02 Partition

Shall be checked for rigidity of fixing, plumb and horizontal as well as vertical alignment.

3.03.03 Pelmets

Shall be checked for rigidity of fixing and adequate clearance of fixture.

3.03.04 Cupboard Shutters

Shall operate smoothly without jamming and locks, bolts and double ball catches shall engage securely. Single ball catches shall not be used.

3.03.05 Drawers

Shall operate smoothly and have backstops to prevent them from being pushed too far. Locks shall engage securely.

3.03.06 Loose Furniture

When placed on a level surface, tables tops etc. shall be horizontal and the pieces stand stably on legs or supports.

4.00.00 IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 848	-	Synthetic resin adhesives for plywood (Phenolic and Aminoplastic)
IS: 1003	-	Timber panelled and glazed shutters.
IS: 2191	-	Wooden flush door shutter (Cellular and hollow core type).
IS: 2202	-	Wooden flush door shutters (solid core type).
IS: 4021	-	Timber door, window, and ventilator frames.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall include of all activities mentioned in “Schedule of Item” for

completion of the work. No separate payment shall be made for fixing, caulking, application of primer coat, polishing, providing of butt hinges, holdfasts, sliding/tower bolts, door stoppers, door closers and other fittings and fixtures.

5.02.00 Measurement

Measurement shall be done in Sqm for door shutters, window shutters, ventilators shutters, partitions etc.

Measurement for wooden frame shall be in CuM.

Pelmets shall be measured in RM.

SECTION – D

SUB-SECTION – D4

ROOF AND UNDERGROUND STRUCTURES WATER PROOFING, INSULATION AND ALLIED WORKS

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	INSTALLATION
3.00.00	ACCEPTANCE CRITERIA AND GUARANTEE
4.00.00	I.S. CODES AND STANDARDS
5.00.00	RATES AND MEASUREMENTS

ROOF AND UNDERGROUND WATER PROOFING, INSULATION AND ALLIED WORKS

1.00.00 SCOPE

This section covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of roof and underground water-proofing, insulation and allied works for buildings and at locations covered under the scope of this package.

2.00.00 INSTALLATION

2.01.00 GRADING UNDERBED

The surface to receive the underbed shall be roughened and thoroughly cleaned with wire brush and water. Oil patches if any shall be removed with detergent. The surface shall be soaked with water and all excess water removed just before laying of the underbed.

The underbed shall not be laid under direct hot sun and shall be kept in shade immediately after laying so as to avoid quick loss of water from the mix and separation from the roof surface. The underbed shall be cured under water for at least 7 days.

The underbed shall be laid to provide an ultimate run off gradient not less than 1 in 120 and as directed by the Engineer. Upto an average thickness of 25mm the underbed shall usually be composed of cement and sand plaster. For higher thickness the underbed shall be made with cement concrete. The underbed shall be finished to receive the waterproofing treatment direct or insulation as the case may be.

2.01.01 Cement Mortar Underbed

The underbed grading plaster shall be average 25 mm thick maximum. It shall consist of cement and coarse sand in the ratio 1:4 nominal by volume. The sand and cement shall be thoroughly mixed dry and then water added. Each batch of mix shall be consumed before the initial set starts.

The plaster shall be fully compacted to the desired grade in continuous operation. The surface shall be even and reasonably smooth.

2.01.02 Cement Concrete Underbed

The undebed cement concrete shall be used where the subgrade is more than average 25 mm thick. It shall consist of cement concrete 1:2:4 nominal mix by volume with 12 mm down stone chips and coarse sand. The aggregate shall be mixed dry and

minimum quantity of water shall be added to make the mix workable.

The mix shall be laid to proper grade, fully consolidated and surface shall be smooth and even.

2.02.00 INSULATION

The Tenderer shall, along with the tender, send specifications of insulating materials he proposes to use and the proposed method of laying. Before bulk supply, the contractor shall send samples of insulating material to the Engineer, and after approval of the samples, the Contractor shall procure and transport the bulk material to the site. Whenever asked by the Engineer, the Contractor shall furnish test certificates from testing laboratory on the insulating and other properties of the materials.

After laying the insulation, the surface shall be made ready as required to receive the waterproofing treatment. If any plastering is used it shall be not leaner than 1:4 cement sand by volume and not thinner than 12 mm and it shall be cured for seven days.

2.02.01 Foam Concrete

This shall be of lightweight foam concrete of average 50 mm thickness or as specified or as shown on drawings. This may be laid in situ in suitable panels or precast blocks. The insulating properties shall be such that the thermal conductivity shall not exceed 0.125 Kcl/sq.m. hr degree C. Before starting the laying of foam concrete samples shall be prepared at site and got tested for approval of the Engineer.

The foam concrete laid shall be sufficiently strong to withstand the usual workload and standard loads expected on the roof. Any damaged portion shall be removed and replaced forthwith. Approval of the Engineer shall be taken before laying the waterproofing over the insulation.

While laying the foam concrete, samples from each batch of the mix shall be kept for test if so desired by the Engineer.

2.02.02 Expended Polystyrene Blocks

The expanded polystyrene block Insulation shall be fire retardant quality and shall have a maximum thermal conductivity of 0.026 Kcl m/sq.m h °C. It must be strong enough to withstand without any deformation under the workload and standard loads expected on the roof.

The Contractor shall lay the expanded polystyrene block as per manufacturer's approved specification. Only specifically experienced workers shall be used for this work. If the Engineer is not satisfied about the efficiency of the workers the Contractor

shall secure manufacturers supervision at no extra cost to the Owner.

2.03.00 Fillets

Fillets at Junction of roofs and vertical walls shall be provided with the same insulating material as provided for the main roof insulation. The fillets shall be 150 mm x 150 mm in size unless otherwise shown on drawings or instructed by the Engineer.

Where there is no insulation over roof slab, fillets shall be cast-in-situ cement concrete (1:2:4) nominal mix volume.

2.04.00 Waterproofing Treatment

2.04.01 Bitumen Felt Treatment

Waterproofing treatment shall be laid by a specialist firm with long experience in the particular trade.

The waterproofing treatment for roofs with bitumen felts shall be done following relevant IS: 1346. Bitumen felt shall conform to IS: 1322 and Bitumen primer to IS: 3384.

The bonding materials shall consist of blown type conforming to IS: 702 or residual bitumen conforming to IS: 73 or a mixture of the two to withstand local conditions of prevailing temperature or gradient of roof surface. The Contractor shall convince the Engineer that the bonding material proposed to be used is suitable for the particular job.

The Contractor shall state the source from where he proposed to procure the materials. Samples of the self-finished felt shall be submitted in advance to the Engineer along with test certificates for his review. Test certificates for the bonding materials shall also be submitted and samples, if desired by the Engineer, shall be provided for confirmatory tests. Samples shall be submitted if instructed by the Engineer.

Minimum overlaps of 100 and 75 mm shall be given at the end and sides of strips of felt and properly bonded with bitumen. Joints in successive layers of felt shall be staggered.

Normal treatment with one layer of felt, heavy treatment with two lavers of felt or Extra Heavy treatment with three layers of felt shall be indicated. Brief details of the various treatments shall be as follows:

a) Normal Treatment - Five courses

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)

3) Hessian base self finished felt, type 3, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m. (min.)

5) 20 mm thick pressed precast concrete tiles with 15 mm, thick 1:4 cement-sand mortar underbed.

b) Heavy Treatment - Seven Courses

With Hessian base felt

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

3) Hessian base self-finished felt, type 3, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

5) Hessian base self-finished felt, type 3, grade I.

6) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

7) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With fiber base felt

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Not applied bitumen at the rate of 1.2 kg/sq.m (Min.)

3) Fiber base self-finished felt, type 2, grade 2.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

5) Fiber base self-finished felt, type 2, grade 2.

6) Hot applied bitumen at the rate of 1.2 kg/sq.m (Min.)

7) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

c) Extra Heavy Treatment – Nine courses

With fiber based felt

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

3) Fiber-base self-finished felt type 2, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sq.m (min.)

5) Fibre base self-finished felt type 2, grade 1.

6) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

7) Fibre base self-finished felt type 2, grade 1.

8) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

9) 20 mm thick pressed precast concrete tiles with 15 mm thick 1:4 cement: sand mortar underbed.

or

With Hessian base felt

1) Primer coat conforming to IS:3384 applied at the rate 0.27lits/sqm min.

2) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

3) Hessian base self-finished felt, type 3, grade 1.

4) Hot applied bitumen at the rate of 1.2 kg/sqm. (min.)

5) Hessian base self-finished felt, type 3, grade 1.

6) Hot applied bitumen at the rate of 1.2 kg/sqm. min.

7) Hessian base self-finished felt, type 3, grade 1.

8) Hot applied bitumen at the rate of 1.2 kg/sqm. min.

9) 20 mm thick pressed precast concrete tiles with 15 thick 1:4 cement: sand mortar underbed.

However, in special cases, more courses, or a combination of fibre base and hessian base felts may be asked for.

The surface to receive the waterproofing treatment must be cleaned and dried satisfactorily and the Engineer's approval taken before starting the work. If any existing waterproofing treatment is being augmented the existing top course shall be completely removed and all damaged felts or other defects repaired.

The Engineer may instruct the Contractor to lay part of the stipulated courses at the first instant to be followed later on with the balance courses. This interim finish shall be done with a course of hot applied bitumen. While doing the balance again hot bitumen shall be applied to start with after repair of all damages to the already laid course.

After completion the surface shall be cleaned taking care that felt cuttings etc. do not find their way into rainwater down comers.

2.04.02 Elastomeric Membrane

a) Material

The material shall consist of high solid content Polyurethane based cold liquid applied coatings as per ASTMC836-89a comprising of urethane pre-polymers extended with flexible material, which cure by reaction with atmospheric moisture to give a continuous film which is rubbery and elastic or any other equivalent material permitted as per ASTM and approved by the Engineer. The material shall consist of high solid coating designed to give a high-build film. The material shall not be diluted. The coating shall have physical feature like high viscosity, 90% solids, high resistance to impact, abrasion and cracking, superior tensile strength, application limit of 70^0C minimum, 300% elongation and forming a perfectly smooth permanently flexible seamless membrane which should have good adhesion to roof substrates (RCC, tiles, brick, and metals), having a minimum life of 10 years. It should also be resistant to acid (mild concentrated), alkalies and have a very low water absorption rate (0.5%) max. at ambient temp. after 7 days.

The pack shall not be older than 9 months after the date of manufacture and packing.

b) Primer coat

It shall consists of polyurethane (P.U.) or any other equivalent material. Primer coat shall be a special blend of moisture curing urethane pre-polymers in solvent. A single coat of this primer shall be applied by brush over the prepared bed as an adhesion coat of an application rate of minimum 6 sq.m per litre.

The primer shall be allowed to dry for minimum of 2hrs. time before the successive finishing coats of P.U. liquid membrane are applied.

c) Finishing coats :

The finishing coats shall consist of two successive liquid coatings of high solids content urethane pre-polymers or equivalent material to form an elastomeric membrane. The overall dry film thickness shall be 1.5mm subject to minimum 500 gm per sq.m per coat application rate.

Each coat shall be allowed to dry for minimum 12 hours before applying the next coat. The surface should be dry and smooth before application.

The coating shall be continued up the parapets/walls for a minimum of 150mm over the finished roof surface. It shall be continued into rain water pipes by atleast 100mm.

The final coat of P.U. liquid when tacky shall be sprinkled with the sand.

For edges, expansion joints and any vulnerable points a later of polyscrim cloth /fabric to be embedded between 2 finishing coats.

d) Surface Finish :

Areas of roof treatment which are vulnerable to accidental damage shall be provided with wearing course consist of minimum 20 mm thick PCC of Grade M15 (using12.5mm size aggregate) cast in panel of maximum size of 1.20m x 1.20m and reinforced with 0.56mm diameter galvanised chicken wire mesh and sealing of joints using sealant or elastomeric compound.

When the roof surface is subjected to foot traffic or used as a working area, a cement mortar (1:4) shall be applied over the top most layer of roofing treatment. Over this, a layer of chequered cement concrete flooring tiles conforming to IS:13801 shall be provided in place of stone grit and cement painted. The tiles shall be laid as per IS:1443.

2.04.03 Waterproofing By Epoxy Resin Based Application

Exposed surfaces of cement concrete, lime concrete or brickwork to be treated for waterproofing by the resin-based application shall be thoroughly cleaned and the epoxy resin based material to be applied as directed by the manufacturer. The material shall not have any adverse effect on the surface on which it is applied and must stick to it uniformly to make a strong durable bond. It shall not be affected by short duration fire, sun exposure, and light duty traffic. The application shall be resistant to growth of fungus and proof against saltpetre action. If desired by the Engineer, a sample shall be prepared in advance and tested for waterproofness for 48 hours under 300 mm depth of standing water. The Contractor shall arrange the demonstration by providing free the materials and labour for the application as free of cost to Owner. This item shall carry a guarantee as specified.

2.04.02 Flashing

Unless otherwise stated flashing shall be done in the same way as the waterproofing except that the last layer shall be finished with two coats of bituminous primer. The flashing shall be extended up the vertical surfaces as shown on drawing. The flashing shall end in grooves in vertical walls. The grooves shall be at leas 65 mm deep and caulked with waterproof mastic cement. The minimum overlap with horizontal roofing felt shall be 100 mm.

Where specified or directed by the Engineer, metal flashing shall be provided. The materials shall be 18 Gage or 22 G G.I. sheets, as specified or as directed by the Engineer.

2.05.00 WATER-PROOFING OF UNDERGROUND STRUCTURES

Basements, ducts, pits, tunnels (excluding tanks) etc below the ground water table and in contact with soil are covered under this. Bonding material shall be blown bitumen of 65/25 grade conforming to IS: 702.

Waterproofing shall be provided on the outside of walls and top of RCC slab and shall be carried out upto 150mm above ground level. The number of layers of bitumen felt to be used for walls and floor unless otherwise shown in the drawing shall be:

a) 2 layers - for depths up to 5m below ground level

b) 3 layers - for depths beyond 5m below ground level

2.05.01 Method of laying the bitumen felts and workmanship shall be as per IS: 1609 and IS: 3067. Water proofing work shall be taken in hand only when the sub-soil water level

is at its lowest; the site shall be kept dry by adequate arrangements for pumping out water till the work has been completed.

For this purpose drains shall be formed along the edges of the excavation but beyond the building line, with suitable collecting sumps.

In case of large excavation areas where it is necessary to dewater under the floor, additional land drains shall be formed across the excavation, to adequately drain the area.

Adequate arrangement shall be made to protect the sides of excavation from slipping while the work is in progress.

The base concrete or mud-mat shall be rendered smooth by a 20mm thick sand-cement plaster (6:1). Any sharp edges/corners, over which the waterproofing course is to be laid, shall be eased out by means of cement.

The surface must be dry before the next operation is carried out.

Water proofing/damp proofing treatment:

A) Heavy Treatment (Two layers of felt)

i) Primer (For vertical faces only), as per I.S. 3384.

ii) Hot applied blown bitumen at the rate of 1.2 Kg/m2

iii) Hessian base, bitumen felt type 3 grades 2

iv) Hot applied blown bitumen @ 1.2 Kg/m2

v) Hessian base, bitumen felt type 3 grade 2

vi) Hot applied blown bitumen @ 1.2 Kg/m2

B) Extra Heavy treatment (Three layers of felt)

i) Primer (for vertical faces only) as per I.S. 3384

ii) Hot applied bitumen at the rate of 1.2 Kg/m2

iii) Hessian base bitumen felt type 3 grades 2

iv) Hot applied bitumen at the rate 1.2 Kg/m2

v) Hessian base bitumen felt type 3 grades 2

vi) Hot applied bitumen at the rate of 1.2 Kg/m2

vii) Hessian base bitumen felt type 3 grades 2

viii) Hot applied bitumen at the rate of 1.2 Kg/m2

The surface must be dry before the next operation is carried out at each stage said above.

The laying of felt over the bitumen so applied that it shall always commence on the floor, and shall be carried over to the walls only after treatment of the floor is complete. The minimum over lapping at sides and ends of strips shall be 10cm. Point for subsequent layers completely sealed by blow lamp.

A protective flooring of either brick flat in cement mortar (1:3) or 6cm thick cement concrete (M 15) or a coat of cement plaster (1:3) 4 cm thick shall be constructed over the bitumen layers to prevent damage to the latter during subsequent construction of the structural floor.

The walls shall be treated in a similar way; the bitumen felts joining at the base with the projecting felt laid over the mud-mat. The wall surface shall be made smooth where necessary with a coat of cement plaster (1:3), the felts laid as for the floor, ensuring that the surface to be treated is dry and then a protective brick wall, 12.5 cm nominal thickness shall be built in cement mortar (1:3) over the projecting mud-mat, the space between the wall and felt being grouted with cement.

3.00.00 ACCEPTANCE CRITERIA AND GUARANTEE

The surface level shall be such as to allow quick draining of rains without leaving any pool anywhere. The finishing course shall be fully secured and shall have an even density. There shall not be any bubble formation or crushed or squeezed insulation or underbed.

The contractor shall give a guarantee in writing for all works executed under this specification supplemented by a separate and unilateral guarantee from the specified agency for the roof waterproofing treatment work. The guarantee shall be for materials and workmanship for 5 years in case of normal treatment, 10 years for heavy treatment and 20 years for extra heavy treatment. The mode of execution of the guarantee shall be such, which shall be acceptable to the Owner.

4.00.00 I.S. CODES AND STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

a)	IS: 73	-	Paving Bitumen
b)	IS: 702	-	Industrial Bitumen
c)	IS: 1203	-	Methods of testing tar and bitumen
d)	IS: 1322	-	Bitumen felts for waterproofing and damp proofing.
e)	IS: 1346	-	Code of practice for waterproofing of roofs with bitumen felts.
f)	IS: 1609	-	Damp-proofing Treatment using Bitumen Felts – Code of Practice
g)	IS: 3067	-	Code of practice for General design details and preparatory work for Damp-proofing and water-proofing of buildings
h)	IS: 3384	-	Bitumen primer for use in waterproofing and damp proofing.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be for complete work, including the cost of all materials and labour, as detailed in the specification unless any portion is specifically excluded in the "Schedule of Items".

No extra shall be paid for finishing around opening, sleeves, pipes, ducts, inserts, etc.

No separate payments shall be made for cleaning of surface, treating of cracks and surface preparation.

5.02.00 Measurement

The finished work shall be measured in Sqm of actual surface area for the purpose of payment.

No deduction shall be made and no extra shall be paid for openings upto 0.4 sqm.

SECTION - D

SUB-SECTION – D5

METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	INSTALLATION
3.00.00	ACCEPTANCE CRITERIA
4.00.00	INFORMATION TO BE SUBMITTED
5.00.00	I.S. CODES
6.00.00	RATES AND MEASUREMENTS

ATTACHMENT

ANNEXURE – A SCHEDULE OF FIXTURES

METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

1.00.00 SCOPE

This section covers supplying and/or erecting and installing of all metal doors, windows, ventilators, louvers, glazed partitions, etc. The scope of work shall also include the assembly and erection of all doors, windows, louvers, glazed partitions, etc. Supplying and/or fixing of all door and window accessories and hardware are also included in the scope.

2.00.00 INSTALLATION

2.01.00 Materials

Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS: 1038 and IS: 1361 or as specified.

Steel sheets for frames, shutters, louver blades etc. shall be of gauge mentioned in drawings and schedules.

Aluminium sections for fabricating doors, windows, partitions etc. shall be extruded sections conforming to IS:733 or IS:1285 or as manufactured by Indian Aluminium Company Limited or approved equivalent. Aluminium door, windows and ventilator shall be fabricated as per IS:1948 and IS:1949. The alloy used shall conform to IS Designation HE 9-WP of IS: 733.

Hardware and fixtures shall be as specified and the best quality from approved manufacturers shall only be used. The tenderer shall specifically state the particular manufacturer's materials he proposes to use. Improper alignment or faulty operation due to inadequate strength of hardware or fixture shall entirely be the Contractor's responsibility.

All hardware and fixtures shall be able to withstand repeated use. Door closures shall conform to IS: 3564 and shall be suitable for doors weighing 61-80 Kg. unless otherwise stated. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or shall be replaced free of charge. Concealed door closers shall be either floor mounted or transom mounted, suitable for installation with metal doors. It shall conform to the performance Requirements and endurance test stated in IS: 3564 - Appendix-A. The Contractor shall submit samples of each type of hardware to the Engineer. The approved samples shall be retained by the Engineer for comparison of bulk supply. The samples shall be returned to the Contractor towards end for incorporation in the job. The mastic for caulking shall be of best quality from a manufacturer approved by, the Engineer. In

general, mastic for fixing of metals frames shall be as per IS: 1081 or as approved by the Engineer.

2.02.00 Fabrication

2.02.01 Steel Doors, Windows, Ventilators, louvers etc.

a) Door Frames

Frames shall be fabricated from 16 gauge (G) sheets. They shall, be mortised, reinforced, drilled, and tapped for hinge lock and bolt strikes. Where necessary, frames shall be reinforced for door closers. Welded construction with mitered Corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose "T" masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be installed. Frames shall be brought to site with floor ties/weather bars installed in, place.

b) Double or Single Plate Flush Door Shutters

Door shutters shall be 45 mm thick, completely flush design and shall comprise of tw0 outer sheets of 18 G steel sheets, rigidly connected and reinforced inside with continuous vertical 20 G stiffeners, spot welded in position at not more than 150 mm on centres including void filled with mineral wool (64kg/cum density).

Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally as shown on drawing by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and heads, shall have proper level on lock stiles and rails to operate without binding, and shall be reinforced at corners to prevent sagging or twisting. Pairs of double doors shall have meeting-stile edges bevelled or rebated. Where shown in drawings, or called for in the schedule of items. The doors shall be sound deadened by filling the inside voids with mineral wool or other suitable approved materials.

Doors shall be mortised, reinforced, drilled, and tapped in shop for hinges, locks, and bolts. They shall also be reinforced for closers, push-plates, and other surface hardwares where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown in drawings, provision shall be made for fixing glazing, vision panels, louvers etc. glazing mouldings shall be of 18 G steel or extruded aluminium sections and suitable for fixing 6 mm. glass. Louvers blades shall be V or Z shaped and made out of 18G sheets.

c) Single or Double Sheet Door Shutters

Single sheet doors shall be made from best quality 18 G (mild) steel sheets, and shall present a flush surface on the outside. The inside shall be stiffened with semi tubular edge and central stiffening rail, which shall convey the lock and other fixture. The frames shall be made from best quality, 16 G mild steel sheets.

Wherever required, provisions for fixing glass panes, louvers etc. shall be made.

The manufacturing shall be done as specified in 2.02.01 (b) "Double Plate Flush Door Shutters."

d) Sliding Door

Sliding doors shall be either double plate or single plate Construction made out of 18 gauge steel sheets with adequate stiffeners. The contractor shall specify the weight of the door in his shop drawings and submit the manufacturer's catalogue of the sliding gear proposed to use. Where called for the Contractor shall make provision for openings to the door for monorail beams. Doors shall close positively to exclude rainwater from seeping in. When called for, sliding doors shall withstand specified wind loads without buckling or jamming. The door shall slide freely under all ambient conditions.

e) Door Threshold

Door threshold shall be provided. Doors without threshold shall have bottom tie of approved type.

f) Steel Windows, Sashes, and Ventilators etc.

These shall conform in all respects to IS: 1038 and IS: 1361, IS: 7452 latest editions. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, and pivot arrangements for ventilators, etc. or as called for. All welds shall be dressed flush on all exposed and contact surfaces. Where composite unit openings are required the individual window units shall be joined together with requisite transoms and mullions. All windows shall be outside glazed, fixed with putty or metal glazing beads as specified. Where aluminium glazing beads are specified, they shall be extruded aluminium channel 9.5 mm x 9.5 mm x 1.6 mm (Indal Section No. 2209) /hindalco /jindal unless otherwise shown on drawings. Aluminium beads shall be given one coat of zinc chromate primer before fixing to windows.

2.02.02 Aluminium Door, Windows, and Frames

Extruded sections shall have a minimum 3 mm wall thickness. All sections shall be approved by the Engineer before fabrication is taken up. Doors frames, mullions, transom etc. shall be anodized in a bath of sulphuric acid to provide a clear coating and electro color coating of required shade as per IS 1868 (minimum anodized coating of grade AC15)of minimum 15 micron thickness. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent Coating shall be applied to the sections before shipment from the factory.

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce an uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

2.03.00 Shop Coat or Paint

The shop Paint for steel doors, windows etc. shall be best lead or zinc chromate primer paint from, approved manufacturer. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. that will be inaccessible after assembly of units shall be given an extra coat of paint before assembly.

Where called for, all steel doors, windows, etc. shall be hot dip galvanized to give a coating weight of 1½ - 2 oz. per sqft. One coat zinc chromate primer coat shall then be applied as shop paint.

Portions of aluminium frame, which come in contact with masonry construction shall be (before shipment from workshop) protected with a heavy coat of alkali resistant paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer.

2.04.00 Handling & Storage of Fabricated Material

All metal doors, windows, etc. shall be packed and crated properly before dispatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.

When taking delivery of items supplied by Owner, the Contractor shall satisfy himself that the items supplied are up to the specified standard. Any defect detected shall promptly be brought to the notice of the Engineer.

All metal doors, windows etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust, mortar etc.

2.05.00 Assembly & Erection at Site

In general, the fixing of steel doors, windows, ventilators, louvers, etc. shall conform to IS: 1081. The Contractor shall assemble and install all steel doors, windows, sashes, fixed metal louvers, etc. including transoms and mullions for composite units in respective places, keening proper "Lines and levels", and in approved workmanlike manner, to give trouble free and leak-proof installations. Installation shall be done according to instructions of the manufacturer, and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. The Contractor shall take all precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the Contractor and made good again as per original, after installation, without any extra charge.

After installation of steel doors, windows, etc. all abrasions to shop-coat of paint shall be retouched and made good the same quality of paint used in shop coat.

All coupling mullions, transoms, frames, etc. in contact with adjacent steel and other members, shall be well bedded in mastic. The Contractor shall bring to the site the cement in original sealed containers of manufacturer and shall apply it as per the instruction. For all frames supplied by either the owner or the Contractor, mastic shall be supplied by the Contractor and caulking done properly as per drawings, specifications and as per instructions of the Engineer.

Door shutters, partitions hardware fixtures etc. shall be fixed only after major equipments have been installed in rooms.

Wherever required, nylon cords of approved quality shall be supplied along with pivoted sashes and shall be of adequate length to terminate one metres from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer.

2.06.0 Fire proof Door

Fire proof doors shall be provided at all fire exit points as specified and also to restrict the spread of fire within buildings whether from internal fire or from external fire. The construction details of door shall conform to the requirements stipulated in

IS:3614(Part-1). Doors shall comply with the testing requirement mentioned in IS:3614 (Part-2). The doors shall be approved by Tariff Advisory Committee(TAC) and shall have minimum 2 hrs. fire rating.

Metal covered (on both sides) Doors having insulating core filled up with mineral wool shall be used at all fire exit points and shall open out side.

All necessary accessories and hardware ,panic bars shall also be supplied along with doors. Fire proof door shall be provided with zinc silicate primer (minimum DFT 75 micron) after blast cleaning the surface to near white metal surface and shall be finished painted with epoxy based painting.

3.00.00 ACCEPTANCE CRITERIA

3.01.00 For fabricated Items

a) Overall dimensions shall be within ±1.5 mm of the size shown on drawings.

b) Mullions, transoms etc. shall be in one length and permissible deviations from straightness shall be limited to ±1.5 mm from the axis of the member.

c) Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm for double leaf doors; the gap at the meeting stiles shall not be more than 1.5 mm.

d) Door leaves shall be undercut where shown on drawings.

e) Doors, windows, frames, etc. shall be on a true plane, free from warp or buckle.

f) All welds shall be dressed flush on exposed and contact surfaces.

g) Correctness of location and smoothness of operations of all shop installed hardware and fixtures

h) Provision for hardware and fixtures to be installed at site.

i) Glazing beads shall be cut with mitered corners.

j) Glazing clips, fixing devices etc. shall be supplied in adequate numbers.

k) Shop coats shall be properly applied.

l) Exposed aluminum surfaces shall be free from scratches, stains, and discoloration. Anodized surfaces shall present a uniform and pleasing look.

3.02.00 For installed Items

a) Installations shall be at correct location, elevation and in general, on a true vertical plane.

b) Fixing details shall be strictly as shown in drawings.

c) Assembly of composite units shall be strictly, as per drawings with mastic caulking of transoms and mullions, gaskets, weather strips etc. complete.

d) All frames on external walls shall be mastic caulked to prevent leakage through joint between frames and masonry.

e) All open able section shall operate smoothly without jamming.

f) Locks, fasteners etc. shall be engage positively. Key shall, be non-interchangeable.

g) Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.

h) Aluminium doors, windows, etc. shall be free from scratches stain or discoloration.

4.00.00 INFORMATION TO BE SUBMITTED

4.01.00 With Tender

a) Names of manufacturers for Doors, windows etc.

b) Manufacturer's catalogue for all hardware and fixtures proposed to be used.

4.02.00 After Award

a) Before starting fabrication of all metal doors, windows, etc. the Contractor shall submit detailed fabrication drawings to the Engineer for approval. The fabrication shall be started only after approval of drawings.

b) He shall submit a programme of work to be done for the approval of the Engineer.

c) Before bulk supply, he shall submit for the approval of the Engineer samples of all bought out items and samples of each type of fabricated items. The samples shall by retained by the Engineer for comparison of bulk supply and returned to the Contractor towards the end for final incorporation in the job.

d)

5.00.00 IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

Specification for Wrought Aluminium and Aluminium Alloy bars, rods and sections (for general engineering purpose)	-	IS: 733
Specification for Wrought Aluminium and Aluminium Alloy, extruded round tube, hollow Section (for general engineering purpose)	-	IS: 1285
Steel doors, windows, and ventilators	-	IS: 1038
Steel windows for industrial, building	-	IS: 1361
Aluminium doors windows, and ventilators	-	IS: 1948
Aluminium windows for industrial buildings	-	IS: 1949
Steel doorframes	-	IS: 4351
Code of practice for fixing and glazing of Metal (steel and aluminium) doors, windows and Ventilators.	-	IS: 1081
Specification for Fire-check Doors – Part 1: Plate, Metal covered and Rolling type	-	IS: 3614
Hot Rolled Steel Sections for Doors, Windows and Ventilators – Specification	-	IS: 7452

6.00.00 RATES AND MEASUREMENT

6.01.00 Rates

Rates shall be applicable of all elevation. Rates shall include preparation of working drawings (if required), supply of material, fixtures, gaskets, erection of unit, caulking

and jamming of frames, including cutting/drilling/welding, grouting, grinding, making good of the structure for installing the unit etc. complete as per "Schedule of Items".

Rates shall also include cost of surface preparation, application of primer, enamel painting or anodizing as applicable.

Rate for fire proof door is inclusive of providing insulation core, primer, shop painting (epoxy based), all hardware as specified in Schedule of items.

6.02.00 Measurement

Supply and installation of doors, windows, and ventilators shall be measured in Sqm in net outer to outer (excluding frame) area of doors, windows, and ventilators of each type used as described in "Schedule of Items". Frame for steel or aluminium shall be measured in Kgs. Wooden frames shall be measured in Cum. Measurement for aluminium partition shall be from net outer to outer area of frames i.e., frames are part of partition.

Measurement for fire proof door shall be in SqM in net area outer to outer of the door.

ANNEXURE-A

SCHEDULE OF FIXTURES

A. TIMBER DOORS

1. For single leaf panel/flush doors

   i) 100 mm brass butt hinges with screws - 3 Nos.

   ii) 150 mm brass tower bolts with screws - 1 No.

   iii) 100 mm x 225 mm clear plastic push Plate with counter sunk brass screws - 1 No.

   iv) 30 mm brass ring pull handle with Plates and screws - 1 No.

   v) 150 mm brass coat hook with screws - 1 No.

   vi) Heavy duty, cylinder looks on active leaf - for flush door. For door-closure, see "Door Schedule".

B. ALUMINIUM DOORS

1. For double leaf door

   i) Concealed hanging arrangement for door leaves.

   ii) Concealed two points bolt encasing simultaneously at head and threshold on inactive leaf, operable from inside.

   iii) Heavy duty, cylinder look on active leaf.

   iv) Pull handle of approved design on both leaves.

   v) Doors stoppers for both leaves.

   vi) Overhead hydraulic door closure for both leaves.
   vii) Floor mounted hydraulic door closer

ANNEXURE-A

C. STEEL DOORS AND WINDOWS

1. Doors

a) Double leaf doors

i) 100 mm butt hinges - 3 Nos. on each leaf.

ii) 300 mm aluminium tower bolt - 2 Nos. (top and bottom) On inside of inactive Leaf. 1. No. (Top only) On inside active leaf.

iii) 200 mm anodized aluminium Pull handle - 1 No. of each leaf.

iv) Door stopper of approved design - 1 No. of each leaf.

NOTE: For locks, door closure and threshold, see "Door Schedule".

b) Single leaf doors

i) 100 mm butt hinges - 3 Nos.

ii) 300 mm aluminium tower bolt - 2 Nos. top & bottom of Inside face

iii) 200mm anodised aluminium Pull handle - 1 No.

iv) Door stopper of approved design - 1 No.

NOTE: For locks, door closures and threshold, sec “Door Schedule".

2. Windows, Ventilators, etc.

a) Side Hung Windows

i) Hinges - As per standard Practice of the Manufacturer, but minimum two Hinges Per leaf.

ii) 12" peg stays - 1 No. per leaf

ANNEXURE-A

iii) 2 point handles - 1 No. per leaf

b) Top Hung Ventilators (Projecting Out)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two Hinges Per leaf.

ii) Adjustable sliding fabrication Assembles - 2 Nos. per leaf.

iii) 2 point handles - 1 No. per leaf.

c) Bottom Hung Ventilators (Projecting in)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two Hinges Per leaf.

ii) Concealed side arms for Opening adjustment. - 2 Nos. per leaf.

iii) Spring Catch - 1 No. per leaf.

ANNEXURE-A

D. ALUMINIUM WINDOW, VENTILATORS, ETC.

(As per 1.S-1948 latest editions)

a) Side Hung Windows

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) 300 mm peg stays - 1 No per leaf

iii) 2 point handles - 1 No per leaf

b) Top Hung Ventilators (Projecting out)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Adjustable sliding fabrication assembles - 2 Nos. per leaf

iii) 2 Point handles - 1 No. per leaf

c) Bottom Hung Ventilation&(Projecting In)

i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.

ii) Concealed side arms for opening adjustment - 2 Nos. per leaf

iii) Spring Catch - 1 No. per leaf

SECTION - D

SUB-SECTION – D6

GLASS AND GLAZING

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	INSTALLATION
3.00.00	ACCEPTANCE CRITERIA
4.00.00	I.S. CODES
5.00.00	RATES

GLASS AND GLAZING

1.00.00 SCOPE

This section covers supplying and fixing of all glass and glazing including all clips, putty, mastic cement etc. wherever required as per specifications.

2.00.00 INSTALLATION

2.01.00 General

The Contractor shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louvers, miscellaneous glazing and partitions, from approved manufacturer like Hindustan Pilkinton or equivalent, having uniform refractive index and free from flaws, specks, and bubbles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site.

Materials

a) Glare reducing or beat absorbing glass shall be "Calorex" of Hindustan Pilkinton or approved equivalent and special care shall be taken to grind smooth and round off the edges before fixing.

b) Clear glass shall be flat draw sheet glass and shall be at least 4 mm thick. Sheet glass for doors shall be minimum 5.5 mm thick.

c) Wired glass shall be thick- rolled glass with centrally embedded 42g wire mesh of Georgian type. This may be of clear or coloured glass, as required.

d) Obscure glasses shall have a cast surface in one side.

e) Coloured and figured glass shall be as per approved sample.

f) In general, the putty shall conform to IS: 400 and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing.

g) Neoprene gaskets with snap-fit glazing beads shall be fixed as per manufacturer's instructions and shall sit snugly against glass to give a leak proof installation.

h) Polycarbonate sheet multi (twin) wall fire retardant and ultra violet resistant with sealed open edges. as per IS: 14443.

i) Patterned, figured or rolled glass :-It is a decorative and translucent glass with figures or patterns on one face. In addition to diffusing light and obstructing

visibility from the outside, the figures soften the interior lighting. This type of glass is usually more fragile and less convenient to clean

j) Ground Glass :- Ground glass surface has been ground to produce a flat but rough (matte) finish. Glass surface has been ground or etched to create a roughened non transparent surface. this are similar as figured glass, obstructing visibility from the outside.

k) heat-reflecting type float glass:

A metallic coating is applied to one side of the glass in order to significantly increase the amount of reflection by the glass of both the visible and infra-red (light and heat) range of the electromagnetic spectrum. This metallic coating can be applied to clear or body tinted glass. The reflective glass imparts a mirror like appearance to the exterior of buildings under most daytime conditions. Due to the coating of metal oxides on the glass, they are widely applied in buildings for its highly reflective surface and its wide palette of colours. It reduces heat gain and glare from the exterior and allows optimum visible light transmission to the interior. An exceptional property of solar reflective glass is that the coating of metal oxides on the glass can be achieved without affecting the transparency of the glass.
Density : 2.4 – 2.5 g/cm3

l) Laminated glass:

Laminated glass is composed of two or more layers of glass with one or more layers of a transparent/ pigmented and specially treated plastic Polyvinyl Butyral [PVB] sandwiched between the glass layers. The glass panes (layers) can be either normal glass or tempered glass. When the glass is broken, fragments tend to adhere to the plastic [PVB] interlayer thereby reducing the risk of injury and helping to resist further damage by weather.
Laminated glass retains its colour and strength for the life of the building and is as easily cleaned as any conventional glass.
When exposed to heat, laminated glass breaks but stays in place longer. The risk of thermal breakage is avoided only when heat strengthened / tempered laminated glass is used.
Density (approximate) : 2.42 – 2.52 g/cm3
Tensile strength : 32 N/sq. M
Compressive strength : 1000 N /mm2
Modulus of elasticity : 70 GPa
Coefficient of linear expansion: 9 x 10–6 m / mK
U value : 2.84 W/sq. m. K for 3 mm thick clear to 5.96 W/sq. m. K for 6 mm thick clear
UV transmittance : 30% for bronze 6 mm thick to 80% for 6 mm thick clear.

Shading co-efficient : 0.5% for 6 mm thick gray to 0.9% for 6mm thick clear.

Visible light transmittance : 25% for 6mm thick bronze to 90% for 6mm thick clear
(product specific information to be referred)

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2.03.00 Glazing, Setting, and Finish

All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the Contractor.

All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in relevant I.S. Codes, four glazing chips shall be provided per glass pane, except for large panes were six or more clips shall be used as per engineer's instructions. All holes that may be necessary for holding the clips glazing heads and all other attachments shall be drilled by, the Contractor.

Glass panes shall be set without springing, and shall be bedded in putty and back puttied, except where mouldings or gasket are specified, putty, mastic cement etc. shall be smoothly finished to the even line and figured glass shall be set with smooth side out.

Where owner will supply glass, the Contractor shall cut it to size and fix them in the same as specified above.

The Contractor shall supply necessary glazing clips, putty, mastic cement etc.

After completion of glazing, the Contractor shall remove all dirt stains, excess putty etc. clean glass panes and leave the work in perfectly acceptable condition. All broken cracked or damaged glass shall be replaced by new ones at the contractor's own cost.

3.00.00 ACCEPTANCE CRITERIA

a) All installation shall be free from cracked, broken, or damaged glass. Edges of large panes of thicker glass and heat absorbing glass shall be inspected carefully for chipped, cracked, or underground edges.

b) Glazing shall be carefully done to avoid direct contact with metal frames.

c) All glass shall be embedded in mastic or fixed by neoprene gaskets to give a leak

proof installation.

d) At completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the Engineer.

4.00.00 I.S. CODES

Following are some of the important I.S.Codes relevant to this Section:

IS: 3548 - Code of practice for glazing in building.

IS: 1081 - Code of practice' for fixing and glazing metal doors, windows ventilators.
IS: 2553 PART-I- Code of practice for safety glass, toughened or laminated glass.
IS: 2835 – 1987-Code of practice for sheet glass, flat transparent sheet glass.
IS: 14443-Code of practice for polycarbonate sheet specification.
IS: 5437- Code of practice for figured rolled and wired gla

5.00.00 RATES

Rates of glass and glazing are included in respective items for supply and installation of window, ventilator, and partitions. No separate payment shall be made for glazing clips, mastic cement, putty, screws; rails, etc. nor for drilling holes in frames for inserting glazing clips.

SECTION - D

SUB-SECTION – D7

ROLLING STEEL SHUTTERS AND GRILLS

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	INSTALLATION
3.00.00	ACCEPTANCE CRITERIA & GUARANTEE
4.00.00	I.S. CODES
5.00.00	RATES AND MEASUREMENTS

ROLLING STEEL SHUTTERS AND GRILLS

1.00.00 SCOPE

This Section covers the design and supply of materials, fabrication, delivery and erection of Rolling Shutters/Grills with motor drive and/or manual operation including all accessories as hereinafter specified.

2.00.00 INSTALLATION

2.01.00 Components

a) Slats for rolling shutters shall be made from tested bright hot rolled double dipped galvanised steel lath section of 18 swg tested mild steel strips at 75 mm rolling centers, interlocking with each other. The profile will be such as to prevent excessive deflection under specified wind load.

b) Rolling grills shall be constructed out of 6mm rods at 35 mm on centers running horizontally flexible connected with vertical links spaced not more than 200 centers. Alternatively, rolling grills shall be made from perforated slats of approved design reinforced with 6mm dia rods.

c) End locks shall be heavy type M.C.I./C.I. and shall be provided at each end of alternate slats unless specified otherwise.

d) Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. When shown on drawings, a flexible weather strip shall be applied to make tight contact with the floor. Bottom lath shall be coupled to a lock plate fabricated from 3mm thick galvanized steel plate and securely riveted with stiffening angles.

e) Guides shall be of such depth as to retain the shutter under a wind pressure of 100 Kg/Sq.m.

f) Shafts shall be of steel pipe of sufficient size to carry the tensional load with a maximum deflection of 1/360th of span. Grease packed ball bearings or bushings shall be provided for smooth trouble free operation.

g) Hoods shall be formed of not less than 20 gauge steel, suitable reinforced to prevent sag.

h) Locks shall be slide bolt and hasp, or cylinder lock operable from one or both sides. Provision securing hand chain with pad-lock, provision for removable handle for hand cranks etc. shall be made as prescribed by the Engineer.

i) Power unit shall be suitable for 3 phase, 50 cycles, 400-volt A.C. power supply and be either floor or wall mounted unit. The motor shall be of sufficient capacity, to move the shutter in either direction at a speed of 0.3 metres per second. In addition to the gear motor each standard power unit shall include a magnetic brake, a reversing starter with built-in overload protection, a geared limit switch and one push button station located inside the building unless otherwise stated in drawing.

It is desirable that the bottom bar of motor operated doors shall be provided with a sensitive edge, electrically connected to stop the travel of the door on meeting an obstruction.

j) Operating chains shall be of tested quality, heavily galvanized and with all ends rounded to assure smooth operation and hand protection.

k) Reduction gears shall be high strength grey cast iron, machine moulded from machine out patterns.

2.02.00 Manually Operated Shutters/Grills (self coiling type or push pull down)

Self-coiling type rolling shutters shall be raised or lowered manually by means of a puffing hook applied to the pulling handles fixed on the bottom lock plate. The length of the pulling hook shall be adequate to push the bottom lock plate to the topmost position with ease. Manually operated shutters shall be easily operable by one person. The speed of operation shall be about 1.3 metres per second. In general, manually operated shutters shall be push pull type for opening up to 8 Sq. metres in area. It shall be used up to a maximum of about 8 m^2 clear area without ball bearings and up to a clear area of about 12 m^2 with ball bearings, as per IS 6248. Larger shutters shall, be either chain or gear operated or crank and gear operated. The crank handle shall be removable. All shutters shall be lockable from one or both sides as desired by the Engineer.

2.03.00 Mechanically or Gear Operated Shutters/Grills

It shall be fitted with ball bearings. It shall be used up to ‘a maximum of about 25 m^2 clear area, if the rolling shutter is operated by a bevel gear-box and crank handle and up to a maximum of about 35 m^2 clear area ,as per IS 6248.
All shutters shall be lockable from one or both sides as desired by the Engineer.Gear-operated type rolling shutters ordinarily employ a worm drive arrangement, the worm driving the worm wheel attached to one end of the roller. Worm drive is preferred in view of its irreversible nature, which provides a safeguard against any accidental downward descent of the curtain due to failure of the springs.

2.04.00 Power operated Shutters/Grills

Electrically operated rolling shutters shall be operated by an electric motor operating on 400/440 V, 3 phase, 50 cycles ac supply. The electric motor shall drive the worm shaft by chain or Vee-belt drive or through a reduction gear box. The reduction gear box shall have a control lever within easy reach from the floor so that the motor may be disengaged and the auxiliary chain gear operating mechanism may be engaged instantly in the event of power failure. The motor unit shall be so mounted that the motor may be completely removed without interfering with the operation of the rolling shutter or the auxiliary drive. The electric drive shall be so designed as to limit the speed of movement of the curtain in either direction to not more than about 10 cm/s

The controls provided for the electric motor shall include push

The controls provided for the electric motor shall include push button control through the medium of a 3-phase reversing starter with Interlocking contractors and overload protection. The reversing starter shall be wall-mounted and fitted adjacent to the shutter in a convenient position. A minimum of 3 phase buttons marked 'Forward ', 'Reverse & 'Stop ' or ' Up ', Down ', ' Stop ' shall be provided with a mechanical locking arrangement to prevent unauthorized or irregular operation of the push buttons. Limit switches shall be provided to cut off current to the motor when the rolling shutter reaches the limit of its travel in the' Up ' and ' Down ' directions.

Arrangement shall also be provided for emergency mechanical Operation of the rolling shutter in the event of failure of electricity or electrical equipment. The emergency mechanical operation shall be by an auxiliary chain wheel and hand chain drive on the worm shaft.

2.05.00 Shop Coat

Shutters shall be painted with one coat of red lead or zinc chromate primer. Where specified, shutters shall be galvanized and subsequently painted one coat of zinc chromate for adhesion of field coat and shop paint as per specification.

2.06.00 Erection

Shutters shall be installed by the manufacturer or his authorized representative and all work shall be as per manufacturer's instructions. Any drilling or cutting to concrete, masonry etc. shall be made good after erection of shutters and all abrasion to shop coat shall be touched up. All electrical work shall be in strict accordance with the latest Indian Electricity Rules

3.00.00 ACCEPTANCE CRITERIA AND GUARANTEE

3.01.00 Shop Inspection

After completing the manufacture of the different components of the rolling shutter, an arrangement for shop inspection by the Engineer shall be made to check the conformity with approved shop drawings.

3.02.00 Field Inspection

After installing the shutters, the Contractor shall test the performance of the shutter in the presence of the Engineer. The shutters shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault free performance.

3.03.00 Guarantee

The Contractor shall give one year's guarantee for the successful operation of the shutters. This shall be supported by a separate and unilateral guarantee from the manufacturer of the shutters.

4.00.00 I.S. CODE

IS: 6248 - Metal rolling shutters and rolling grills.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates for rolling shutters and grill shall include the cost of the locks, guide channels, cost of drive as specified. In case of electrically operated rolling shutters, the rate shall also include the mounting of controls, wire and wiring from the nearest junction box, conduit and other electrical connections and cost of electric motor.

5.02.00 Measurement

Supply and installation of rolling shutter and grill shall be measured in Sqm in net outer to outer (including frame) area of each type used as described in “Schedule of Items”.

SECTION - D

SUB-SECTION – D8

MISCELLANEOUS METAL

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	INSTALLATION
3.00.00	ACCEPTANCE CRITERIA
4.00.00	IS CODES
5.00.00	RATES AND MEASUREMENTS

MISCELLANEOUS METAL

1.00.00 SCOPE

This section covers supply, fabrication and erection of miscellaneous metal items of light nature in gates, balcony and stair hand rails, structural works, ladders, hangers, masonry anchors, anchor bolts, fasteners, chain link fencing, barbed wire fencing etc. as specified or shown on drawing or as instructed by the Engineer. The above items shall be of fabricated or cast of mild steel, aluminium, brass, cast iron, M.S.& galvanized M.S. sheets, aluminium sheets, expanded metal, wire mesh as shown on drawings or specified.

2.00.00 INSTALLATION

2.01.00 Fabrication/casting

2.01.01 General

All work shall be done according to approved shop drawings. All workmanship shall be equal to the best practice in modern structural or foundary shop.

2.01.02 Shop Connections

a) All shop connections shall be riveted or welded except when noted otherwise on drawings.

b) Welding of steel shall be done in accordance with IS: 816.

c) Welding of aluminium shall be done accordance with IS: 2812, “Arc welding of Aluminium and Alloys.” Special care shall be taken to grind smooth all welded surface that shall remain exposed to view. Welds shall be electrically continuous if so required by the Engineer.

2.01.03 Shop Coat

Before leaving the shop, all metal work shall be thoroughly cleaned by effective means of all loose mill seals, rust and foreign matter. Except where encased in concrete, all steelwork shall be given one coat of approved metal protective paint, applied be brush thoroughly and evenly, well worked into joints and other open spaces. All paint shall be applied to dry surfaces. When specified steel work shall be galvanised or painted with a coat of zinc chromate primer. Aluminium surfaces, which shall come in contact with masonry, shall be given one coat of bituminous paint.

2.02.00 Erection

2.02.01 Bracing

The Contractor shall provide all necessary temporary guys and braces to ensure alignment and stability of the members and to take care of all loads to which the structure may be subjected, including erection of equipment and operation of the same.

2.02.02 Temporary Bolting-Up

As erection proceeds the Contractor shall plum up and level all members and shall securely bolt up to take care of all dead load, wind load and erection stresses. Wherever erection equipment or other loads are carried by members during erection, proper provision shall be made to take care of the stresses resulting from the same.

2.02.03 Turned Bolt

For field connections where bolting is specified, holes for the turned bolts may be reamed in the field, if required. All drilling or reaming for turned bolts shall be done after the parts to be connected are assembled.

2.02.04 Welding

Where specified on drawings, welding shall be done in accordance with IS: 816 for steel and IS: 2812 for Aluminium & Alloys.

2.02.05 Cutting and Fitting

No cutting of sections, flanges, webs of angles shall be done without the approval of the Engineer. Where indicated on the drawings, holes, cuttings, etc. shall be provided as required for installation, to the work by the other Contractors. No additional holes or cuttings, than those shown on drawings, shall be made without the approval of the Engineer.

2.02.06 Drifting

Correction minor misfits and a reasonable amount of reaming and cutting of excess stock from rivets may be permitted. For this, light drifting may be allowed to draw holes together. Twist drills shall be used to enlarge as necessary to make connections, reaming that weakens the members or make it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins or a moderate amount of reaming and slight chipping and

cutting shall immediately be called to the attention of the Engineer-and approval of the method of correction obtained. The use of cutting torches to enlarge or alter rivet holes shall not be permitted.

2.02.07 Spot Painting

All field rivets and bolts and also any serious abrasion to shop paint shall be spot painted with the same materials and used for the shop paint or equivalent.

2.02.08 Good

All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer.

2.02.09 Grouting

All bearing plates, lintels and beams, etc. shall be set to proper grade and level by the Contractor and the Engineer's approval obtained before proceeding with the grouting. Grouting shall be done in 1:1:2 concrete with 6 mm down stone chips or as specified in schedule of items.

2.02.10 Anchor Fasteners

The anchor fasteners shall be of two type viz. for masonry works and for concrete works. The expansion sleeves are different for masonry type anchor fastner and concrete type anchor fastener. Depending upon the safe tensile load capacity of each fastener, size of anchor fastener varies. The Contractor shall submit the Manufacture's literature showing the average pull out and average shear value for anchor of various sizes. Anchors shall be fixed in position strictly as per the manufacturer's instructions and as approved by the Engineer.

Anchor fastener is considered as light duty for carrying safe tensile load up to 0.5MT per fastener and as heavy duty for carrying safe tensile load above 0.50MT per fastener.

Heavy Duty Anchor Fasteners

The safe tensile load carrying capacity of the anchors shall be arrived by providing the minimum factor of capacity of 2.5 for the characteristic load of the anchor. Minimum size of anchor shall be M8 (8mm). All anchors shall be from the approved manufacturers like HILTI or equivalent.

a) Anchor fasteners shall be supplied and fixed in position by the contractor. Anchor fasteners can be of mechanical bonding or chemical bonding.
b) Capacity of the anchor shall be established after considering the effect of concrete

grade, embedment depth, concrete thickness, anchor spacing and edge distance from the concrete edge.

c) The selection for the particular type of bonding for the anchors shall be made after considering the concrete grade, available embedment depth, load to be transferred, space available for installing anchors.

d) The mechanical bonding anchor are torque controlled anchors made from carbon steel of grade 8.8 as per IS:1367 part 3. Anchors in bolt as well as nut version are acceptable. The bolt version anchors consist of bolt washer, sleeves, plastic section, expansion sleeves and a cone. Nuts version anchor consists of nuts, threaded rod, washer, sleeves, plastic section, expansion sleeves and a cone. All steel component of anchor shall be electro galvanised to minimum 5 micron coating thickness. The plastic section shall be of polyacetal Derlin 100 or equivalent.

e) Chemical bonding anchor shall consist of foil capsule and threaded rod. The foil capsule shall contain the resin and hardener. The threaded rod shall have chiselled tip. The behaviour of anchors under fire shall conform the heating curves as per ISO:834. Anchors of size M8 to M24 shall conform to grade 5.8 and anchors of size M27 to M39 shall conform to grade 8.8 as per IS:1367 part 3. All steel components of the anchors shall be electro-galvanised to minimum 5 micron thickness.

Light Duty Anchors

This anchor shall comprise of stud, nut, washers, and expansion sleeve. The one end of the stud shall have thread and the other end shall have cold formed conical head. All steel components of the anchors shall be electro-galvanised to minimum 5 micron thickness. The expansion sleeve shall preferably be of stainless steel of SS316. The anchors shall conform to minimum grade 5.8 as per IS:1367 part 3.

2.02.11 Pipe Joints

MS pipes or GI pipes shall be joined by threaded sockets or by welding. Cast iron pipes shall be socket and spigot joined and caulked with hemp and molten head.

2.03.0 FENCING

2.03.01 Galvanised Chain Link Fencing

The material requirement shall conform to IS: 2721 latest edition. The galvanised chain link fencing shall be woven from 3.15mm dia. wire with mesh size of 50mm unless otherwise specified. The mesh wire shall not vary from specified dia. by more than $\pm$0.05mm. All steel wire shall be hot dipped galvanised wire. The dia shall be measured over the galvanised coating. The line wire shall be 4.0mm dia. GI wire. The stirrup wire for securing the line wire to the intermediate post (RCC/structural steel)

shall be GI wire 2.5 mm diameter. The tying wire for securing the chain link fencing to the line wire shall be 1.6mm diameter GI wire. Hair pin chain staples for fastening down the bottom of galvanised chain line fencing to the concrete sill shall be 3.15mm wire. The ends shall be bent outwards for securing anchorage.

Cleat for eye bolts shall be of uniform size and shall consist of mild steel angle of 75 x 50 x 8 mm. The eye bolts strainer shall consist of bolt with welded eye sufficiently threaded and fitted with a nut and washer. Two-way eye bolt strainer shall have suitable ring nuts fitted after the wires have been strained on one side. Stretcher bar shall consist of GI flats 25 x 4.75 mm. They shall be secured to the cleats by steel bolts.

The chain link fencing shall be strained between each pair of straining posts and secured to each straining posts by means of a stretcher bar. One of top line wire shall be threaded through appropriate adjacent row of mesh, care being taken that no meshes in the row are bypassed by the line wire except where deviation is necessary at the straining posts. The second top line wire shall be strained in front of the fencing. The fencing shall be attached to the top and bottom line wire by wire ties spaced at 150mm apart and to the other middle line wire by wire ties spaced at 450mm apart.

The bottom of fencing shall be treated as follows:
Hair pin staples shall be threaded through the bottom row of mesh at 750mm c/c and set in the sill 25mm below the chain link fencing to a depth of 150mm.

2.03.02 PVC coated Galvanised Chain Link Fencing

The PVC coated galvanized chain link fencing shall be woven from minimum 8 gauge PVC coated wire (including PVC coating) with mesh size of 75mmX75mm. The diameter of the hot dip galvanized steel wire for chain link fencing excluding PVC coating shall not be less than 12 gauge. The mesh wire shall not vary from specified dia. by more than +0.05mm. Other fixing details shall be as provided under sub head Galvanised **Chain Link Fencing** above.

2.03.03 Barbed Wire Fencing

The barbed wire shall be conform to IS: 278 latest edition. The barbed wire shall be galvanised and galvanising shall conform to the requirement laid down for 'light-coated wire' of IS:4826 and it shall be smooth and relatively free of lumps etc. Wire with excessive roughness blisters, salammoniac spots shall be rejected. The barbed wire shall be made from two line wires and two point wires. The barbs shall have four points and shall be formed by twisting two point wires, each two turns, tightly around both or one line wire (Type A - around both line wire, Type B - around one line wire) making altogether four complete turns. The barbs shall be so finished that four points are set and located or locked as far as possible at right angle to each other.

Straining posts shall be provided at all ends and corners of fences or at changes in direction or acute variation in level and at intervals not exceeding 66 M on straight lengths of fence. Intermediate posts shall be spaced at regular intervals not exceeding 3.0m. Struts shall be fitted to all straining posts behind the chain link fabric in the direction of line of fence. There shall be four evenly spaced row of line wire in all. The top line wire shall be doubled, making five line wire in all. The bottom wire shall be closed to the ground. Each line wire shall be strained tightly by means of eyebolts strainers or winders at each straining points. Each line wire shall be secured to each intermediate post by a wire stirrup passed through a hold in the post and secured to the line wire by three complete turns on each sides of the post. The barbed wire shall be fitted with one dropper at the centre of each bay, secured to the wire so that they could not be bunched together. Droppers for barbed wire shall be of mild steel of not less then 25 x 4.75 mm thick with 38 x 4.85 mm half round staples for fastening the barbed wire to them. Bracing for the rows of barbed wire shall be approved by the Engineer.

2.03.04 Concertina Fencing

Concertina shall be from high tensile serrated galvanized wire (HTSW) made with wire diameter of 2.5 mm which will be stretched to 6m and attached on two strands of galvanized HTSSW (high tensile spring steel wire) of 2.5mm dia by means of clips at 1m interval. These two HTSSW strands will be attached to the fence posts/ angles with 12mm security fasteners.

3.00.00 ACCEPTANCE CRITERIA

a) All items shall be correct shape, size, weight etc. shown on drawings and schedule of items.

b) For installed items, the tolerances shall be as follows

   i) Permissible deviation from, straightness – 1 in 1000.

   ii) Seats, stiffener connections etc. shall be as per approved drawings and shall not interfere with architectural clearances.

c) All castings shall be free from blowholes, cracks, and other blemishes.

d) All MS wire fencing shall be in true vertical plain, and shall not bulge.

4.00.00 IS CODES

IS:278 Specification for Galvanised Steel Barbed wire for fencing.

IS:816 Code of practice for use of Metal Arc welding for general construction in mild steel.

IS:1367 Industrial Fasteners – Threaded steel fasteners - Technical supply condition.

IS:2721 Specification for Galvanised Steel Chain Link fence fabric.

IS:2812 Arc welding of Aluminum and Alloy

5.00.00 RATES AND MEASURMENTS

5.01.0 Rates

Rates shall include supply, fabrication and installation for misc. metals works as required for completion of works like gates, fencing, handrails, ladders, hangers, anchors etc., unless otherwise specified in Schedule of Items.

Rate for fencing shall also include excavation, concreting and supply, erection & fabrication of post (post made of either structural steel or reinforced cement concrete), unless any specific item is excluded in the schedule of items.

5.02.0 Measurements

Measurement for MS gates shall be in MT.

Measurement for fencing shall be in Sqm unless otherwise specified in schedule of item.

Measurement for Anchors shall be in nos. for the type as specified in schedule of items.

Measurement of other misc. metals shall be done in MT unless otherwise specified in schedule of items.

SECTION - D

SUB-SECTION – D9

MASONRY AND ALLIED WORKS

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	MATERIALS
3.00.00	INSTALLATION
4.00.00	I.S. CODES
5.00.00	RATES AND MEASUREMENTS

MASONRY AND ALLIED WORKS

1.00.00 SCOPE

This section covers furnishing, installation including handling, transporting, batching, mixing, laying scaffolding, centering, shuttering, finishing, curing, protection, maintenance and repair of common building materials till handing over of masonry and allied works for use in structures and locations covered under the scope of this package.

2.00.00 MATERIALS

a) Brick

Bricks for general masonry work shall be of class designation 7.5 of nominal dimensions as per standard specification under IS: 1077, well burnt, of uniform size, shape and colour, free from cracks, flaws or modules of free lime and emit clear ringing sound when struck. Fractured surface shall show uniform texture free from grits, lumps holes etc. Water absorption after 24 hours immersion shall not exceed 20% by weight for bricks. Dimensional tolerance shall not exceed 8% of the size shown in drawings for bricks. All bricks shall have rectangular faces and sharp straight edges. The bricks shall show no efflorescence after soaking in water and drying in shade.

Each brick shall have the manufacturer's identification marks clearly marked on the frog. Representative samples shall be submitted and approved samples shall be retained by the Engineer for further comparisons and reference. Any brick not found up to the specification shall be removed immediately from site at the Contractor's own cost.

Bricks shall not be dumped at site. They shall be stacked in regular tiers, even as they are unloaded; to minimize breakage and defacement of bricks. Bricks selected for different situation of use in the work shall be stacked separately.

Fly ash lime bricks shall be as per the requirements of IS:12894 and clay ash bricks shall be as per the requirements of IS: 13757.

b) Stone

All stones shall be obtained from approved quarries, hard, tough, durable compact grained, uniform in texture and colour and free from decay, flaws, veins, cracks and sand holes. The surface of a freshly broken stone shall be bright, clean, and sharp and shall show uniformity of texture, without loose grains and free from any dull, chalky, or earthly appearance. Stone showing mottled colours shall not be

used for face work. A stone shall not absorb more than 5 per cent of its weight of water after 24 hours immersion. The type of stone shall be as specified on drawings and/or instructed by the Engineer. Samples shall be submitted by the Contractor and approved samples shall be retained by the Engineer for comparison of bulk supply.

c) Cement

Cement used shall be Ordinarily Portland Cement or Portland Slag Cement or Portland Pozzolana Cement conforming to IS Codes and shall be fresh when delivered. In special cases, Rapid Hardening Portland Cement, Low Heat Cement etc. may be permitted or directed to be used by the Engineer. The Contractor shall submit the manufacturer's certificate for each consignment of cement procured to the Engineer. If at any time, the Engineer feels that the cement being used by the Contractor is not up to specification, he may stop the work and send the samples of the cement to a testing laboratory for standard tests and all expenses incurred thus shall be borne by the Contractor. The Contractor shall also have no claim for this type of suspension of work.

The cement shall be stored above the ground level in perfectly dry and watertight sheds. The bags shall be stacked in a manner so as to facilitate removal or first in first out basis. Any material considered defective by the Engineer shall not be used by the Contractor and shall be removed from the site immediately.

d) Coarse Aggregate

Coarse aggregates shall be as per IS: 383 latest editions, consisting of hard, strong and durable pieces of crushed stone and shall be free from organic or clay coatings and other impurities like disintegrated stones, soft flaky particles etc. and any other material liable to affect the strength, durability or appearance of concrete.

Aggregates other than crushed stone conforming to the provisions of specification may be used if permitted by the Engineer.

Washing of aggregates by approved means shall be carried out, if desired by the Engineer.

Grading of coarse aggregates shall generally conform to IS: 383 and shall be such as to produce a dense concrete or the specified proportions and strength and of consistence that will work readily into position without segregation.

Aggregates shall be stored on brick soling or an equivalent platform so that they do not come in contact with dirt, clay, grass, or any other injurious substances at any stage.

Aggregate of different size shall be kept in separate stacks. If so desired by the Engineer aggregate from different sources shall be stacked separately with proper care to prevent intermixing.

e) Sand

Sand shall be hard, durable, clean, and free from adherent coatings or organic matter and shall not contain clay balls or pellets. The sand shall be free from impurities such as iron pyrites, alkalis, salts, coal, mica, shale or other laminated materials in such forms or quantities as to affect adversely the hardening, strength, durability or appearance of mortar, plaster or concrete or to cause corrosion to any metal in contact with such mortar, plaster or concrete. All sand shall be properly graded and shall be as per relevant IS Code. Sand for concrete shall conform to IS: 383.

f) Water

Water shall be clean, fresh and free from organic matters, acids or soluble salts and other deleterious substances which may cause corrosion, discoloration, efflorescence etc.

g) Reinforcement

Reinforcement steel shall be clean and free from loose mill scales, dust, loose rust, oil and grease or other coatings, which may impair proper bond. Structural steel shall conform to IS: 2062. Mild steel and medium tensile steel bars and hard-drawn steel wire for concrete reinforcement shall conform to IS: 432. Cold twisted steel bars shall conform to IS: 1786. Hand drawn steel wire fabric shall conform to IS: 1566. Hexagonal wire netting shall conform to IS: 3150. All steel bars including and above 10 mm diameter shall be of tested quality. All wire netting shall be galvanized.

Reinforcement bars shall be stored off the ground and under cover if so desired by the Engineer. If necessary, a coat of cement wash shall be given to the bars to guard against rusting.

3.00.00 INSTALLATION

3:01.00 Soling

3.01.01 Brick Soling

The ground shall be dressed, consolidated by ramming, or by light rolling and a 12 mm thick cushion of sand laid. On the sand cushion the bricks shall be laid with fine

joints and placed firmly in position by hammering with wooden mallet. The surface shall be free from undulations. The 'frog' side shall be on the underside. The joints shall be broken the in all direction and bricks cut as required. The pattern of laying and number of layers shall be as per Schedule of item. Orientation shall be as desired by the Engineer. After laying of each layer of bricks sand shall be spread over and worked into the joints to pack the bricks tight.

3.01.02 Stone Soling

The stones for soling shall be selected on the basis of thickness of soling specified in the Schedule of Items. The larger stones shall be laid and the gaps filled by smaller stones. The interstices shall then be firmly packed with sand by flooding with water.

3.02.00 Brick-on-Edge

Excavation shall be done close to the brick dimensions and in perfect alignment. Bricks shall be firmly placed by hammering with wooden mallets and sides and joints packed firmly with earth so that the edging is not disturbed easily. Alignment and level shall be acceptable to the Engineer.

3.03.00 Masonry

3.03.01 General

All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings.

3.03.02 Cement Mortar

Cement mortar shall be prepared with materials specified in clause 2.00.00. Sand for masonry mortar shall conform to IS: 2116. Cement and sand in the specified proportion shall be mixed dry thoroughly and minimum water added to attain required workability.

Surplus mortar droppings from masonry, if received on surface free from dirt may be mixed with fresh mortar if permitted by the Engineer who may direct addition of additional cement without any extra payment. No mortar, which has stood for more than half an hour, shall be used.

3.03.03 Brick Masonry

Bricks shall be soaked by submergence in clean water for at least two hours in approved vats before use. Bricks shall be laid in English bond unless specified

otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next bricks is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provide bond for plaster or pointing.

Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickworks two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.

3.03.04 Exposed Brickwork

Brickwork in superstructures, which is not covered by plaster, shall be as shown on drawing and executed by specially skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformity of brick courses. Masons must check workmanship frequently with plumb, spirit level, rule, and string. All brickwork shall be cleaned at the end of days work. If face bricks are specified, the brickwork shall be in composite bricks, with face bricks on the exposed face and balance in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed face shall be specially selected from routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean, and pointed as specified. Where face bricks are used carborandum stone shall be used for rubbing down.

3.03.05 Reinforced Brickworks

Reinforcements shall be as specified. All reinforcements shall be thoroughly cleaned and fully embedded in mortar. Where M.S. bars are used as reinforcement, these shall be lapped with dowels if left in R.C. columns or welded to steel stanchions.

3.03.06 Stone Masonry

Stones shall be thoroughly soaked before laying. Stones shall be laid on their natural quarry beds. Individual stones shall be fitted with mallet and properly wedged to reduce thickness of mortar joints. Thickness of joint shall be not less than 8 mm and not greater than 25 mm. At least two stones shall run the full width of the wall for every square meter of surface area.

3.03.07 Exposed Stone work

Stonework, which is to be kept exposed, shall be as shown on approved drawing. It shall be executed by specially skilled mason. Stones used for exposed face shall be specially selected. All exposed stone faces shall be kept clean and free from mortar and pointed up neatly as the work proceeds in a manner called for in the drawings or instructions. A sample wall, 10 Sq.M. area shall be built and approved by the Engineer and all works shall match with this sample.

3.03.08 Composite Masonry

Where stonework facing with brick masonry backing is specified the bond between them shall be achieved by bond stones of dimensions and frequency as desired by the Engineer.

3.03.09 Expansion & Separation Joints

Location of joints shall strictly be as shown on drawings or as instructed by the Engineer. Expansion joints shall be as shown on drawings and specified. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall meet the approval of the Engineer.

Separation joints shall be with standard waterproof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer.

3.03.10 Mouldings, Cornices, Drip Course

These shall be made as shown in drawings. Bricks or stone shall be cut and dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with Carborundum stone.

3.03.11 Curing

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry weather at the end of days work top surface of masonry shall be kept wet by ponding.

3.03.12 Embedding of fixtures

All fixtures shall generally be embedded in mortar and masonry units shall be cut as required.

3.03.13 Encasing of Structural Steel

This shall be done by building masonry work round flanges, webs etc., and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be wrapped with chicken wire mesh when shown on drawings or instructed by the Engineer. The minimum lap in chicken wire mesh shall be 50 mm.

3.04.00 Damp Proof Course (DPC)

Unless otherwise specified Damp-proof course shall be 40 mm thick 'artificial stone' in proportion 1:1½:3 cement sand stone-chips (10 mm down) with admixture of a waterproofing compound as approved by the Engineer. The percentage of admixture shall be as per manufacturer's specifications but not less than 2% by weight of cement. The top surface shall be double chequered and cured by ponding for seven days.

3.05.00 Damp Proof Membrane

Damp proof treatment using fibre or hessian base bitumen felt shall be 6, 8 or 10 course treatment as specified in IS: 1609. The number of courses shall be as shown as drawings or as specified. Sequence of work shall be as directed by the Engineer. Extreme care shall be taken to prevent damage to felt during and after laying. The Contractor shall be obliged, at his own expense, to rectify any leakage appearing within 5 years of installation by removing and renewing the coats at the point of leakage.

Where shown on drawing, damp proof membrane with one layer bitumen paper or one layer alkathene sheet shall be laid with minimum 150 mm lap under slabs on grade.

3.05.00 Plinth Protection

Plinth of buildings shall be protected with brick-on-edge paving of minimum 750mm width unless otherwise shown on the drawings. The treatment shall consist of laying bricks in cement mortar 1:6 (1 cement: 6 sand) over a 75mm thick bed of dry graded brick aggregate, 40mm nominal size, grouted with sand. The top shall be finished with 1:2 cement mortar pointing (1 cement: 2 sand). Plinth protection shall be laid with a minimum outward slope of 1 in 50. The brick aggregate shall be well graded, broken from well burnt or slightly overbumt and dense brickbats. It shall be homogeneous in texture, roughly cubical in shape, clean and free from dirt or any other foreign matter.

The ground shall first be prepared to the required slope around the building. The high portions of the ground should be cut down; hollows and depressions filled up to the required level from the excavated earth and rammed so as to give uniform outward slope. The bed shall be watered and rammed with heavy iron square rammers. Surplus

earth, if any, shall be disposed off beyond a lead of 50m or as directed by the Engineer.

Over this, 75mm thick bed of aggregate of 40mm nominal size, shall be laid with a minimum outward slope of 1 in 50. Aggregates shall be carefully laid and packed, bigger sized being placed at the bottom. The brick aggregates shall be consolidated dry with heavy iron rammers.

The aggregates shall then be grouted evenly with sand at the rate of 0.6 cubic metre per square metre area, adequately watered to ensure filling of voids by sand and again rammed with heavy iron rammers. The finished surface shall give uniform appearance. After the subgrade has been compacted thoroughly, brick flooring with bricks of specified strength in cement mortar 1:6 (1 cement: 6 sand) shall be laid.

The bricks shall be laid on edge in Diagonal/Herring Bone Bond or other paftem as specified or as directed by the Engineer. Bricks shall be laid on 12mm thick mortar bed and each brick shall be properly bedded and set home by gentle tapping with handle of trowel or wooden mallet. Its inside face shall be buttered with mortar before the next brick is laid and pressed against it. On completion of the portion of flooring, the vertical joints shall be fully filled from the top with mortar. The surface shall present a true plain surface with the required slope.

The pointing shall be done in cement mortar 1:2 (1 cement: 2 sand). The mortar shall be pressed into the joints and shall be finished off flush and level with the edges of the bricks so as give a smooth appearance. The edges shall be neatly trimmed with a trowel and a straight edge. The mortar shall not spread over surface of the masonry.

Brick flooring & pointing shall be kept wet for a minimum period of seven days. These shall be protected from rain by suitable covering when the mortar is green.

4.00.00 I.S. CODES

Some of the important relevant codes for this section are:

IS: 1127: Recommendations for dimensions and workmanship of natural building stones for masonry work.

IS: 1597: Code of Practice for Construction of stone Masonry.

IS: 1609: Code of Practice for laying Damp proof treatment using bitumen felts.

IS: 2212: Code of Practice for Brickwork.

IS: 2250: Code of Practice for preparation and use of masonry Mortar.

IS: 5134: Bitumen Impregnated Paper & Board.

IS: 12894: Pulverized Fuel Ash-Lime Bricks - Specification

IS: 13757: Specification for burnt clay fly ash building bricks

5.00.00 RATES AND MEASUREMENTS

5.01.00 Rates

Unit rate for masonry work shall include the following:

a) Raking out joints for plastering or pointing or finishing the joint flush as the work proceeds.

b) Preparing top sand sides of existing wall for joining old with new work.

c) Providing, dismantling and removing the scaffolding.

Unit rate for DPC shall be inclusive of formwork and bitumen painting.

5.02.00 Measurement

Brickwork in wall of half brick thickness shall be measured separately in Sqm stating the wall thickness and more than half brick thickness shall be measured by volume. Plaster thickness shall not be considered for computation of volume.

Masonry work in sub structure and super structure shall be measured separately, unless otherwise specified in the Schedule of items.

No deductions shall be made and no extra payment shall be made for following:

a) Opening upto 0.1 Sqm each in area. In calculating the area of the opening lintels or sills shall be included along with the size of the opening.

b) Drainage holes and recesses for cement blocks to embed holdfasts for doors, windows etc.

c) Pipe and fixtures upto 300mm dia. and nothing extra shall be paid for the mortar used for fixing.

Reinforcement in masonry work shall be paid separately under respective items.

Damp proof course shall be measured in Sqm. No deduction shall be made and no extra shall be paid for opening upto 0.1 Sqm in area.

Plinth protection shall be measured under respective item of works executed required for completion of the work as specified.

SECTION - D

SUB-SECTION – D10

FINISH TO MASONRY AND CONCRETE

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	INSTALLATION
3.00.00	ACCEPTANCE CRITERIA
4.00.00	I.S. CODE
5.00.0	RATES AND MEASUREMENTS

FINISH TO MASONRY AND CONCRETE

1.00.00 SCOPE

This Section covers finishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of finishing items for masonry and concrete. This shall also include the work to be done to make the surface suitable for receiving the finishing treatment.

Before commencing finishing items the Contractor shall obtain the approval of the Engineer regarding the scheduling of work to minimize damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

2.00.01 INSTALLATION

2.01.00 Preparation of Surface

All joints in masonry walls shall be raked out to a depth of at least 10 mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be rushed down with stiff wire brush to remove all loose dust from joints and thoroughly, washed with water. All laitance shall be removed from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess of water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base in the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval of the Engineer shall be taken as to the acceptability of the base.

2.02.00 PLASTERING

2.02.01 Mortar

Mortar for plastering shall be as specified.
For sand cement plaster, sand and cement in the specified proportion shall be mixed dry, on a watertight platform and minimum water added to achieve working consistency. The sand for plaster shall conform to IS: 1542.

No plaster, which has stood for more than half an hour, shall be used; plaster that shows tendency to become dry before this time shall have water added to it.

2.02.02 Application of Plaster

Plaster, when more than 12 mm thick, shall be applied in two coats a base coat followed by the finishing coat. Thickness of the base coat shall be sufficient to fill up all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The lower coat shall be thicker than the upper coat; the overall thickness of the coats shall not be less than the minimum thickness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than 'applied by trowel'.

To ensure even thickness and true surface, patches of plaster about 100 mm to 150 mm square or wooden screed 75 mm wide and of the thickness of the plaster, shall be fixed vertically about 2000 mm to 3000 mm apart, to act as gauges. The finished wall surface shall be true to plumb, and the Contractor shall, without any extra cost to the Owner, make up any irregularity in the brickwork with plaster.

All vertical edges of brick pillars, doorjambs etc. shall be chamfered or rounded off as directed by the Engineer. All drips, grooves, mouldings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.

2.02.03 Finish

Generally, the standard finish shall be used unless otherwise Shown on drawing or directed by the engineer. Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the engineer regarding the texture, color and finish.

a) Standard Finish

Wherever punning is indicated, the interior plaster shall be finished rough; otherwise the interior plaster shall generally be finished to a smooth surface. The exterior surface shall generally be finished with a wooden float.

b) Neat Cement Finish

Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a paste of neat cement at the rate of one (1) kg. per Sq.M. and rubbed smooth with a trowel.

c) Coloured Plaster Finish

This shall be done in the same way as specified in Clause 2.02.02 but using Coloured cement in place of ordinary cement. When coloured plastering is specified in more than one coat, the topcoat only shall be made with coloured cement.

Coloured cement shall be either ready mixed material or may be obtained by mixing pigments and cement at site, as approved by the Engineer. The pigments to be mixed with cement shall conform to Appendix-A of IS: 2114 latest editions.

Samples of colouring material shall be submitted to the engineer for approval and material procured, shall conform in all respects to the approved samples, which shall remain with the Engineer. All coloured cement and/or pigments shall be stored in an approved manner in order to prevent deteriorations.

d) Pebble-dash Finish

Mortar of required thickness consisting of 1 part cement and 4 parts sand by volume shall be applied in the usual manner as described under plastering Clause 2.02.02. While the mortar is still plastic small pebbles or crushed stone of size generally from 10mm to 20mm as approved by the Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wood float or the flat end of oil a trowel, in order to ensure satisfactory bond between the dashing and the mortar.

e) Rough-cast Finish

A wet plastic mix of 3 parts coloured cement 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6 mm to 12 as approved by the Engineer) shall be thrown on to the wall by means of a plaster's trowel and left in the rough condition.

f) Scraped Finish
Ordinary plaster as described under Clause 2.02.02 after being leveled and allowed to stiffen for a few hours, shall be scraped with a steel straight edge to remove the surface skin. The pattern shall be as approved by the Engineer.

g) Textured Finish

Mortar consisting of 1 part cement and 3 parts sand by volume shall be applied in a manner as specified under "Plastering" Clause 2.2.2 Ornamental treatments in the form of horizontal or vertical rib texture fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer.

h) Sand Faced Plaster

The plaster shall be applied in 2 coats. The first coat or the scratch coat should be approximately 14mm and shall be continuously carried out without break to the full length of wall or natural breaking points such as doors, windows, etc. The scratch coat shall be dashed on the prepared surface with heavy pressure, brought to true and even surface and then lightly roughened by cross scratch lines, to provide bond for the finishing coat. The mortar proportion for this scratch coat shall be as specified in the respective item or work. The scratch coat shall be cured for at least 7 days & then allowed to dry. The second coat shall be 6mm thick and it shall not be applied until at least 10 days have elapsed after the application of scratch coat. Before application of the second coat, the scratch coat shall be evenly damped. This coat shall be applied from top to bottom in one operation & without joints; finish shall be straight, true, & even. The mortar of this coat shall be as specified under the respective item of work. White sand for finish shall be used for the second coat & for finishing work. Sand for finish shall be of even coarse size & shall be dashed on the surface & sponged.

2.02.04 Curing

All plastered surfaces after laying shall be watered, for a minimum period of seven days, by an approved method, and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence, as soon as the plaster has hardened sufficiently and not susceptible to damage. Each individual coat of plaster shall be kept damp continuously, for at least two days, and then dried thoroughly, before applying the next coat.

2.03.00 Pointing to masonry

All Joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1 part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finishes with suitably tools to shape as shown on the drawings. Any surplus mortar shall be scalped off the wall face leaving the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.04.00 Plaster with Metal Lath

The supports, hangers, brackets, cleats etc. shall be as shown on drawings and/or as approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection.

The metal lath shall be expanded metal, with 12 mm x 38 mm mesh, 16 thick and 3 mm wide strands. Side laps shall be minimum 12 mm and end laps 25 mm minimum. The plastering shall be minimum 20 mm thick measured from the back of lath and applied in two-layers. The mortar for plastering shall consist of 1 part cement and 4 parts sand by volume mixed as specified in plastering, Clause 2.02.01. The application, finish etc. shall be as specified under relevant clause above. Where called for a 2 mm Plaster of Paris punting shall be applied over plaster as a finishing coat to give perfectly smooth and even finish.

2.05.00 Lime Punning

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, strained and aged, mixed with 1 part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and more than 3 mm. The plastered surface shall be saturated with water before application of the lime punning. The punting shall be applied by skilled workman and given a smooth and ever finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

2.06.00 Plaster of Paris Punning

Plastered surfaces, where specified shall be finished with Plaster-of-Paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Sq.M. areas and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

2.07.00 Stone Facing

Stone facing where specified shall be done as shown on design drawings and approved shop drawings. The stone shall be as specified on drawings. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall submit three copies of shop drawings for the Engineer's approval before commencing the work.

The thickness of facing stone shall be not less than 25 mm unless otherwise specified on drawings.

The stone slabs shall be cut and finished to sizes as per pattern shown on drawings. They shall be fastened to wall with suitable non-corrodible anchorage as approved by the Engineer. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanized (weight of zinc coating shall. not be less than 700 gms per square meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1 part cement and 3 parts of sand by volume. After the mortar is set and cured for at least four days, the exposed surface shall be rubbed and polished as approved by the Engineer.

The completed surface shall be neat, or uniform texture and acceptable to the Engineer.

Where pointing is specified on drawings it shall be done by mortar as specified on drawings.

3.00.00 ACCEPTANCE CRITERIA

Finish to masonry and concrete shall fully comply with the Specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specification or as shown on drawings.

4.00.00 I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 1661: Code practice for cement and cement-lime plaster finish on wall & ceilings.

IS: 4101: code of practice for external facings and veneers.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall also include providing, dismantling and removing of scaffolding, surface preparation, curing and all type of surface, shapes/ profiles and at all elevations.

5.02.00 Measurement

All plastering shall be measured net (on surface area on which it is applied) in Sqm. Plaster work shall be classified according to the type used and shall be measured separately. Plaster on ceiling and walls shall be measured separately. Soffits of stairs shall measured as plastering on ceiling.

No deduction shall be made for opening not exceeding 0.5 Sqm and for ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sills of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for opening but jams, soffits, and reveals shall be measured and paid for.

SECTION - D

SUB-SECTION – D11

PAINTING, WHITEWASHING, POLISHING

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	INSTALLATION
3.00.00	ACCEPTANCE CRITERIA AND TESTING
4.00.00	I.S. CODES AND STANDARDS
5.00.00	RATES AND MEASUREMENTS

PAINTING, WHITE WASHING, POLISHING, ETC.

1.00.00 SCOPE

This section covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces of wood work, masonry, concrete plastering, plaster of paris, false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items.

Copper, bronze, chromium plate, Nickel, stainless steel and aluminium shall generally not be painted or finished except if otherwise specified.

Before commencing painting, the Contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage; disfiguration or staining to work of other trades or other installations.

2.00.00 Installation

2.00.01 Materials

Materials shall be highest grade products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible and paint of one shade is obtained from the same manufacturing batch. Each and every supply of primer, finish paint etc. shall be accompanied by manufacturer’s test certificate. All paint shall be subject to analysis from random samples taken at site from painters bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finished coats to be applied.

All unspecified materials such as snellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognized manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.

a) White Wash/Colour Wash

Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the engineer, and shall conform to IS: 712 latest editions. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 grams of gum to 6 litres of white wash water and a little of indigo or synthetic ultramarine blue shall be added to the lime. Mineral colour not affected by lime shall be added to white wash to get the required tint/shade approved by the Engineer.

b) Dry distemper

Shall be made from suitable pigments, extenders, lime proof tinters, water-soluble binders etc. and share conform to IS: 427. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacture. Only sufficient quantity of distemper required for a day's work shall be prepared.

c) Oil Bound Washable Distemper

Shall be of oil emulsion type containing suitable preservatives and shall conform to IS: 428. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for a day's work shall be prepared.

d) Waterproof Cement Paint

Shall be made from best quality white cement and lime resistant colours with accelerators, waterproofing agents and fungicides. The paint shall conform to IS: 5410.

e) Acrylic based weather coat paint

Providing and applying two or more coats of **Acrylic based weather coat paint** of approved brand and manufacture and required shade over one coat of primer after necessary cleaning/ washing, preparing the surface using coir brush/ wire brush, sand paper, including filling of cracks with putty wherever required etc. all complete to give smooth, hard, durable & glossy finish over a coat of primer over prepared plaster surface as per manufacturers guidelines. The final finished coating shall be fungus resistant, UV resistant, water repellent and extremely durable with colour fastness as per specification.

f) Acrylic Emulsion Paint

Shall be water-based acrylic copolymer emulsion with rutile titanium dioxide and other selected pigments and fungicide conforming to IS: 5411 (Part-1). It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, shall be able to withstand washing with mild soap and water without any deterioration in colour, or without showing flaking, blistering, or peeling.

g) Acrylic Distemper

Two or more coats of **acrylic distemper o**f approved brand and manufacture to give an even shade including a priming coat with distemper primer complete.

h) Acid/Alkali Resistant Paint

Providing and applying 2 or more coats of **acid/alkali resistant paint** of approved brand and colour to floors, walls and ceiling including preparation of surface to receive paint, providing and applying bitumen primer confirming to IS 158 complete all as per manufacturer's recommendations and as approved by engineer, at all heights above or below grade level, complete as per specifications.

i) Fire Resistant Transparent Paint

Two or more coats of **fire resistant transparent paint** as per IS 162 on all woodwork over French polish as per IS 348 or flat oil paint as per IS 137 of approved grade and manufacture to give an even shade as per specifications.

j) Anti-Corrosive Bitumastic paint

Two or more coats of black **anti-corrosive bitumastic** painting of approved brand and manufacture to give an even shade complete.
Bitumen paint (black bituminous anti-corrosive paint)
Bitumen based anti-corrosive paint conforming to IS: 158 shall be used.

k) Resin Bonded Granular Textured

Providing and applying **resin bonded granular textured finish, for external applications** shall consist of crushed stone/quartz chips of .5 mm to 2.5 mm size and of approved natural colour/shade and bonded with synthetic resins, adhesives and additives altogether in a single pack mix, applied on cured and dried plaster surface with a dry film thickness of minimum 2 mm. The final finish shall have UV resistance, fungus, bacterial resistance properties all complete with grooves filled with poly

sulphide sealant of matching colour and shade as per specification/drawing/approval of engineer in charge.

l) Epoxy Paint

Providing and applying ready made **Epoxy Paint** over areas other than steel structure with suitable pigments of approved shade as per specification and direction of Engineer. The epoxy paint shall be a two pack material and shall be resistant to water, splash, spillage & acidic environment. The epoxy paint coating shall be of 150micron thickness over epoxy primer.

m) Synthetic plaster for external applications

Providing and applying **Synthetic plaster for external applications** composed of synthetic fibre and petroleum based chemical similar to RENOVO or equivalent and of approved natural color/shade applied on cured and dried plaster surface. The final finish Paint shall have UV resistance, fungus, bacterial resistance properties all complete with grooves filled with poly sulphide sealant of matching color and shade as per specification/drawing/approval of engineer in charge.

n) Synthetic Enamel Paint

Shall be made from synthetic resins and drying oil with rutile titanium dioxide and other selected pigments to give a smooth, hard, durable and glossy finish to all exterior and resist interior surfaces. White and pastel shades shall not yellowing and darkening with aging. The paint shall conform to IS: 2932 and IS: 2933.

o) Aluminium Paint

Shall be in two pack containers and shall resist weathering. The paint shall conform to IS: 2339.

p) Varnishing

Shall be best quality alkyd varnish suitable for brushing over the tint of paint or light natural wood and shall not darken or yellow with age.

q) French Polish

Shall be made from best quality shellac, denatured spirit and other suitable alcohol soluble ingredients and made by a well known approved manufacturer. The material shall conform to IS: 348.

French polish shall not be used on bare wood it shall only be used as finishing coat

on wood after the woods pretreated with a liquid wood filler conforming to IS: 345 is applied and rubbed out.

2.00.02 Storage

The Contractor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement, & stains. Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the contractor to prevent fire.

2.01.00 Preparation of surface

Before starting the work the Contractor shall obtain the approval of the Engineer regarding the soundness & readiness of the surface to be painted on.

2.01.02 Wood

All surfaces shall be free from, dirt and loose or peeling paints. The surface shall be rubbed down smooth. All nails & screws shall be sunk below the surface and filled with putty after applying an under coat. Small knots that do not justify cutting and sap streaks shall be covered with minimum 2 coats of pure shellace coating applied thinly & extended 25 mm beyond the area. All large, loose, or resinous knots shall be removed and filled with sound wood. All work shall be done as per IS: 2338.

2.01.02 Masonry, Concrete, and Plastered Surface

Surface shall be free from all oil, grease, efflorescence, mildew, loose paint, or other foreign and loose materials. Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of resurfacing may lead to the finishing paint being different in shade from, the original surfaces, the resurfaces area shall be treated with minimum one coat of cement primer, which should be continued to the surrounding area for a distance of minimum 100 mm.

Surface with **Mildew or Efflorescence** shall be treated as below:

All mildewed surfaces shall be treated with an approved fungicide such as ammoniacal wash consisting of 7g of copper carbonate dissolved in 80ml liquor ammonia and diluted to water, or 2.5 percent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied.

2.01.03 Metal

The surface preparation shall be done in accordance with IS:1477(Part-1) 'Code of practice for painting of ferrous metals in building' and as directed by Engineer. All metal surfaces shall be absolutely clean, dry, and free from rust, scales, weld slag, flux deposit, wax, grease, dried soap films, foreign matters like cement mortar etc and free from existing loose red oxide zinc chromate primer and should be removed by means of wire brushes, hand scrappers, sand paper, emery cloth, emery papers, or by mechanical power tools etc. or as directed by Engineer. For exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanized iron surfaces shall be pretreated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat. The actual painting work should be commenced only after obtaining clearance from the Engineer regarding proper cleaning of the surface.

2.02.00 Application

2.02.01 General

The method of application shall be as recommended by the manufacturer. In case of selection of special shades and colour (not available in standard shades) the Contractor shall mix different shades and prepare test panels of minimum size 1 meter square as per instruction of the Engineer and obtain his approval prior of application of finishing paints.

Proper tools and implements shall be used. Scaffoldings used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor notes.

Painting shall be done by skilled labours in a workmanlike manner. All materials shall be evenly applied so as to free of sags, runs, crawls, or other defects. All coats shall be of proper consistency. In case of application by brush, no brush marks shall be visible. The brushes shall be clean and in good condition before application of paint.

All priming undercoat for painting shall be applied by brush only, and rollers spray equipments etc. shall not be used.

No work shall be done under conditions that are unsuitable production of good results. No painting shall be done when plastering is in progress or is drying. Application of paint, which seals the surfaces to moisture shall only be done after the moisture on and below the surface has dried out.

All coats shall be thoroughly dry before succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface is not covered

property by applying the specified number of coats, further coats shall be applied by the Contractor when so desired by the Engineer.

All primers and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.

Painting on ferrous metal surface shall, be done as per IS: 1477 (Part I & 2). The total dry thickness of film should not be less than 120 Micron.

2.02.02 White Washing

The surface where white washing is to be applied shall be cleared of all loose materials and dirt. All holes and irregularities of the surface shall be filled up with lime putty and shall be allowed to dry up before white washing.

One coat of whitewash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat shall be applied and in case the Engineer feels that one or more coats are required the Contractor shall do so without any extra cost to the Owner. No brush marks shall show on the finished surface.

2.02.03 Dry Distemper

New plastered surface shall be allowed to dry for at least two months. New lime or lime cement plastered surface shall be washed with a solution of 1 part Vinegar to 12 parts water or 1:50 sulphuric acid solution and for 24 hours after which the wall shall be thoroughly washed with clean water. For cement-plastered surface, the surface shall be washed with solution of 100 gms. of zinc sulphate to 1 litre of water and allowed to dry.

Dry distempering shall be done as per manufacturers instruction. In applying the distempers the brush, should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long, otherwise brush marks may result.

2.02.04 Oil bound washable distemper

The distemper shall be applied after surface is primed with an alkali resistant primer, and followed by minimum two coats of oil bound washable distemper all as per manufacturer's instruction.

2.02.05 Waterproof Cement Paint

Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours) the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

2.02.06 Acrylic Emulsion Paint

Paint shall be applied after providing one coat of cement primer solvent of approved quality and primer shall be conform to IS: 109. Lime gauged cement plastered surfaces shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer. Painting shall be done strictly as per manufacturer's specification.

2.02.07 Synthetic Enamel Paint

Shall be applied on properly primered surface. Subsequential coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coats.

2.02.08 Aluminium Paint

The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacturer's direction. When more than one coat of paint is required or indicated, the next coat shall only be applied after the previous coat become hard dry.

2.02.09 Clear Synthetic Varnish

The Varnish shall be applied on wood surface after (a) filling, (b) staining & (c) sealing operations are carried out. The application of a combination of filler and stain shall not be permitted.

For the finishing coats of varnish, the surface shall be allowed to dry and be rubbed down lightly, wiped off and allowed to dry. Careful attention to cleanliness is required for varnishing. All dust and dirt shall be removed from the surface as well as from the neighbourhood. Damp atmosphere and draughts shall be avoided, and exposure to extreme heat or cold & dampness shall not be allowed.

The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with light strokes to avoid frothing. It shall be allowed to flow on white

the next section is being laid on excess varnish shall then be scrapped off the brush and the first section be crossed, recrossed and then laid off lightly. The varnish once it has begun to set shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh.

The varnish shall be minimum of two coats, with the first coat being a flatting varnish. This shall be allowed to dry hard and be flatted down, before applying the next coat. Sufficient time must be allowed between coats to get a hard dry surface before next coat is applied. All work shall be as per relevant IS Code.

2.02.10 French polish

All unevenness of the surface shall be rubbed down to smoothness with sand paper and the surface shall well dusted .The pores in the shall be filled up with a paste of whitening in water or methylated spirit with a suitable pigment like burnt siemme or umber.

After application of the filler paste, the French polish shall be applied with a pad of woollen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles so that the polish is sparingly but uniformly applied over the entire area to give an even surface. A trace of linseed oil may be used on the pad for case of application. The surface shall be allowed to dry before further coats are applied in the same manner. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly damped with methylated spirit, and rubbed lightly and quickly with circular motions to leave the finished surface with a uniform texture and high gloss.

2.02.11 Chemical Resistant Paint

For chemical resistant paints, epoxy, chlorinated rubber, or vinyl butryl paint system shall be used. Manufacturer's recommendation shall be followed regarding the paint system, exposed to moderately to severe corrosive condition and subject to acid/alkali spillage & fumes, shall be followed.

2.03.00 Protection

Furniture and other movable objects, equipment, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipment shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.

2.04.00 Cleaning up

In addition to provisions in general conditions the Contractor shall, upon completion of painting etc. remove all marks and make good surfaces, where paint has been splashed or splattered, including all equipment, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.

3.00.00 ACCEPTANCE CRITERIA AND TESTING

a) All painted surfaces shall be uniform and pleasing in appearance.

b) All varnished surfaces shall be of uniform texture and high glossy finish.

c) The colour, texture etc. shall match exactly with those of approved samples.

d) All stains, splashes, and splatters of paints and varnishes shall be removed from surrounding surfaces.

Testing

a) As, each part of the work is under progress, i.e. preparation of surface, providing primer, providing different coats of finishing paints, it shall be passed by the Engineer. Variation from the drawings or specification or standard etc. shall not be accepted. The Contractor shall ascertain from the Engineer as to which parts will be inspected and passed from time to time. The Contractor shall provide all necessary arrangement for inspection of the painting work during its different working phase. The Contractor shall provide necessary scaffolding, approach for inspection of the above as per direction and satisfaction of the Engineer. All the necessary cost for scaffolding, approach, platform, lighting arrangement testing and inspection shall be borne by the Contractor. Such inspection and testing will not, however, exonerate the Contractor from his responsibilities for proper workmanship, material etc.

b) The Contractor shall carry out all sampling and necessary testing in accordance with the relevant Indian Standards and shall conduct such tests as called for by the Engineer. Where no specific testing procedure is mentioned in the relevant codes, the tests shall be carried out as per the prevalent accepted Engineering practice as per the direction of the Engineer. Tests shall be done in a laboratory, approved by the Engineer, and cost of testing shall be borne by the contractor.

c) Material/workmanship unsuitable for acceptance shall he removed and replaced by the Contractor. The work shall be redone as per Specification of the contract and direction of the Engineer without extra cost to owner.

4.00.00 I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 348	Specification for French polish
IS: 427	Specification for Distemper, dry colour as required.
IS: 428	Specification for Distemper oil emulsion, colour as required.
IS: 1477 (I & II)	Code of Practice for painting of ferrous metal in buildings.
IS: 2338 (I & II)	Code of Practice for finishing of wood and wood based materials.
IS: 2339	Specification for Aluminium, Paints for general purposes in dual containers.
IS: 2395	Code of Practice for painting concrete, masonry, and Plaster surface.
IS: 2932	Specification for enamel, exterior type-1.
IS: 5410	Specification for cement paint, colour as required.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be unit rates for complete items described in the “Schedule of Items”.

Rate shall include cleaning, preparation of surface, supply and application of primer, painting and providing all protection and scaffolding required at site.

5.02.00 Measurements

Painting over the concrete/masonry/wooden surface shall be measured net (on the surface area on which it is applied) in Sqm.

No deduction shall be made for opening not exceeding 0.5 Sqm and ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sill of these

openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for opening but jams, soffits, and reveals shall be measured and paid for.

Corrugated surfaces shall be measured flat and measured area shall be increased by 15%.

Painting of structural steel works shall be measured in M.T. unless specified otherwise.

SECTION - D

SUB-SECTION – D12

FLOOR FINISH AND ALLIED WORKS

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	INSTALLATION
3.00.00	ACCEPTANCE CRITERIA
4.00.00	I.S. CODES
5.00.00	RATES AND MEASUREMENTS

FLOOR FINISH AND ALLIED WORKS

1.00.0 SCOPE

This section covers furnishing, installation, finishing, curing, testing, protection, maintenance till handing over various types of floor finishes, and allied items of work as listed below

a) In Situ Finishes

i) Integral finish to concrete base

ii) Terrazzo finish

iii) Granolithic finishes

iv) Patent Stone

v) Metallic Hardener like “Ironte”/Hardonate Finish

vi) Mastic Asphalt finishes

vii) Chemical Resistant finish

b) Tiled Finishes

i) Terrazzo tile

ii) Chequered tile

iii) Glazed tile

iv) Vitrified Tiles Finish

v) Tesserae (Mosaic etc.)

vi) Chemical Resistant

vii) Rubber, Vinyl etc.

viii) Stone Slab including Kota Stone.

1.01.00 Base

The base to receive the finish is covered under other relevant specifications.

1.01.01 Sequence

Commencement, scheduling and sequence of the finishing works shall be planned in detail and must be specifically approved by the Engineer in view the activities of other agencies working in that area. However, the Contractor for the finishing items shall remain fully responsible for all normal precautions and vigilance to prevent any damages whatsoever till handing over.

2.00.00 INSTALLATION

2.00.01 Special Materials

Basic materials are covered elsewhere under the Specification. In general, all such materials shall be as per relevant Codes where available. In all cases these materials shall be of the best quality available indigenously unless specified otherwise.

The materials for finishing items must be procured from well-reputed specialized manufacturers and on the basis of approval of samples by the Engineer. The materials shall be ordered, procured and stored well in advance to avoid compulsion to use substandard items to maintain in the construction schedule.

2.00.02 Workmanship

Only workers specially experienced in particular items of finishing work shall be engaged, where such workers are not readily available, with the Engineer's permission, experienced supervisors recommended by the manufacturer shall be engaged. In particular cases where the Engineer so desires the Contractor shall get the finishing items installed by the manufacturer.

2.00.03 Preparation of the Base Surface

The surface to be treated shall be thoroughly examined by the Contractor. Any rectification necessary shall be brought to the notice of the Engineer and his approval shall be taken regarding method and extent of such rectification work.

For all types of flooring, skirting, dado and similar locations, the base to receive the finish shall be adequately roughened by chipping, raking out joints and cleaning thoroughly all dirts, grease etc. with water and hard brush and detergent if required, unless otherwise directed by the manufacturer of any special finishing materials or specifically indicated in this specification.

To prevent of water from the finishing treatment the base shall be thoroughly soaked with water and all excess water mopped up.
The surface shall be bone dry where adhesives are used for fixing the finishes.

Prior to commencement of actual finishing work the approval of the Engineer shall be taken as per the acceptability of the surface.

2.01.00 In Situ Finishes

2.01.01 Integral Finish To Concrete Base

While the surface of the concrete laid as per specification for 'Cement Concrete' has been fully compacted and levelled but the concrete is still `green' thick slurry, made with neat cement shall be applied evenly and worked in with iron floats. When the slurry starts to set it shall be pressed with iron floats to have a firm compact smooth surface without trowel mark or undulations. This finish shall be as thin as possible by using 2.2 kg. of cement per SqM. of area.

The surface shall be kept in shade for 24 hours and then cured for at least 7 days continuously by flooding with water. The surface shall not be subjected to any load or abrasion till 21 days after lying.

As desired by the Engineer the surface, while still 'green' shall be indented by pressing strings, the marking shall be of even depth, in straight lines and the panels shall be of uniform and symmetrical patterns.

2.01.02 Terrazzo Finish in Situ

It shall consist of an underbed and a topping laid over an already laid and matured concrete base.

a) Thickness

Unless otherwise specified the total thickness of the 'finish shall be minimum 40 mm for horizontal and 25 mm for vertical surface of which the topping shall be not less than 10 mm. While the topping shall be of uniform thickness the under bed may very in thickness to provide necessary slopes. The vertical surface shall project out 6 mm from the adjacent plaster or other finish. Necessary cutting into the surface receiving the finish shall be done to acc ate the specified thickness. All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.

b) Mix

i) Underbed

The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 parts cement, 1½ parts sand and 3 parts stone chips by volume. For vertical surfaces the mix shall consist of 1 part cement to 3 parts sand by volume. The sand shall be coarse. The stone chips shall be 10 mm down well graded. Only sufficient water to be added to give a workable consistency.

ii) Topping

The mix for the topping shall be composed of cement, colour Pigment, marble dust and marble chips. Proportions of the ingredients shall be such as to produce the terrazzo of colour texture and pattern approved by the Engineer. The cement shall be white or gray or a mixture of the two to which pigment shall be added to achieve the desired colour. To 3 parts of this mixture 1 part marble powder by volume shall be added and thoroughly mixed dry. To 1 part of this mix 1 to 1½ parts of marble chips by volume shall be added and thoroughly mixed dry again.

The pigment must be stable and nonfading. It must be very finely ground. The marble powder shall be from White marble and shall be finer than IS Seive No.: 30. The size of marble chips shall be between 1 mm to 20 mm. Sufficient quantity to cover each visible area shall be prepared in one lot to ensure uniform colour. Water to make it just workable shall be added to a quantity that can be used up immediately before it starts to set.

c) Laying

The underbed shall be laid in panels. The panels shall not be more than 5 Sq.M. in area of which no side shall be more than 2.5 M. long. For exposed locations the maximum area of a panel shall be 2.0 Sq.M. The panel shall be laid in alternate bays or chequered board pattern. No panel shall be cast in contact with another already laid until the latter has contracted to the full extent.

Dividing strips made of aluminium or glass shall be used for forming the panels. The strips shall exactly match the total depth of underbeds plus topping.

After laying, the underbed shall be levelled compacted and brought to proper grade with a screed or float. The topping shall be laid after about 24 hours while the underbed is still somewhat “green” but firm enough to receive the topping. A slurry of the mixture of cement and pigment already made shall be spread evenly and brushed in just before laying the topping. The topping shall be rolled f or horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water and to achieve a compact dense mass fully bonded with the

underbed. The surface of the topping shall be trowelled over, pressed and brought to a smooth dense surface showing a minimum 75% area covered by marble chips in a even pattern of distribution.

d) Curing

The surface shall be left for curing for about 12 to 18 hours and then cured by allowing water to stand on the surface or by covering with wet sack for four days.

e) Grinding and Polish

When the surface has sufficiently hardened it shall be watered and ground evenly with rapid cutting coarse grade (no.80) grit blocks, till the marble chips are exposed and the surface is smooth. Then the surface shall be thoroughly washed and cleaned. A grout with already prepared mixture of cement and pigment shall be applied to fill up all pinholes. The surface shall be cured for 7 days by keeping it moist and then ground with fine grit blocks (no.: 120). It shall again be cleaned with water, the slurry applied again to fill up any pinholes that might have appeared and allowed to be cured again for 5 days. Finally, the surface is ground a third time with very fine grit blocks (no.: 320) to get smooth surface without any pinhole. A suitable machine shall do the grinding. Where grinding machine can not be used hand grinding may be allowed when the first rubbing shall be with carborundum stone of coarse grade (no.:60), second rubbing with medium grade (no.: 80) and final rubbing and polishing with fine grade (no.: 120). The surface shall be cleaned with water, dried, and covered with soil free, clean sawdust if directed by the Engineer. The final polishing shall be postponed till before handing over if desired by the Engineer. Just before handing over the surface shall be dusted with oxalic acid at the rate of 0.33 gm. per. Sq.M., water sprinkled on to it and finished by buffing with felt or hessian bobs. The floor shall be cleaned with soft moist rag and dried. However, all excess wax polish to be wiped off and the surface to be left glossy, but not slippery.

2.01.03 Granolithic Finish

Granolithic finish shall either be laid monolithically over base concrete or separately over hardened base concrete.

a) Thickness

The finish shall be average 20 mm and minimum 12 mm thick, unless specified otherwise.

b) Mix

The mix shall consist of 1 part cement: 1 part coarse sand 2 parts coarse aggregate by volume. The coarse aggregate shall be very hard like granite and well graded between 6 mm and 12 mm. Minimum quantity of water to get workability shall be added.

c) Laying of Monolithic Topping

The concrete base shall be laid as per specification "Cement Concrete" and levelled upto the required grade. The form shall remain sufficiently protruding to take the finish.

Within about 3 hours of laying the base while it is still fully -green- the topping shall be laid evenly to proper thickness and grade. If considered necessary the surface ' of the base shall roughened by wire brushing. Unless manual operation is permitted by the Engineer, mechanical vibrators of suitable design shall be used to press the topping firmly and work vigorously and quickly secure full bond with concrete base.

The laitance brought to the surface during compression shall be removed carefully without disturbing the stone chips. The surface shall then the lightly trowelled to remove all, marks. When sufficiently set, hand trowelling shall be done to secure a smooth surface without disturbing the stone chips.

For large areas the laying shall be in panels of maximum 25 Sq.M. area. The panels shall be laid in chequered board pattern.

d) Laying of Topping Separately on Hardened Base

The base concrete shall be prepared as stated in clause 2.00.03 and a slurry of neat cement applied just prior to laying the granolithic concrete mix (1:1:2). The method of compaction etc. shall be same as for monolithic topping.

e) Curing

Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface had hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or pounding of water on the surface. The floor shall not be exposed to heavy traffic during this period.

f) Grinding

If grinding is specified, it shall start only after the finish has fully set. Clause 2.01.02 (e) shall be followed. However, the Engineer shall decide upon the ultimate polish required.

g) Finishing

Where specified, sodium, silicate or magnesium or zinc silico fluoride treatment shall be done. The number of coats to be applied shall be as per approved drawings or as instructed. The concentration and method of application of the solutions shall be as specified in IS: 5491.

2.01.04 Patent Stone

It shall consist of an underbed and a topping laid on an already laid and matured concrete base.

a) Thickness

The patent stone finish shall have thickness as stipulated under clause 2.01.02 (a) except that the topping shall be 12 mm thick.

b) Mix

i) Underbed

The mix shall be as stipulated under clause 2.01.02 (b).

ii) Topping

The mix for the topping shall consist of 1 part cement and 2 part stone aggregate 6mm nominal size by volume.

c) Laying

The Patent Stone finish including the underbed shall be laid in alternate bays or in Chequered board pattern. No panel shall be cast in contact with another already laid till the contraction of the latter has already taken place.

The maximum area of each panel shall be 3 Sq.M. of which no side shall be more than 2 M. long.

A cement grout shall be applied and worked into the surface to receive the finish; the underbed then laid, compacted, and leveled to proper grade with a screed or float. The topping shall be applied evenly on the underbed while it is not fully set but firm enough and rolled and pressed to get full bond. The topping shall be trowelled to a dense finish to the satisfaction of the Engineer. All trowel marks shall be mopped out with a soft cloth to give a clean smooth surface.

After the surface is sufficiently set, the finished floor shall be kept moist for 7 days for curing. If desired the finish shall be polished as directed by the Engineer.

2.01.05 Metallic Hardener Like 'Ironite'/ `Hardonate' Finish

This will consist of a topping (incorporating iron particles) to bond with concrete base while the latter is `green'.

a) Thickness

Unless otherwise specified the metallic hardener finish shall be of 12 mm depth.

b) Material

The hardening compound shall be uniformly graded iron particles free from non-ferrous metal impurities, oil, grease, sand soluble alkaline compounds or other injurious materials when desired by the engineer, actual samples shall be tested.

c) Mix

Proportion of the metallic hardener shall be as specified or as indicated by the manufacturer. However, in absence of any such direction 1 part metallic hardener shall be mixed dry, with 4 parts cement, by weight. To this mixture 6 mm nominal size stone chips shall be added in proportion of 1 part cement (mixed with hardener) to 2 parts of stone chips by volume and uniformly mixed. Minimum quantity of water shall be added to make it workable.

d) Laying

The concrete floor shall be laid as per specification 'Cement Concrete' and levelled upto required grade. The forms, if any, shall remain sufficiently projecting to make the finish. The surface shall be roughened by wire brash as soon as possible.

The finish shall be laid while the concrete underbed is still very `green' within about 3 hours of laying of the latter. The finish shall be of uniform thickness and even dense surface without trowel marks, pin holes etc. This topping layer shall be pressed firmly and worked vigoursly and quickly to secure full bond with the concrete base. Just when the initial set starts the surface shall be finished smoothened with steel trowel.

The finished floor shall be cured for 7 days by keeping it wet.

2.01.06 Mastic Asphalt Finish

This is a one-layer treatment on concrete or brick base.

a) Thickness

The thickness shall be as specified in the drawing.

b) Materials

Bitumen shall be industrial Bitumen of the grade 90/15 and 75/15 conforming to IS: 702.

Mineral filler shall be dry stone dust passing through 75 micron IS Sieve.

Fine aggregate shall be crushed and graded natural limestone or other hard work.

Coarse aggregate shall be crushed siliceous stone or other approved aggregate 6 mm stone chips shall be used for finish upto 20 mm thick & 10 mm chips for thicker finish.

c) Composition

Bitumen mastic shall conform IS: 1195 and shall be either brought to site in blocks weighing about 25 Kg or prepared at site. If brought in blocks, these shall be remelted in mechanically agitated mastic cookers and coarse aggregate, preferably preheated fed in successive portions until the complete change is thoroughly, and incorporated. At no stage during the remelting and mixing process, shall the temperature exceed 205°C.

d) Laying

The hot mastic shall be laid on dry base surface cleaned thoroughly by wire brushing and sweeping. The mastic shall be levelled and when cooled to some extent shall be finished with a wooden float with addition of small quantity of fine sand if required. No load shall be allowed till the finish has cooled to normal temperature.

The mastic shall be laid in suitable panels of about 1.5 Sq.M. in area each formed by formers. Succeeding panels shall be laid overlapping the finish panel so as to melt its edges and form a continuous finish without joint.

2.01.07 Chemical Resistant in Situ Finish

Chemical resistant in situ finish shall be as epoxy resin with suitable filler material over a primer. The minimum thickness shall be 6 mm. About its performance the Engineer shall have to be fully satisfied by test results and examination of similar treatment already in existence. The contractor shall get it done by a specialized Manufacturer and get guarantee of performance from the organization and pass it on to the Owner in addition to his own guarantee.

2.02.00 Tiled Finish

These shall include finish tiles, stone slabs, and similar manufactured or natural items over already laid and matured base of concrete or masonry by means of an underbed or an adhesive layer.

2.02.01 Terrazzo Tile Finish

The finish will consist of manufacture terrazzo and an underbed.

a) Thickness

The total thickness including the underbed shall be minimum 40 mm for floors 30 mm for walls unless otherwise specified.

The skirting, dado and similar vertical surfaces shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the tiled finish, to accommodate the specified thickness shall be done.

b) Tiles: Terrazzo

The tiles shall, unless specifically permitted in special cases be machine made under quality control in a shop. The tile shall be pressed hydraulically to a minimum of 140 Kg. per Sq.cm.

Each tile shall bear on its back permanent and legible trademark of the manufacturer. All angles of the tiles shall be right angles all arises sharp and true, colour and texture of the wearing face uniform throughout. Maximum tolerance allowance length and breadth shall be ± 1 mm and the thickness ± 3 mm. Face of the tile shall be plane, free from pinholes and other blemishes.

The tiles shall be composed of a backing and topping. The topping shall be of uniform thickness not less than 10 mm.

The total thickness including the topping shall be as specified but not less than 20 mm in any case.

The backing shall be composed of 1 part ordinary gray cement and 3 parts of stone chips by weight mixed with water.

The topping shall be as specified under clause 2.01.02 (b).

The tile shall be cured at the shop for at last 14 days before delivery to the site. First grinding shall be given to the tiles at the shop before delivery. Tiles shall be packed properly to prevent damage during transit and storage. The tiles must be carefully stored to prevent staining by damp, rust, oil, and grease or other chemicals.

Tiles made in each batch shall be kept and used separately so that colour of each area of the floor may remain uniform.

The manufacturer shall supply along with the tiles the grout mix containing cement and pigment in exact proportions as used in topping of the tiles. The containers for the grout mix shall be suitably marked to relate it to the particular type and batch of tiles.

c) Mix: Underbed

The underbed for floor and similar horizontal surfaces shall be 1 part lime putty: 1 part surkhi: 2 parts coarse sand by weight mixed with sufficient water to form a stiff workable mass. For skirting and dado and all vertical surfaces it shall be about 12 mm thick and composed of 1 part cement and 3 parts coarse sand by weight.

d) Laying

The underbed mortar shall be evenly spread and brought to proper grade and consolidated to a smooth surface. The surface shall be roughened for better bond. Before the underbed had time to set and while it is still fairly moist but firm, cement shall be hand dusted over it or a cement slurry applied and the tiles shall immediately be placed upon and firmly pressed by wooden mallet on to the underbed until it achieves the desired level. The tiles shall be kept soaked for about 10 minutes just before laying. The joints between tiles shall be as close as possible and not more than 1.5 mm wide.

Special care shall be taken to check the level of the surface and the lines of the joints frequently so that they are perfect.

When tiles are required to be cut to match the dimensions these shall be sawn and edges rubbed smooth. The location of cut tiles shall be planned in advance and approval of the Engineer taken.

At the junction of horizontal surface with vertical surface the tiles on the former shall enter at least 12 mm under the latter.

After fixing, the floor shall be kept moist and allowed to mature undisturbed for 7 days. Heavy traffic shall not be allowed.

If desired dividing strips as specified under Clause 2.01.02(c) may be used for dividing the work into suitable panels.

e) Grinding and Polishing

Procedure shall be same as Clause 2.01.02(e). Grinding shall not commence earlier than 14 days after laying of tiles.

2.02.02 Chequered Tile Finish

The finish shall consist of manufactured gray or coloured cement tiles or terrazzo tiles with chequered face and an underbed laid over concrete or brick surface.

a) Thickness

Thickness shall be same as in clause 2.02.01 (a).

b) Tiles: Chequered

The tiles shall have chequers not less than 2.5 cm. c/c and not more than 5 cm. c/c. Depth of grooves shall be not less than 5 mm. The grooves shall be uniform and straight.

The tiles shall conform to clause 2.02.01 (b) except that these may have the topping in terrazzo or plain gray cement or colour pigment added to cement.

c) Under-bed
As per clause 2.02.01 (c).

d) Laying
As per clause 2.02.01 (d).

e) Grinding and Polishing

As per clause 2.02.01 (e) except that the tiles shall be ground and polished by hand and after laying taking special care in polishing the grooves properly and uniformly.

2.02.03 Glazed Tiles Finish

This finish shall be composed of glazed earthenware tiles with an under bed laid over a concrete or masonry base.

a) Thickness

The total thickness shall be between 20mm and 25mm including the underbed.

The tile finish on vertical surface shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the finish, to accommodate the specified thickness shall be done.

b) Tiles: Glazed

The tiles shall be of earthenware, covered with glaze white or coloured, plain or with designs, of 150 mm x 150 mm nominal sizes and 5.5 mm to 6 mm on thick unless otherwise specified. The tolerance shall be ± 1.5 mm for length and breadth and ± 0.5 mm for thickness specials like internal and external angles; beads, covers, cornices, corner pieces etc. shall match. The top surface of the tiles shall be glazed with a gloss or matt, unfading stable finish as desired by the Engineer. The tiles shall be flat and true to shape. The colour shall be uniform and fractured section shall be fine grained in textures, dense and homogeneous. The tiles shall be strong and free from flaws like cracks, craze, specks, crawlings, etc. and other imperfections. The edge and the underside of the tiles shall be completely free from glaze and the underside shall have ribs or indentations for better anchorage with the fixing mortar.

The coloured tiles, when supplied, shall preferably come from one batch to avoid difference in colour.

c) Mix: Underbed

The mix for the underbed shall consist of 1 part cement and 3 parts coarse sand by weight mixed with sufficient water or any other mix if specified.

d) Laying
Same as clause 2.02.01 (d).

e) Finishing

The joints shall be cleaned and flush pointed with white cement and cured for 7 days by keeping it wet. The surface shall be cleaned with soap or suitable detergent, washed fully, and wiped with soft cloth to prevent scratching before handing over.

2.02.03 Vitrified Tiles Finish

Vitrified tile is a tile which has been processed in such a way that it has extremely low porosity (and water absorption) which make it stain resistant and very strong. Vitrified tiles have a water absorption of < 0.5%.thickness of tile as per manufacturer specification. This may be glazed or unglazed. Vitrified tiles are made by mixing silica and clay to form a non porous tile with glassy texture.

Vitrified tiles are resistant to chemicals, abrasion, fire & staining, acid resistance easy to maintain and ensures hygienic surroundings. Vitrified tiles have strength greater than 300Kg/square cm. Size : 600 MM X 600 MM.

a) Mix: Underbed

The mix for the underbed shall consist of 1 part cement and 3 parts coarse sand by weight mixed with sufficient water or any other mix if specified.

b) Laying
Same as clause 2.02.01 (d).

d) Finishing

The joints shall be cleaned and flush pointed with white cement and cured for 7 days by keeping it wet. The surface shall be cleaned with soap or suitable detergent, washed fully, and wiped with soft cloth to prevent scratching before handing over.

2.02.04 Tesserae Finish (Mosaic etc.)

This finish consists of manufactured vitreous, glass, ceramic or similar hard small pieces set in an underbed over a concrete or masonry surface, already laid.

a) Thickness

The total thickness including the underbed shall be between 16 mm & 25 mm.

b) Tesserae Finish

These shall usually be 6 mm thick small piece of ceramic vitreous china, tinted glass, or similar hard wearing, strong, and durable material in desired shapes and sizes and patterns.

The supply shall come in the desired pattern in full or sections conveniently for handling, stuck to pieces of strong thick paper on the surface to be exposed. The gum used for this purpose must be water soluble and non-staining. The sections shall be properly marked to avoid mistakes and master drawing shall be available at the site for guidance.

c) Mix: Underbed
Same as clause 2.02.03 (c)

d) Laying

The specification for laying if given by the manufacturer of the item shall be followed provided it is approved by the Engineer. Otherwise clause 2.02.03 (d) shall generally be followed. However, instead of gray cement the slurry shall be made with white cement to fix the panels. The paper-mounted patterns in sections shall be carefully placed and pressed in position true to lines and levels. Earliest possible the paper shall be peeled off and surface examined and cleaned, joints flush pointed with white cement and cured for 7 days by keeping it wet.

2.02.05 Chemical Resistant Tiled Finish

This shall include all verities of special tiles used for specific chemical resistance function and an underbed over already laid concrete or masonry.

a) Tiles

The chemical resistant tiles shall be of the best indigenous Manufacture unless otherwise specified and shall be resistant to the chemical (both acid and alkali). The tiles shall have straight edges, uniform thickness, plain surface, uniform nonfading colour, and textures.

Usually the chemical resistant tiles shall not absorb water more than 2% by weight. The tiles shall have at least compression strength of 700 Kg/cm^2. The surface shall be abrasion resistant and durable.

b) Laying

The mortar used for setting or for underbed these tiles shall be durable, strong and chemical resistant epoxy mortar. The grout, which shall be to the full depth of tile, shall have equal chemical resistant properties. Joints shall be pointed if so desired. The setting and fixing shall be according to the manufacturer's specification approved by the Engineer.

2.02.06 Rubber, Vinyl, or Vinyl Asbestos Tiles Finish

This shall include various types of tiles manufactured from rubber, vinyl etc. set with an adhesive on concrete or masonry base. An underbed may be required to secure desirable surface and grade.

a) Thickness

The thickness of the tiles shall be as incorporated in drawing.

b) Tiles

Unless otherwise desired the tiles shall be squares of approved dimensions. The tolerance in dimensions shall be ± 1.5 mm.

The face of the tiles shall be free from porosity, blisters, cracks, embedded foreign matters or either physical defects which affect appearance or serviceability. All edges shall be cut true and square. The colour shall be nonfading and uniform in appearance, insoluble in water and resistant to alkalies, cleaning agents and usual floor polishes.

Each tile shall be marked on the back legibly and indelibly with manufacturer's trademark, the thickness, sizes, batch number, and date of manufacturer.

Tiles shall be delivered securely packed and stored in clean, dry well ventilated place at a temperature near about to that the tiles shall be called upon to stand ultimately.

Adhesive to be used for sticking the tiles shall be approved by the tile manufacturer. The adhesive shall have a short drying time and long life in addition to toughness.

c) Mix: Underbed

The underbed where required to make up the specified thickness or to give the required grade or to get the right type of surface shall be composed of 1 part like putty:1 part cement: 3 parts coarse sand mixed with just sufficient water to make it workable.

d) Laying

The tiles shall be kept in the room to be tiled for at least 24 hours to bring them to the same temperature as the room. For air-conditioned space, the air-conditioning shall be completed before tiling is taken up.

The surface to receive this finish shall be firm even textured but not too smooth, without undulations and other deficiencies. If an underbed is laid the same shall be cured for at least 7 days by keeping it moist and then fully dried.

The surface shall be thoroughly cleaned. All loose dust particles shall be removed. Oil and grease if any shall be completely cleaned by use of detergent.

The adhesive shall be applied to fully dry surface in desired thickness uniformly. The adhesive shall also be applied to the backs and edges of the tiles and allowed to surface dry. The tiles shall be placed neatly on the surface exactly to the approved pattern and set with a suitable tool. If the edges tend to curl, weights are to be used to keep the edges down. Special care shall be taken to avoid formation of air pockets under the tiles. The joints shall be very fine. Any adhesive squeezed out through the joints shall be removed immediately.

e) Finishing

If any adhesive mark is there on the surface a soft cloth soaked in solvent shall be used to wipe it off. The surface shall be cleaned with soft soap, dried, and polished

with an approved type of polish just before handing over.

2.02.07 Stone Slab Finish: Marble, Stone, and Similar Fine Grained Stone including Kota stone

a) Thickness

The underbed shall be minimum 12 mm and average 20 mm thick. The slabs will be 20 mm thick.

b) Stone Slab

The stone slabs shall be made from selected stock, which is hard, sound, homogeneous and dense in texture and free from flaws. Angles and edges shall be true, square, and free from chipping and surface shall be plane. The slabs shall preferably be machine cut to the required dimensions. Tolerance of ± 5 mm in dimensions and ± 2 mm in thickness will be allowed. Unless specified the slabs shall be minimum 300 mm x 300 mm.

The stone slabs shall come from specific regions and in specified quality with top surface fine chisel dressed. All sides shall also be fine chisel dressed to the full depth to allow finest possible joints.

The slabs shall be delivered to the site well protected against damages and stored in dry place under cover.

c) Mix: Underbed
Same as clause 2.02.01 (c).

d) Laying

The sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand stone and washed before laying.

The underbed mortar shall be evenly spread and brought to proper level on the area under each slab. The slab shall be laid over the underbed, pressed, and tapped down with wooden mallet to the proper level. The slab shall then be lifted and the underbed corrected as necessary and allowed to stiffen a little. Next, thick cement slurry shall be spread over the surface. The edges of the slab shall be buttered with slurry of cement, gray / white / mixed with pigment matching the colour of the stone slabs. The slab shall be gently laid and tapped with wooden mallet to bed properly to a very fine joint and to the required level. All surplus cement slurry shall be removed and the surface mopped clean with wet soft cloth. The laid finish shall be cured for 7 days by keeping it wet.

e) Polishing, Finishing

Fine chiselling shall be done to remove the slight undulations that usually exist at the joints. The polishing and finishing shall be done as specified under clause 2.02.01 (e). However, the joints shall be so fine in the case of stone slabs that grouting shall not be called for.

2.02.08 Stone Slab Finish: Sand Stone and Similar Coarse Grained Stone Finish

Generally clause 2.02.07 shall be followed except that the workmanship and finish shall not be fine as which are explained hereunder.

The slabs shall be rough chiselled or fine chiselled as specified. Tolerance may be allowed upto ± 6 mm for rough finish, but no sharp unevenness and shall be allowed. For fine chiselling the unevenness shall be limited to ± 2 mm. The sides shall be chisel dressed at least to half slab depth so that the maximum deviation from straight line shall be within 25 mm. Beyond this depth the edge may be slightly splayed.

The joint thickness shall be kept limited to 5 mm in case of rough finish and 3 mm in case of fine finish unless wider joints are specified. The joints shall be grouted with white or coloured cement. If fine joints in the flooring are specified, the edges of slabs shall be cut in such a way that it shall form a inverted 'Y'.

3.00.00 ACCEPTANCE CRITERIA

The finish shall be checked specially for:

a) Level, Slope, Plumb as the case may be

b) Pattern and Symmetry

c) Alignment of joints, dividing strip etc.

d) Colour, texture

e) Surface finish

f) Thickness of joints

g) Details at edges, junctions etc.

h) Performance

i) Precautions specified for durability

4.00.00 I.S. CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 777 : Glazed earthenware tiles

IS: 1196 : Code of practice for laying bitumen mastic flooring.

IS: 1197 : Code of practice for laying of rubber floors

IS: 1237 : Cement concrete flooring tiles

IS: 1443 : Code of practice for laying and finishing of cement concrete flooring tiles.

IS: 2114 : Code of practice for laying in situ terrazzo floor.

IS: 3461 : PVC asbestos floor tiles

IS: 4860 : Specification for acid resistant bricks

IS: 5518 : Code of practice for laying of flexible PVC Sheet and tile flooring.

IS: 5491 : Code of practice for laying in situ granolithic floor topping.

IS: 13712 : Code of practice for ceramic tile.

IS: 4457 : Code of Practice Unglazed Vitreous Acid Resisting Tile.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be for the complete work (including dividing strips, ironite, metals, tiles etc. if any) as per the schedule of items. Rates shall be applicable for application on horizontal and vertical surfaces at all elevations and for all types of work including stairs tread and riser, laying in desired pattern and panels, cost of specials (if any) rounding of corners, mouldings etc.

Rates shall be including provision of side shuttering (if required) for casting of floor in alternate panels and or without dividing strips.

5.02.00 Measurement

The finished surface shall be measured in Sqm for area unless otherwise specified. Deduction shall not be made for opening or embedded articles having area not exceeding 0.1 Sqm.

SECTION - D

SUB-SECTION – D13

SHEET WORK IN ROOF AND SIDING

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	INSTALLATION
3.00.00	ACCEPTANCE CRITERIA
4.00.00	I.S. CODES
5.00.00	RATES AND MEASUREMENTS

SHEET WORK IN ROOF AND SIDING

1.00.00 SCOPE

This section covers supply, cutting & fabrication and erection of corrugated/plain asbestos, corrugated galvanized iron, aluminum, permanently colour coated troughed zinc-aluminium alloy coated M.S. sheet or other sheet for covering to roof and sides at various elevations as specified.

2.00.00 INSTALLATION

2.01.00 Storage of Materials

All materials shall be stored by the Contractor in proper way to prevent all damage.

2.02.00 Workmanship

The workmanship shall be according to best construction practice to give a watertight finish to the satisfaction of the Engineer. Fixing of gutters and down pipes shall be according to IS: 2527.

2.02.01 Asbestos Sheeting

Asbestos sheets of profiles as specified shall be fixed with minimum 150 mm end lap and side laps as per manufacturer's specification. Hook bolts or J-bolts shall be 8 mm dia. at 305 mm centres. Six (6) mm dia. galvanized iron seam bolt and nut with G.I. flat washers and bitumen washers shall be used for stiching ridge cappings, corner pieces, ventilators, north light curves etc.

2.02.02 C.G.I. Sheeting and Aluminium Sheeting

Side laps shall be 2 corrugations for roof and one corrugation for side sheeting. End laps shall be minimum 150 mm for roof and 100 mm for side sheeting. In ridges and hips where plain sheets are used, the end laps shall be minimum 100 mm. Holes in C.G.I. sheets shall preferably be made on the ground. The sheets should be placed on purlins/trestles and holes punched in the ridge of the corrugation from the outside inward for obtaining proper seating of limpet washers. Sheets shall be secured to sheet framing by 8 mm dia. galvanised iron hooks or J-bolts and maximum spacing of the bolts shall be 305 mm. The length of the hook or J-bolts shall be to suit the sections of the bearers. Sheets shall also be bolted at the ends at every third corrugation with 6 mm dia. galvanized iron seam bolts and G.I. flat washers and bituminous washers.

2.02.03 Fibre Glass Reinforced Plastic Sheeting

This shall be of thickness and profile as specified. Colour and light transmittance shall be as mentioned. Where used in conjunction with C.G.I. or asbestos sheeting, the end and side laps and fixing device shall be same as used for general sheeting. Where used in lieu of glass, the fixing shall be by means of timber or metal glazing beads. In all cases, the installation shall be completely watertight and able to withstand the designed wind-pressure.

2.02.04 PERMANENT COLOUR COATED SANDWICHED INSULATED METAL CLADDING SYSTEM

i. Troughed zinc-aluminium alloy coated (both sides) M.S. sheet having 0.6mm minimum thickness (or high tensile steel sheet having minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used on external face (outer face) of cladding system. Weight of coating shall not be less than 275 gm/sq.m. The outer side (exposed face) shall be permanently colour coated with Polyfluro Vinyl Coating (PVF_2) of Dry Film Thickness (DFT) 20 microns (minimum) over primer. Inner side of external sheet shall be provided with suitable pre-coating of minimum 7 microns.

ii. Troughed zinc-aluminium alloy coated (both sides) M.S. sheets of minimum 0.6mm thickness shall be used as inner liner (internal face) of cladding system. The exposed face shall be permanently colour coated with silicon modified polyester paint of DFT 20 microns (minimum) over primer. Inner face of external sheet shall be provided with suitable pre-coating of minimum 7 microns. The weight of coating shall not be less than 275 gm/sqm.

iii. The permanent colour coated sheet shall meet the general requirements of IS:14246 and shall conform to class 3 for the durability.

iv. Inner sheet shall be fixed directly to side runners and Z spacers made out of at least 2 mm thick galvanized steel sheet of grade 375 as per IS:277. Inner sheet shall be fixed at the rate not more than 1.50M centre to centre to hold the insulation and external sheeting. The fasteners shall be of high quality corrosion resistant grade of self tapping / self drilling type provided with suitable cap.

v. The insulation shall be of bonded mineral wool of minimum thickness 50mm conforming to IS:8183, having a density of 32 Kg/cu.m. for glass wool & 48 Kg/cu.m. for rock wool.

2.02.05 PERMANENT COLOUR COATED (NON-INSULATED) METAL CLADDING SYSTEM

i. Troughed zinc-aluminium alloy coated not less than 275 gm/sq.m M.S. sheets having 0.6 mm minimum thickness (or High tensile steel sheet having minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used for the cladding system. The outer side (exposed face) shall be permanently colour coated with PVF_2 paint of minimum DFT 20 microns over primer and the inner side (internal face) shall be coated with same paint of minimum DFT 12 microns over primer. These shall be fixed directly to runners. The sheets shall meet the general requirement of IS:14246 and shall conform to class 3 for the durability.

ii. **FLASHING, CAPS, TRIM CLOSURES ETC.**

All flashings, trim closures caps etc. required for the metal cladding system shall be made out of plain sheets having same material and coating specification as mentioned above for the outer face of the sandwiched metal cladding.

3.00.00 ACCEPTANCE CRITERIA

The installations shall present a neat appearance and shall be checked for water tightness. The following shall be checked:

a) Side and end laps

b) Absence of cracks, holes or damages in sheet

c) Spacing of bolts

d) Provision of double washers (G.I. and asbestos or bituminous washers)

e) Proper installation of flashing.

4.00.00 I.S. CODE

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 3007 : Code of practice for laying of asbestos cement sheets.

IS: 2527 : Code of practice for fixing rainwater gutters and down

pipes for roof drainage.

IS: 1626 : Specification for asbestos cement building pipes, gutters and fittings.

IS: 277 : Specification for galvanized steel sheets (plain and corrugated).

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates shall be unit rate for complete item described in "Schedule of Items" and shall include all wastage.

5.02.00 Measurement

Sheeting work in roof & sides shall be measured in Sq.M. for net area of the work done. Profiled sheeting shall be measured flat and not girthed. Opening less than 0.40 Sqm shall not be deducted. No extra shall be paid for extra labour in cutting and for wastage etc. No payment shall be made for laps in sheeting works.

SECTION - D

SUB-SECTION – D14

SUSPENDED CEILING

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	INSTALLATION
3.00.00	SAMPLES
4.00.00	SHOP DRAWINGS
5.00.00	ACCEPTANCE CRITERIA
6.00.00	RATES AND MEASUREMENTS

SUSPENDED CEILING

1.00.00 SCOPE

This section covers supply and installation of suspended ceiling together with the suspension system as shown on drawing or specified in schedule of item with all materials, labour and equipments. The work shall also include providing of openings in the ceiling for lighting, air-conditioning diffusers etc. as shown on drawings or as instructed by the Engineer.

2.00.00 INSTALLATION

2.01.00 Suspension System

2.01.01 General

Suspension system shall consist of the grid supporting the ceiling panels, intermediate runner supports for the grid if any and hangers, wall angles etc. required to suspend the grid or the runners from structural works, slabs and beams.

All members of the suspension system shall be of sufficient strength and rigidity to carry, the ceiling boards or sheets in a true and level plane without exceeding a deflection of 1/360th of their span. All joints in ceiling panels shall run straight and cross joint shall be at perfect right angles. Angle moulds where shown on drawings shall be securely fixed to walls. All drillings of structural concrete and installation of suitable anchoring device for installation including welding of the suspension system shall be included in the rate. All M.S. sections used for supports etc. shall be given one coat of synthetic enamel paint over a coat of red lead primer.

2.01.02 Metal Grid Suspension System

Aluminium grid ceiling system shall be “Bead lock” as manufactured by W A Beard shell and Co. Pvt. Ltd. or Ajit India Limited or approved equal. Steel grid ceiling system shall be 'Jolly Snap Grid' as manufactured by Jolly Board Limited or approved equal.

Steel tees as intermediate members and steel channels, as end pieces will be assembled in the form of grid. Size of tees and channels shall be as required.

The cross-tees shall intersect main tee runners in pattern shown on drawing and positively locked together with intersection members. All perimeter areas shall have tee runners fixed to vertical wall surfaces and end channels shall be fixed to runners leaving return air space between vertical wall and channels, unless otherwise shown on drawings. Angle cleats or other suitable fixing device shall be fixed to the structural

beams above for fixing of hangers. Main runners shall be hung by M.S. flats, angles, rods or 12G or heavier galvanized tie wire hangers at maximum 1.2 metre centres. Extra hangers shall be provided at light fixtures that are supported from the ceiling system. The spacing of main and cross runners shall be as shown on drawings(as per shop drawings).Turnbuckles shall be provided in M.S. rods for adjustment in levels.

2.02.00 Ceiling Panels

2.02.01 Material

Ceiling panels shall be best quality material in thickness and properties called for in the "Schedule of items". The Contractor shall submit test certificates to the Engineer for approval before bulk supply. The ceiling panels may be of following type:

a) Plaster of Paris ceiling (decorative).

b) Gypsum board plain and perforated false ceiling (decorative)

c) Expanded polystyrene insulation board with plastic fascia.

d) Mineral fibre tile false ceiling.

e) Bonded wooden particle board (Plain and decorative)

f) Glass fibre reinforced gypsum plaster board ceiling(GRG)

g) Flat asbestos sheets (with plastic fascia).

2.02.02 Installation of Ceiling Panels

Installation of Ceiling panels shall be strictly as per manufacturer's instruction.

For concealed grid system, tiles shall be fixed to the supporting grid in manner shown on drawing or as specified by the manufacturer. Where V joints in tiles are called for in drawings, these shall be in true lines. Where flush surface is required, the joints shall be filled with approved filler material and finished to give a neat uniform surface. Special care shall be taken to neatly finish the ceiling at junctions with walls, light fixtures, diffusers etc.

2.02.03 Aluminium Lineal Ceiling System

Aluminium lineal ceiling (permanently colour coated) system shall be "Luxalon 84C " or approved equal and the installation shall be strictly as per manufacturer's instruction/ specification subject to approval of the Engineer.
Aluminium lineal ceiling shall comprise of plain panels, 84 mm wide and 12.5 mm deep with a 23.9 mm recessed flange, roll formed out of 0.5 mm thick corrosion resistant aluminium alloy panels stove enamelled on both sides, fixed on roll-formed carriers made of enamelled 0.95 mm thick aluminium, 32 mm wide and 39 mm deep with prongs to hold panels in the module of 100mm, at maximum spacing 1.2 M centre to centre. The carriers shall be suspended from roof by 4 mm dia galvanised steel wire hangers with special height adjustment clips made out of spring steel at maximum spacing of 1.2 M c/c. Hangers shall be fixed to roof by 'J' hooks and nylon inserts. 50 mm thick resin bonded mineral wool (spintex 300 or equivalent) insulation (density48 kg/cum) conforming to is 8183 bound in polythene shall be laid on top of panels. Lineal ceiling shall be fixed in pattern as per detailed drawings.

2.02.04 Providing, fixing and laying **permanently colour coated aluminium false ceiling** of approved colour with stove enamel finish of approved make in LINEAR and SQUARE type with corrosion resistance aluminium alloys panels of minimum thickness 0.5mm including 50mm thick mineral wool insulation (as per IS:8183) bound in polythene bags on top of panels. Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures. A.C. ducts etc. suitable M.S. channel (minimum MC 75) grid 1200 c/c maximum shall also be provided above the false ceiling level for movement of personnel to facilitate maintenance of lighting fixtures, AC ducts etc.The work to be complete as per specifications, drawings and direction of engineer.

2.02.05 Providing, fixing and laying a**nodised** natural colour matt finished **aluminium false ceiling** of Jindal/Hindalco make with corrosion resistance aluminium alloys panels of minimum thickness 0.5mm including 50mm thick mineral wool (density 48kg/cum insulation (as per IS:8183) bound in polythene bags on top of panels. Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures. A.C. ducts etc. suitable M.S. channel (minimum MC 75) grid shall also be provided above the false ceiling level for movement of personnel to facilitate maintenance of lighting fixtures, AC ducts etc.The work to be complete as per specifications, drawings and direction of engineer.(Materials for structural platform grid for movement made up of MS Channels/ Beams / Angles shall be supplied by BHEL and shall be paid under ST No 2301).

2.02.06 Providing and Fixing **12mm thick Gypsum board plain/perforated false ceiling tiles (600x600mm)** of India Gypsum or equivalent make in plan or elevation with aluminum grid, metal suspension system, anchor fastener adjustable hangers etc. including two or more coats of acrylic emulsion paint of approved colour to give an even shade with smooth finish all complete as per architectural design and detail. metal

suspension system as per ASTM C-635 shall be hot dipped M.S.galvanized (grade 180 as per is :277) nominal size of T-section shall be 24 x 38 mm or 24 x 25 mm cross runners. 24mm wide exposed flange surface shall be permanently color coated. suspension system shall be as per manufacturer's specification supported over movement platform. The work to be complete as per specifications, drawings and direction of engineer.(Materials for structural platform grid for movement made up of MS Channels/ Beams / Angles shall be supplied by BHEL and shall be paid under ST No 2301)

2.02.07 Providing, fixing and laying light weight **mineral fiber tile false ceiling** of minimum thickness 15 mm and exposed surface semi-perforated with depth of perforation as 4 mm and humid resistance of 95% RH and fire performance of class 0/1 as per BS 476 with metal suspension grid system with galvanized Tees of section 24 X 38 mm for main runners of approved color and make as per specification including 50mm thick mineral wool insulation (density48kg/cum) as per IS:8183 bound in polythene bags on top of panels. Additional hangers and height adjustment clips shall be provided for return air grills, light fixtures. A.C. ducts etc. suitable M.S. channel (minimum MC 75 @ 1.2m) grid shall also be provided above the false ceiling level for movement of personnel to facilitate maintenance of lighting fixtures, AC ducts etc. complete with cut-outs etc.The size of tiles shall be 600 X 600 mm or
600 X 1200 mm. Required MS channel shall be measured & paid extra under respective item unit rate.

2.02.08 Providing and fixing **glass fiber reinforced gypsum plaster board (GRG) ceiling** (having gypsum core mixed with glass fiber) system consisting of metal supporting grid system forming panels of specified size, suspended from RCC slab/structural steel or catwalk way grid above with 4 mm (minimum) galvanized wires (rods) with special height adjustment clips, including preparation of working drawing, providing openings for AC ducts, return air grills, light fixtures etc (but excluding the cost of catwalk way grid) all complete as per drawings, specification and instructions of the engineer.

3.00.00 SAMPLES

Samples of Ceiling panels and metal suspension system components as noted below shall be submitted for Engineer's approval:

Panels : 3 samples approximately 300 mm square/long each

Suspension System : 3 samples of short length : each of main and secondary system

4.00.00 SHOP DRAWINGS

Shop drawings shall be submitted for approval as required and approval shall be obtained prior to delivery of suspended ceiling components. Shop drawings shall be co-coordinated with all related work and shall show the following information:

a) A reflected ceiling plan of areas indicated to receive the ceiling showing electrical and mechanical features.

b) Typical Intermediate framing for support where required.

c) Hanger fastening details.

d) Panels - unit support at ceiling penetrations.

e) Details of splicing method for main and cross runners.

f) A table indicating load bearing capacity of main and cross runner

g) A note stating that the suspension system member furnished will not deflect more than 1/360 of the span under the indicated loading.

5.00.00 ACCEPTANCE CRITERIA

Finished ceiling shall be at the correct plane and present a pleasing and uniform appearance, free from, sags, warps, disfigured, or damaged board. Cutouts for light fixtures, diffusers etc. shall be of exact dimensions and in exact locations.

6.00.00 RATES AND MEASUREMENT

6.01.00 Rates

Rates shall be for the complete item called for in the “Schedule of Items”. No extra payment will be made for alignment and adjustment of lighting fixtures, air-conditioning diffusers, access panels etc. The rate shall include all cutting and wastage from standard size sheets, runners/carries etc.

6.02.00 Measurement

Actual area of work shall be measured in Sqm correct to second place of decimal. However, no deduction will be made for opening upto 0.25 Sqm. each in area.

SECTION - D

SUB-SECTION – D15 (PART – I)

WATER SUPPLY

TABLE OF CONTENT

CLAUSE NO.	DESCRIPTION
1.0.0	SCOPE
2.0.0	INSTALLATION
3.0.0	TESTING AND ACCEPTANCE
4.0.0	I.S. CODES

STANDARD TECHNICAL SPECIFICATION FOR WATER SUPPLY

1.0.0 SCOPE

This section includes supply of all materials, labour and incidentals for water supply for residential, business and industrial and other types of buildings. The water supply system of a building or premises covers service pipes and the necessary connecting pipes, fittings, control valves and all appurtenances in or adjacent to the building or premises.

1.0.1 Materials

All materials, fittings, fixtures and appliances shall be of the best quality conforming to relevant Indian Standard and shall be procured from approved manufacturers. Unless specifically allowed by the Engineer, the Contractor shall submit samples of fittings and fixtures which will be retained by him for comparison when bulk supplies are received at the site. Ultimate choice of type, model and manufacturer lies completely with the Engineer.

It shall be the responsibility of the Contractor to procure the materials selected by the Engineer. Hence order are to be placed with the manufacturers in time, so that the materials are available at the site well ahead of their requirement.

The materials brought to the site, shall be stored in a separate secured enclosure away from the building materials. Pipe threads, sockets and similar items shall be specially protected till final installation. Brass and other expensive items shall be kept under lock and key. Fragile items shall be checked thoroughly when received at the site and items found damaged shall not be retained at the site.

1.0.2 Pipes and Pipe Fittings

Under scope of this specification, pipes and pipe fittings may be any or a combination of the following types :

a) Cast Iron

b) Steel : lined, coated with bituminous composition, out coated with cement concrete or mortar or galvanised.

c) Reinforced Concrete

d) Prestressed Concrete

e) Lead (Not to be used for potable water)

f) P. V. C.

g) Copper

h) Brass

i) Wrought iron

j) G.I

1.0.3 **Water Reservoirs**

Water reservoirs like pressed steel tanks and G.I. tanks shall come under scope of this specification. Reservoirs made of concrete masonry or fabricated steel shall be covered by respective work specifications.

1.0.4 **Related Works**

All works, like earthwork, masonry, concrete, steelwork, cutting holes, chases, repairs and rectification associated directly with installation of water supply systems shall come under scope of the Contractor unless specifically excluded.

1.0.5 **Regulation**

The work which is required to be carried out under the scope of this section, shall be executed by a licensed plumber only (engaged by the Contractor) and he shall obtain all necessary sanctions, permissions, certificates etc. from Municipal and/or other Local Authorities and shall abide by all the rules of such Authorities.

2.0.0 **INSTALLATION**

While basic layouts may be available in the drawings provided by the Owner, the details might have to be supplemented by the Contractor for approval of the Engineer.

Special attention shall be given by the Contractor to economy. Symmetry of layout is very important. Fittings meant for operation shall be located and oriented to allow easy reach and operation. Maintenance, repairs and replacements of pipes, fittings and fixtures must be conveniently possible.

2.1.0 **Pipe Lines**

2.1.1 **Laying**

In addition to fulfilling the functional requirements all pipelines shall be laid true to line, plumb and level. Any deviation shall need approval of the Engineer. Meticulous care shall be taken to avoid chances of airlock and water hammer.

Pipes shall be laid on continuous unyielding surface or on reliable supports at least one near each joint and spacings as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every direction and easy maintenance. Pipes shall be encased or concealed in masonry or concrete if shown on drawing or directed by the Engineer.

2.1.2 Back Flow

The layout of pipe work shall be such that there is no possibility of back flow towards the source of supply from any cistern or appliances, whether by siphonage or otherwise. All pipe works shall be so laid or fixed and maintained as to be and to remain completely water-tight, thereby avoiding waste of water, damage of property and the risk of contamination of the water conveyed.

2.1.3 Contamination

There shall be no cross connection whatsoever between a pipe or fitting for conveying or containing wholesome water and a pipe or fitting for containing impure water or water liable to contamination or of uncertain quality of water which has been used for any purpose.

No piping shall be laid or fixed so as to pass into or through any sewer, scour outlet or drain or any manhole connected therewith.

2.1.4 Underground Pipings

Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic and other loads and frost, where applicable.

The size and depth of the trench shall be as approved by the Engineer. Back-filling shall be done with selected fine earth, unless otherwise permitted in 150 mm layers and carefully consolidated. Special care shall be taken while filling in the vicinity of the pipe to avoid damage. Before backfilling the laid pipe shall be fully tested and approved.

Where the pipe rests on rock it may be bedded on a layer of fine selected material or concrete to avoid local point support.

The trench shall be so treated by gradient and filling in the area that it does not act as a drainage channel.

2.1.5 Concealed Piping

Where desired by the Engineer or shown on the drawings the pipes shall be concealed in masonry or concrete of the structure. The Contractor may co-ordinate with the building Contractor for leaving the chases, openings, conduits as necessary.

However, the Contractor will rectify if required the chases, openings and conduits, supplement and make good after laying and testing of the concealed pipelines.

2.1.6 **Jointing of Pipes**

Jointing of pipes shall be completely leakproof and durable. Instruction of the manufacturer shall be followed unless desired otherwise by the Engineer. However, usually recommended practices are stated below for guidance :

a) **Cast Iron**

i) **Spigot and Socket Joints**

Lead joint : The joint is made by first caulking in clean spun yarn upto half depth and filling the reminder by running in molten lead taking care that no dross enters the joint and then thoroughly caulking the lead. The lead need not extend into the joint further than the back of the groove formed in the socket. After completing the joint it shall not be allowed to move. For rectification the joint shall be completely redone.

ii) **Flanged Joints :** Flanged joints shall be made by jointing rings of good quality, smooth and hard compressed fibre board of thickness not less than 1.5 mm and of such width as to fit inside the circle of bolt. Diagonally opposite bolts shall be tightened in pairs and in stages so that degree of all bolts in a joint are similar. Damaged gaskets shall be replaced.

b) **Steel**

Plain ended steel pipes may be jointed by welding. Screwed and socketed joints shall be carefully tightened. Care shall be taken to remove any burr from the ends of the pipes. Jointing compound, if used, shall be lead free and approved by the Engineer. Once a joint has been screwed up it shall not be backed off unless threads are recleaned and new compound applied.

c) **GI Pipes**

Threads shall be cut with sharp tools, and before jointing all scales shall be removed from pipes by suitable means. The screw / threads of the pipe shall be cleaned out and the joint made by screwing the fittings after treating the threads with approved pipe jointing compound. Once a joint has been screwed up it shall not be backed off unless threads are recleaned and new compound applied.

d) **Lead**

Lead and lead alloy pipes shall be jointed with wiped solder joints.

e) **Concrete**

Concrete pipes may be socket and spigot ended collar or band jointed. Joints shall be effected by caulking with 1:3 cement sand mortar.

f) **P. V. C.**

Manufacturer's instruction shall be followed. For heating approved equipment with adequate control shall be used.

g) **Tyton Joint**

The manufacturer's instruction shall be strictly followed in making such joints. Tyton joints shall be made by push-on type specification stipulated by the pipe manufacturer. The tools specified by the pipe manufacturer shall be used to secure the joint fully.

2.1.7 **Painting**

Where mentioned in the Schedule, underground steel and cast iron pipes shall be given 2 coats of bituminous paint on the outside after laying, when painting is to be done above ground G.I. pipes shall be given a coat of zinc chromate primer, C.I. and M.S. pipes shall be given one coat of red lead or zinc chromate primer. Top coats shall be minimum 2 coats of best quality paint.

2.2.0 **Storage Tank - Pressed Steel Tank**

Unless otherwise mentioned, water storage tanks shall be pressed steel tanks of nominal size and capacity as mentioned in the Schedule and fabricated with all flanges external, all flanges internal, or bottom flange internal and side flanges external, as shown on drawings or schedule of items. The fabricator shall supply 6 prints of fabrication drawings to the Engineer for prior approval showing thickness of plates, method of jointing the plates, all supports, stays, gussets etc. Pads, cleats etc. required for supporting the tanks shall be supplied by the manufacturer. Inlet, overflow vent pipes, manholes etc. shall be arranged and provided as shown on drawing or mentioned in the schedule. Unless otherwise specified, the outlet pipe shall be 50 mm above the bottom of the tank and there shall be a 150 mm free board at the top of the tank.

All tanks shall be supplied with mosquito-proof covered top with manhole not less than 450 mm diameter. Tanks deeper than 1.00 Metre shall be provided with m.s. internal access ladder adjacent to the manhole. Water level indicator shall be provided if asked for. Two coats of anti-corrosive paint over a suitable primer shall be applied to both internal and external surface of tanks. Such paint if used shall not impart any taste or odour to water and be of lead free composition..

Erection of tanks shall be in accordance with detailed drawings and manufacturer's instructions. The two finishing coats of paint shall be applied to outside after erecting is complete.

2.2.1 G. I. Water Tank

G. I. water tanks shall be procured from a reputed manufacturer. The design shall be good enough to withstand the loads safely. Galvanised iron water storage tank shall be made of minimum 2 mm thick galvanised iron sheet. Plain sheets shall be fixed at the corner to angle iron frames by means 6 mm rivets at 40 mm pitch for tanks upto 1000 litres capacity and 8 mm rivets at 35 mm pitch for tanks above 1000 litres capacity. Tanks above 1000 litres shall have 20 mm dia. galvanised / iron stay rods, one fixed to angle framing at top and two in the body of the tank for extra strength. Holes for rivetting shall be drilled and not punched. White lead shall be applied to the joints before rivetting.

In case it is desired by the Engineer that corners of tank should be welded instead of rivetted then the sheets shall be welded to form a tank will not have angle iron frame.

Tanks shall have 400 mm dia. holes at the top with hinged covers. The covers shall be made of galvanised iron sheet with angle iron frame. The cover shall be just loose but close fitting to keep out dust and mosquito and will not be airtight. It shall be complete with lockable arrangement.

Tanks shall be provided with rising main inlets of 40 mm dia. galvanised iron pipe or as shown on Drawing and 25 mm dia. G.I. overflow pipe. The rising main shall be connected to the tank with a ball valve near the top which disconnects the supply when tank is full up to the point of overflowing.

2.2.2 PVC Water Tank

PVC water shall be of Syntex or approved reputed manufacturer.

Tanks shall be provided with rising main inlets of 40 mm dia. galvanised iron pipe or as shown on Drawing and 25 mm dia. G.I. overflow pipe or as shown on Drawing. The rising main shall be connected to the tank with a ball valve near the top which disconnects the supply when tank is full up to the point of overflowing.

The ball valve permits the entry of water when the tank is empty and disconnects the supply when the tank is full. It consists of a hollow floating ball made of copper, plastic or hand Tubber, 110 mm in diameter, attached to an arm which is so pivoted that the end near the pivot closes the orifice of the main when the ball is raised to the required height of water in the tank and opens the main as soon as the ball drops with the fall of water level as it is drawn off through the distribution pipes. The ball valve shall be fixed to the tank independent of the inlet pipe and set in such a position that the body of the ball valve cannot submerge when the tank is full upto the water line. The ball valve shall be so adjusted as to limit the level of the water line. The level of the water

in the tank to 75 mm below the lip of the overflow pipe. Free surface shall be about 150 mm above the maximum water filled level.

2.3.0 Valve, Cocks, Taps

All valves, stop cocks, taps etc. shall conform to relevant Indian Standard Specification and shall be of best quality from approved manufacturers. These shall be suitable for working pressures mentioned in the Schedule. Nominal size and material shall be as per schedule.

2.4.0 Protection

Open end of each pipe shall be protected during installation by suitable covers or plugs so that the ends, threads, sockets or spigot are not damaged and no foreign material can find its way into the pipe line.

Fittings and fixtures liable to be misused or stolen during the construction phase shall be fitted only before testing and handing over.

3.0.0 TESTING AND ACCEPTANCE

3.1.0 Inspection Before Installation

All pipes, fittings and appliance shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes and fittings shall be inspected on site before laying and shall be sounded to disclose cracks. Any defective items shall be clearly marked as rejected and forthwith removed from the site.

3.2.0 Testing of Mains After Laying

After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25 mm inlet with a stop cock, allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 5 Kg/CM^2 or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long mains or mains of a large diameter, by a power driven test pump, provided that the pump is not left unattached. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable less for at least five minutes. The end of the main shall be closed by fitting a water-tight expanding plug and the plug shall be secured by struts to resist the end thrust of the water pressure in the mains.

3.3.0 Testing of Service Pipes and Fittings

The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working

conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely water-tight. All pipings, fittings and appliances shall be checked for satisfactory support and protection from damage, corrosion and frost.

4.0.0 I.S. CODES

Important relevant IS Codes for this Specification are listed below :
Latest editions shall always be consulted.

IS:2065	:	Code for Practice for water supply in buildings
IS:1172	:	Code of basic requirements for water supply, drainage and sanitation
IS:1200 (Pt. XVI)	:	Laying of water and sewer lines including appcurtnant items.
IS:1239 (Pt. I & II)	:	Specification for Mild Steel Tubes and Mild Steel Tubulars and other wrought steel pipe fittings (10 mm to 15 mm nominal diameter)
IS:1536	:	Specification for Centrifugally cast (Spun) iron pressure pipes for water gas and sewage
IS:1537	:	Specification for vertically cast iron pressure pipes for water, gas and sewage.
IS:3486	:	Specification for Cast iron spigot and socket drain pipes (80 mm to 250 nominal diameter)
IS:3589	:	Specification for Electrically welded steel pipe for water, gas and sewage (200 mm to 2000 mm nominal diameter)
IS:784	:	Prestressed concrete pipes
IS:458	:	Concrete pipes (with or without reinforcement)
IS:783	:	Code of Practice for laying of concrete pipes
IS:1592	:	Asbestos cement pressure pipes
IS:1626	:	Asbestos cement pressure pipes, gutters and fittings (Spigot and Socket types)
IS:404	:	Lead pipes
IS:3076	:	Low density polyethylene pipes for potable water supplies
IS:4984	:	High density polyethylene pipes for potable water supplies
IS:2501	:	Copper tubes for general engineering purposes

IS:407 : Brass tubes for general purposes

IS:1230 : Cast iron rain water pipes and fittings

IS:804 : Rectangular pressed steel tanks

SECTION - D

SUB-SECTION – D15

DRAINAGE AND SANITATION

TABLE OF CONTENT

CLAUSE NO.	DESCRIPTION
1.0.0	SCOPE
2.0.0	INSTALLATION
3.0.0	TESTING AND ACCEPTANCE
4.0.0	CODES AND STANDARDS

STANDARD TECHNICAL SPECIFICATION FOR DRAINAGE AND SANITATION

1.0.0 SCOPE

1.1.0 This section covers the layout and construction of drains for roof water, surface water and sewage together with all fittings and fixtures and inclusive of ancillary works, such as connections, manholes and inspection chambers used within the building and from the building to the connection to a public sewer or to treatment work, septic tank and soak pit dispersion trenches.

2.0.0 INSTALLATION

2.0.1 General

All pipe lines, locations of fittings and fixtures, etc. shall be as per drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, symmetry and levels shall be strictly ensured. All items shall be fully secured against movement in any direction and so located as to allow easy maintenance.

All pipe lines, fittings and fixtures shall be installed leakproof. When the works under scope of this specification linked up with works executed by others, the connections shall be such as to prevent any splashing or spilling or emission of foul odour and gases.

2.1.0 Rainwater Downcomers

Rainwater downcomers shall be standard Cast Iron Pipes. In case where specifically desired, M.S, UPVC, GI and HDPE pipes may also be used. M.S. pipes shall be painted outside with two coats of anticorrosive paints under a coat of primer.

Rainwater downcomers shall run along and be secured to walls, columns etc. where desired by the Engineer these may have to be installed in chases cut in the structure.

All pipes shall be well secured and supported by adequately strong brackets. The brackets may be wrought iron clevis type, split ring type or perforated strap iron type as approved by the Engineer. For vertical runs each pipe shall hang freely on its brackets fixed just below the socket. Suitable spacer blocks shall be provided against the vertical surface to which the pipe is fixed.

All bends and junctions shall be supplied with watertight cleanouts.

Roof and floor drains and yard gullies shall be installed, if required, by cutting into the structure and grouted with 1:2:4 cement concrete. All gutters shall be provided with removable gratings.

All horizontal pipes shall have a minimum fall of 1 in 100.

2.2.0 Gutters

The gutters shall be made of G.I. All gutters shall be supplied by reputable specialised firms. Each section shall be sufficiently rigid, edges and corners straight and the slopes perfectly uniform. G.I. gutters shall have the edges strengthened by suitable means.

Unless noted otherwise the gutters shall have a minimum fall of 1 in 120. Adequate number of string supports shall be provided so that there is no reflection even when the gutter is full. Each joint must have a support. Unless otherwise specified the supports shall be fabricated M.S. brackets. All junctions shall be thoroughly watertight. The joints may be made by rivetting, bolting or soldering. All joints between successive lengths of gutters shall have on overlap of at least 5 cm. The drop in the overlap shall always be in the direction of the fall of the gutter. Ends of gutters shall be closed watertight. Junction with rainwater down comers shall be made fully watertight and secured.

2.3.0 Soil and Drainage Pipes

2.3.1 Gradients

If not specified the minimum gradients of soil and drainage pipe line shall be as follows :

100 mm nominal dia : 1 in 35
150 mm nominal dia : 1 in 65
230 mm nominal dia : 1 in 120
300 mm nominal dia : 1 in 200

2.3.2 Relation with water supply pipe lines

Unless specifically cleared by the Engineer, under no circumstances shall special drainage and soil pipes be allowed to come close to water supply pipelines.

2.3.3 Laying

Each separate pipe shall be individually set for line and for level. Where lengths of sewer or drain pipes are laid in trench, properly painted sight rails shall be fixed across the trench at a height, equal to length of the boning rod to be used, above the required invert level of the drain or sewer at the point where the sight is fixed. More sight rails shall be required at manholes, change of gradient and intermediate positions if the distance for sighting is more than 50 ft. apart. The excavation shall be boned in at least once in every 6 ft. The foot of the boning rod shall be set on a block of wood of the exact, thickness of the wall of the pipe. Each pipe shall be separately and accurately boned between sight rails.

2.3.4 Support and Protection on Pipelines

All pipes shall be laid with sockets leading uphill. Preferably the pipe shall rest on solid and even foundations for the full length of the barrel. However, the pipe manufacturer's instruction as approved by the Engineer shall be followed in the matter of support and jointing.

To achieve full and continuous support, concrete for bedding and packing is the best. Where pipes are not bedded on concrete, the floor shall be left slightly high and carefully placed so that the pipe barrels rest on undisturbed ground. If anywhere the excavation has been carried too low packing shall be done in concrete. Where laid on rock or very hard ground which cannot be easily excavated to a smooth surface, the pipes shall be laid on a cradle of fine concrete floor of gravel and crushed stone over laid with concrete or on a well consolidated gravel and crushed stone bed as desired by the Engineer. PVC or similar pipes shall be laid directly on stable soil and packed with selected soil.

The minimum support and protection for glazed stoneware pipes shall be as follows :

a) When cover is less than 2 metre below ground level and where pipes are unavoidably exposed above ground surface, the pipes shall be completely encased or surrounded with concrete.

b) Where pipes are laid on soft soil with the maximum water table laying at the invert of the pipe, the sewer shall be bedded on concrete.

c) Where the pipes have to be laid on soft soil with the maximum water table rising above the invert of the pipe, but below the top of the barrel, the pipe sewer shall be haunched.

d) Where maximum water table is likely to rise above the top of the barrel or wherever the pipe is laid on soft soil the pipe sewers shall be completely encased or surrounded with concrete.

Cast iron pipes and concrete pipes may be supported on suitable concrete or brick support, where specified. The supports shall be unyielding and strong enough. At least one support shall be located close to ends. Spacing of intermediate supports shall be as decided by the Engineer. Pipes shall be secured to the supports by approved means.

Anchoring of pipes where necessary shall be achieved by suitable concrete encasing designed for the expected thrust.

2.3.5 Entry into structures

For entry of the pipe lines into any building of structure suitable conduits under the structure or sleeves shall be used. The conduits and sleeves shall be such as to allow easy repairs and replacement of the pipes. When openings or chases are required to be made in the structure for entry of pipe lines, locations and sizes shall be marked and checked by the Engineer. After laying of the pipeline the openings and chases shall be mended.

2.3.6 Ducts

Where solid, waste and ventilating pipes are accommodated in ducts, access to cleaning areas shall be provided. Connection to drain shall be through a gully with sealed cover to guard against ingress of sewer gas, vermin or backflow.

2.3.7 Traps and Ventilating Pipes

Pipes are carrying off the waste from water closets and waste water and overflow water from baths, wash basins, sinks to drains shall be trapped immediately beneath such fixtures. Traps shall have minimum water seal of 50 mm and shall be ventilated whenever such ventilation is necessary to maintain water seal of the trap.

Ventilating pipes shall be carried up vertically from the drain to a height of at least 600 mm above the outer covering of the roof of the building or as shown on drawings. All vertical ventilating, anti-syphonage and similar pipe shall be covered on top with a cowl. The cowl shall be made of C.I. unless desired otherwise by the Engineer.

2.3.8 Manhole and Inspection Chambers

The maximum distance between manholes shall be 30 meter unless specially permitted otherwise. In addition, at every change of alignment gradient or diameter there shall be a manhole or inspection chamber. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 metres unless desired otherwise.

Manhole shall be constructed so as to be watertight under test. The bending at the sides shall be carried out in such a manner as to provide no lodgement for any splashings in case of accidental flashing of the chamber. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement, sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide smooth flow.

Connecting to existing sewer lines shall be through a manhole.

Manholes shall be provided with standard C.I. covers. The covers shall be close fittings so as to prevent gases from coming out. Suitable heavy duty covers shall be used where necessary as decided by the Engineer.

2.3.9 **Cutting of Pipes**

Manufacturer's instructions shall be followed for cutting of pipes where necessary. Suitable and approved tools shall be used for the cutting so as to leave surface clean and square to the axis of the pipe.

2.3.10 **Jointing**

Jointing of laid pipes shall be so planned as to avoid completely any movement or strain to the joints already made. If any joint is suspected to be damaged it shall be opened out and redone.

All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and water-tight when underground. Method of jointing shall be as per instructions of the pipe and fittings manufacturer and as approved by the Engineer. However, in the absence of any instruction available from the manufacturer the methods as detailed hereunder shall be used.

a) **Cast Iron Pipes**

Socket and spigot pipes shall be jointed by the cast lead joints. The spigot shall be centered in the socket of the next pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. When the gasket or hemp yarn has been caulked tightly a jointing shall be placed round the barrel and tightened against the face of the socket to prevent airlock. Molten lead shall then be poured in to fill the remainder of the socket and caulked with suitable tools right round the joint to make up for shrinkage of the molten metal on cooling and shall be finished 3 mm behind the socket face.

Joints in cast iron pipes with special jointing arrangements like 'Tyton' joints etc. shall follow the instructions of the manufactures.

In special cases if flanged joints are accepted by the Engineer the joints shall be made leakproof by inserting approved type of rubber gaskets. The bolts shall be secured in stages to avoid uneven strain.

b) **Concrete Pipes**

Care shall be taken to place the collar centrally over the joint.

2.4.0 **Trenches and other excavations**

Width of the trench at the bottom shall be such as to provide 200 mm clearance on either side of the pipe for facility of laying and jointing.

Excavated material shall be stacked sufficiently away from the edge of the trench and the side of the spoil bank shall not be allowed to endanger the stability of the excavation. Spoil may be carted away and used for filling the trench behind the work.

Turf, top soil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement.

All excavation shall be properly timbered, where necessary.

Efficient arrangements for dewatering during excavation and keeping it dry till backfilling shall be made to the satisfaction of the Engineer. Sumps for dewatering shall be located away from the pipe layout.

Where the excavation proceeds through roads necessary permissions shall be secured by the Contractors from the appropriate authorities.

Special care shall be taken not to damage underground services, cables etc. These when exposed shall be kept adequately supported till the trench is backfilled.

The backfilling shall be done only after the pipeline has been tested and approved by the Engineer. Special care shall be taken under and sides of the pipe during handpacking with selected material. At least 300 mm over the pipe shall also be filled with soft earth or sand. Consolidation shall be done in 150 mm layers. The surface water shall be prevented from getting into the filled up trench. Traffic shall not be inconvenienced by heaping up unduly the backfilling material to compensate future settlement. All future settlements shall be made good regularly to minimise inconvenience of traffic where applicable.

2.5.0 **Fixtures**

The Tenderer shall mention in his bid the type and make of the fixtures he intends to use enclosing manufacturer's current catalogues. In the absence of any such agreement, the Engineer shall be at liberty to choose any type and make.

All fixtures and fittings shall be of approved quality and type manufactured by well known manufacturers. All items brought to the site must bear identification marks of the type of the manufacturer. Procurements shall be made well in advance and inspected and approved immediately by the Engineer. All fixtures shall be adequately protected, covered and plugged till handed over.

All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated. The connecting lead pipes and bends shall weigh at least 3 kg. per 25 mm dia per

meter length. Where PVC or similar pipes are allowed the Contractor shall produce the test reports and convince the Engineer about their durability.

Unless specified in the contract the fixtures shall be as specified hereinafter.

2.5.1 **Water closet**

a) **Raised type**

It shall include glazed vitreous china basin with siphon, open front solid plastic seat and plastic cover, low level 12.5 litre PVC flushing cistern (same colour of wc) with valveless fittings, supply connections and necessary fittings. All fittings shall be chromium plated. Colour of basin, wc, cistern, seat and cover shall be as desired by the Engineer.

b) **Squatting type**

It shall include glazed vitreous china pan with foot rests and low level 12.5 litre PVC flushing cistern with valveless fittings, supply connections and necessary fittings. All fittings shall be chromium plated. The foot rests shall be made of white glazed vitreous china with chequered surface. Colour of basin, wc, cistern, shall be as desired by the Engineer.

2.5.2 **Urinals**

It shall consist of wall type glazed vitreous china urinals, photo voltaic control flushing cistern complete with supply connections, flush pipe, lead pipes, gratings, traps and all other necessary fittings. All fittings shall be chrome plated.

2.5.3 **Wash basin**

It shall be made of glazed vitreous china. The basin shall be flat back, wall hung by painted cast iron brackets and complete with pattern with hot and cold brass faucets with nylon washers, waste chain, waste washers, lead waste pipes with traps, perforated waste complete with necessary fittings. All fittings including faucets shall be chromium plated. Colour of wash basin shall be as desired by the Engineer.

2.5.4 **Sink**

It shall be made of vitreous china. It shall be wall hung by painted cast iron brackets and complete with one brass faucet with nylon washers, waste chain, waste washers, lead waste pipes with traps, perforated waste with necessary fittings. All fittings including faucets shall be chromium plated.

2.5.5 **Bathroom mirror**

It shall be made of the best quality 6 mm thick glass and produced by a reputed mirror manufacturer. It shall be wall mounted with adjustable revolving brackets. The brackets, screws and other fittings shall be chromium plated.

2.5.6 **Glass shelves**

Glass shelves shall consist of 6 mm thick clear glass with guard rails and shall be wall mounted with brackets. All brackets, guard rails and screws shall be chromium plated.

2.5.7 **Towel rail**

Towel rails shall be 20 mm dia chromium plated MS pipes wall mounted with steel brackets. The brackets, screws etc. shall also be chromium plated.

2.5.8 **Soap holder**

It shall be made of chromium plated strong members. The holders shall be wall mounted with chromium plated screws.

2.5.9 **Liquid soap dispenser**

It shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting and screws shall be chromium plated.

2.5.10 **Toilet roll holder**

It shall be made of glazed vitreous china with suitable cover cum cutter. Wall mounting screws shall be chromium plated.

2.5.11 **Installation**

All plumbing fittings and fixtures shall be installed in most workmanlike manner by skilled workers. These shall be perfect in level, plumb, plane, location and symmetry. All items shall be securely anchored to walls and floors. All cuttings in walls and floors shall be made good by the Contractor.

2.6.0 Septic tank & effluent disposal

2.6.1 **Septic tank**

Septic tank shall consist of the tank itself with inlet and outlets therefrom complete with all necessary earthwork and backfilling. The details of septic tank shall be as shown on drawings. This item shall also include ventilating pipe of at least 100 mm dia whose top shall be provided with a suitable mosquito proof wiremesh and cowl. Ventilating pipe shall extend to a height of about 2 meter when the septic tank is at least 15 meter away from the nearest building and to a height of 2 meter above the top of building when it is located closer than 15 meter. Ventilating pipes can be connected to the normal soil ventilating system of the building where allowed.

2.6.2 Effluent Disposal

The effluent from the septic tank shall be disposed by allowing it into an open channel or a body of water if the concerned authority approves or into a soak pit for absorption by soil or shall be allowed to be absorbed by soil through open jointed CI pipes laid in a trench filled with broken bricks.

2.6.3 Soak pit / Chlorination Chamber

The soak pit shall be complete as shown on drawing. It shall consist of a 900 mm dia pit 1000 mm in depth below the invert level of the inlet pipe. The pit shall be lined with stone, brick or concrete blocks set in cement mortar (1:6) and filled with brick bats. Inlet pipe shall be taken down to a depth of 900 mm from the top as an anti-mosquito measure.

2.6.4 Joining C.I. Pipes / dispersion trenches

Minimum dia of the CI pipe shall be 150 mm nominal. The trench for laying the pipes shall be minimum 600 x 600 mm pipes. The joints of the pipes shall be made with lead. The entire length of the pipe within the trench shall be buried in a 250 mm layer gravel or crushed stone of uniform size. On top of gravel/crushed stone layer is a 150 mm bed of well graded coarse aggregate. Ordinary soil is used for filling the top of trench.

2.6.5 Commissioning septic tank and Soak pit/Chlorination Chamber

After the septic tank has been proved watertight and the sewage system is checked the tank shall be filled with water to its outlet level before the sewage is let into the tank. It shall be seeded with well digested sludge obtained from septic tank or sludge digestion tank. In the absence of digested sludge a small quantity of decaying organic matter such as digested cow-dung may be introduced.

3.0.0 TESTING AND ACCEPTANCE

3.1.0 Inspection before installation

All pipes, fittings and fixtures shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes shall again be inspected on site before laying by sounding to disclose cracks. All defective items shall be clearly marked and forthwith removed from the site.

3.2.0 Testing of Pipelines

Comprehensive tests of all pipe lines shall be made by simulating conditions of use. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review and instruction. The Engineer's discretion regarding tolerance shall be final.

General guidance for the tests are given below :

a) **Smoke test**

All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a smoke test conducted under a pressure of 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oily waste or tar paper or similar material in the combustion chamber of a smoke machine. Chemical smokes are not satisfactory.

b) **Water test**

For pipes other than Cast Iron

Glazed ware and concrete pipes shall be subjected to a test pressure of at least 1.5 m head of water at the highest point of the section under tests. The tolerance figure of two litres per centimeter of diameter per kilometer may be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

Subsidence of test water may due to one or more of the following cases :

a) Absorption by pipes and joints

b) Sweating of pipes or joints

c) Leakage at joints or from defective pipes

d) Trapped air.

Allowance shall be made for (a) by adding water until absorption has ceased and after which the test proper should commence. Any leakage and the defective part of the work shall be cut out and made good.

For cast iron pipes

Cast iron sewers and drains shall be tested as for glazedware and concrete pipes. The drain plug shall be suitably strutted to prevent their being forced out of the pipe during the test.

c) **For straightness**

i) By inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball with roll down the invert of the pipe end emerge at the lower end; and

ii) By means of a mirror at one end of the line and lamp at the other. If the pipe line is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipe line is not straight.

3.3.0 **Testing Septic Tank**

The septic tank shall be tested for watertightness. It shall be filled up with water and allowed to soak for 24 hours. Then, it shall be topped up and allowed to stand again for 24 hours and loss of level recorded. The fall shall not be more than 15 mm.

3.4.0 **Fixtures etc.**

All fixtures and fittings shall be connected by watertight joints. No dripping shall be accepted.

4.0.0 **CODES AND STANDARDS**

Some of the important Codes and Standards relevant to this specification shall be followed : Latest editions shall always be consulted.

IS:1172 - Code of basic requirements for water supply drainage and sanitation.

IS:1200 (Pt. XVI) - Laying of water and sewer lines including appurtenant items.

IS:1239 (Pt. I & II) - Mild Steel Tubes and Mild Steel Tubulars and other wrought steel pipe fittings.

IS:1536 - Centrifugally cast (Spun) iron pressure pipes for water gas and sewage.

IS:1537 - Vertically cast iron pressure pipe for water, gas & sewage.

IS:3486 - Cast Iron spigot & socket drain pipes.

IS:1742 - Code of Practice for building drainage.

IS:5329 - Code of Practice for sanitary pipe work above ground for buildings.

IS:2470 - Code of Practice for designs and construction of septic tank for small and large installations.

IS:3076 - Low density polythelene pipes for potable water supplies.

IS:4984 - High density polythelene pipes for potable water supplies.

IS:1537 - Vertically cast iron pressure pipes for water, gas and sewage.

IS:1538 - Cast Iron fittings for pressure pipes for water, gas & sewage.

IS:1230 - Cast Iron rain water pipes and fittings.

IS:3889 - Centrifugally cast (spun) iron spigot & socket soil waste and ventilating pipes, fittings and accessories.

IS:1729 - Sand cast iron spigot & socket soil, waste and ventilating pipes and accessories.

IS:1626 - Asbestos cement building pipes, gutters and fittings (spigot & socket types).

IS:458 - Concrete pipes (with and without reinforcement)

IS:783 - Code of Practice for laying of concrete pipes.

IS:784 - Prestressed concrete pipes.

IS:651 - Salt glazed stoneware pipes & fittings.

IS:4127 - Code of practice for laying of glazed stoneware pipes.

IS:1726 - Cast Iron manhole covers and frames intended for use in drainage works.

IS:5961 - Cast Iron gratings for drainage purposes.

IS:5219 (Part-I) - 'P' & 'S' traps.

IS:771 - Glazed earthen-ware sanitary appliance.

IS:772 - General requirements of enamelled cast iron sanitary appliances.

IS:774 - Flushing cistern for water closets & urinals (valveless siphonic type).

IS:775 - Cast Iron brackets & supports for wash basins and sinks.

IS:2548 - Plastic water closet seats & covers.

IS:2527 - Code of Practice for fixing rain water gutters and down-pipes for roof drainage.

IS:2556 - Vitreous sanitary appliances.

SECTION - D

SUB-SECTION – D16

ROAD AND DRAINAGE

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	CODES AND STANDARDS
a.	EXECUTION
4.00.00	TESTING AND ACCEPTANCE CRITERIA
5.00.00	MEASUREMENT

Standard Technical Specification For Road And Drainage

1.00.00 Scope

The scope include all works required for the construction of road including construction of embankment, sub-base course, base course, tack coat, bituminous macadam, wearing course, liquid seal coat, shoulder and all incidental items of work specified or not shown but reasonably implied or necessary for the completion of the work etc.

The scope also include all works required for the construction of drainage including construction of road side drains, RCC culverts, pipe culverts, drainage pipes, manholes and all other incidental items necessary for the completion of the work etc.

1.01.00 Works To Be Provided By The Contractor

The works to be provided by the contractor unless specified otherwise shall include but not be limited to the following.

a) Construction of roads including providing all materials, labour, supervision, services, equipments, tools and plants, transportation etc all required for the completion of the work.

b) Submission of detailed scheme of all operations required for executing the work (e.g. material handling, placement, services, approaches etc) to the engineer for approval.

c) Carrying out tests whenever required by the engineer to assess the quality of work and submission of the test results to the engineer after completion of the same etc.

1.02.00 Work To Be Provided By Others

No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

1.03.00 Conformity With Designs

The contractor shall carryout the work as per the construction drawings, specification and as directed by the engineer.

1.04.00 Materials To Be Used

All materials required for the work shall be the best commercial variety and as approved by the engineer.

2.00.00 Codes and Standards

All works under this specification shall conform to the latest revision and/or replacement of the following or any other IRC/IS Codes and Standard Practices unless specified otherwise.

a) Specification for road and bridge works of Ministry of Shipping & Transport (Road Wing) Published by the IRC

b) IRC: 19 - Standard specification and code of practice for Water bound Macadam

c) IRC :SP 11 - Hand Book of Quality Control for Construction of Roads and Runways

d) IS:456 - Indian Standard Code of Practice for Plain and Reinforced Concrete.

e) IS:2212 - Code of Practice for Brick work

f) IS: 783 - Code of Practice for Laying of Concrete Pipes

g) IS: 1201 - Methods of testing tar and bituminous materials to 1220

h) IS: 73 - Specification for paving bitumen

i) IS: 215 - Specification for Road tar

j) IS: 216 - Coal tar pitch

k) IS: 217 - Specification for cut-back bitumen

l) IS: 454 - Specification for cut-back bitumen from waxy crude

m) IS: 1834 - Specification for hot applied sealing compound for joint in concrete

n) IS: 1838 - Specification for performed fillers for expansion joints in concrete, non extruding and resilient type
Part I Bitumen impregnated fibre

Part II CNSL Aldehyde resin and coconut pith

o) IS : 334 - Glossary of terms relating to bitumen and tar

p) IS: 1077 - Common burnt clay building bricks

q) IS : 3117 - Specification for bitumen emulsion roads (anionic type)

r) IS : 1200 - Method of measurement of building and civil engineering work (Part-17)- Road work including airfield pavements

s) Other specifications mentioned elsewhere in this specification.

In case any particular aspect of work is not covered specifically by the specification/Indian Standard Code of practices, any other standard practice as may be specified by the engineer shall be followed.

2.01.00 Quality Control

The Contractor shall establish and maintain quality control for all materials, procedures, workmanship and equipments used. All works shall conform to the lines, grades, cross sections and dimensions shown on the drawings, specification and as directed by the engineer. Permitted tolerances for road works are described hereinafter.

a) Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of ± 25mm therefrom. The corresponding tolerance for edges of the roadway and lower layers of the pavement shall be ± 40mm.

b) Longitudinal Profile

The finished levels of the sub-grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the engineer and shall not exceed the tolerances as mentioned below.

Sub-grade ± 25 mm
Sub-base ± 20 mm
Base course ± 15 mm
Wearing course ± 10 mm

Tolerance in wearing course shall not be permitted in conjunction with the positive tolerance on base course if the thickness of the wearing course is thereby reduced by more than 6 mm.

c) Surface Regularity of Sub-grade and Pavement Courses

The surface regularity of the completed sub-base, base course and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table - I. The longitudinal profile shall be checked with a 3m long straight edge at the middle of each traffic lane along a line parallel to the centre of the road. The transverse profile shall be checked with a set of three camber boards at intervals of 10m.

TABLE –I

PERMITTED TOLERANCE OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sl. No.	Type of Construction	Longitudinal profile with 3m straight edge					Cross Profile
		Maximum permissible Undulation (mm)	Maximum number of undulations permitted in any 300m length with undulation exceeding (mm)				Maximum permissible variation from specified profile under camber template (mm)
			18	12	10	6	
1	2	3	4	5	6	7	8
1.	Earthen sub-grade	25	30	-	-	-	15
2.	Granular sub-base	15	-	30	-	-	12
3.	Water Bound Macadam with oversize metal (40-90 mm size)	15	-	30	-	-	12
4.	Water Bound Macadam with normal size metal (20-50 mm and 40-63 mm size), Bituminous Penetration Macadam	12	-	-	30	-	8
5.	Surface dressing** (two coat) over WBM (20-50 mm or 40-63 mm size metal), Bituminous penetration macadam	12	-	-	20	-	8

6.	Open graded premix carpet, mix seal Surfacing	10	-	-	-	30	6
7.	Bituminous macadam	10	-	-	-	20***	6
8.	Semi-dense carpet	10	-	-	-	20***	6
9.	Asphaltic Concrete	8	-	-	-	10***	4

Notes:

1. ** For surface dressing in all other cases, the standards of surface evenness will be the same as those for the surface receiving the surface dressing.

2. *** These are for machine laid surfaces. If laid manually due to unavoidable reasons, tolerance upto 50 percent above these values in this column may be permitted at the discretion of the Engineer. However this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 on the table.

3. Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied.

3.00.00 Execution

3.01.00 Setting Out

Within 15 days of the award of contract, the contractor shall prepare and submit to the Engineer detailed drawings/schemes of embankment filling and excavation works as proposed to be executed by him showing the dimensions as per construction drawings and specification adding his proposals of drainage and dewatering of pits, watering and compacting the embankment fill etc. On receiving the approval from the Engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the Engineer and fix permanent points and markers for ease of future checking. These permanent points and markers will be checked by the Engineer and certified by him after which the contractor shall proceed with the work. It should be noted that this checking by the Engineer prior to the start of the work will in no way absolve the contractor of his responsibility of carrying out the work to true lines and levels as per the approved drawings. If any errors are noticed in the Contractor's work at any stage, the contractor at his own risk and cost shall rectify the same. Profiles of the embankment made with Bamboo, earth or other convenient materials and strings shall be set up at suitable intervals for the guidance of the workmen.

3.02.00 Clearing and Grubbing

Before commencement of earthwork, the surface area of ground to be occupied shall be cleared of all fences, trees, logs, stumps, bushes, vegetation, rubbish, slush etc. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below ground level or 300mm below formation level whichever is deeper. After the removal of roots of trees, the pot holes formed shall be filled with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the Engineer. The trees shall be cut into suitable pieces as instructed by the Engineer. Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be burnt or removed from the site to the approved disposal areas as may be specified. Useful materials, saleable timbers, firewood etc shall be the property of the Owner and shall be stacked properly at the work site in a manner as directed by the Engineer.

3.03.00 Filling in Embankment

3.03.01 General

The material used for constructing the embankment shall be earth, moorum, gravel or a mixture of the above or any other material approved by the Engineer. The material shall be free from lumps and clods, boulders and rock pieces, roots and vegetation, harmful salts and chemicals, organic materials, loose silts, fine sands and expansive clays in order to provide a stable embankment. The filling and compaction operation should be such that the best available materials are saved for the top portion and will result in an acceptable and uniform gradation of material and provide impermeability and stability to the embankment when compacted. The size of the coarse material in the mixture of earth shall ordinarily not exceed 75mm. However the Engineer may at his discretion permit the use of material coarser than the specified if he is satisfied that the same will not present any difficulty as regard to the placement and compaction of the fill material are concerned. Ordinarily, only the materials satisfying the density requirements as given below in Table-II shall be employed for embankment construction.

Table - II

Density Requirements of Embankment Materials

Sl. No.	Type of Work	Maximum laboratory dry density when tested as per IS: 2720 (Part - VII)
1.	Embankment upto 3m height	Not less than 1.44 gm/cc
2.	Embankment exceeding 3m height and embankment of any height subject to long period of inundation	Not less than 1.52 gm/cc
3.	Top 0.5m of the embankment below sub-base and shoulders (where earth shoulders are specified)	Not less than 1.65 gm/cc

Expansive clays exhibiting marked swell and shrinkage properties shall not be used for embankment construction.

The material for embankment construction shall be obtained from approved sources with preference given to the materials available from nearby road excavation or any other excavation under the same contract.

3.03.02 Setting Out

After the site clearance, the work shall be set out true to lines, curves, slopes, grades and sections as shown on the approved drawings or as directed by the Engineer. The contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboo, stones, lime, mortar, concrete etc required in connection with the setting out of the works and establishment of the bench marks. The limits of the embankment shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. To ensure the safety, the pegs should normally be fixed about 500mm away from the actual limits of the fill and to be painted in a distinct colour. The centreline of the embankment shall be pegged at regular intervals of 25/30m and at all skews/curves. The actual profile of the embankment shall be made at every third centre line peg with bamboo posts and strings. Preferably prototype profiles developed with wooden planks need to be fixed at every 200m and at the intersection points at curves. The profile shall be about 3m long.

3.03.03 Stripping and Storing top soil

The construction of the earthen embankment by filling shall conform to the dimensions, slopes and other details shown in the approved drawings. Before commencement of the embankment construction, the surface area of ground to be occupied after clearing and grubbing shall be stripped off to a minimum depth of 150mm or more as directed by the Engineer in order to remove all perishable materials and any soil which may become unstable on saturation or may interfere with the development or proper bonding between the foundation and embankment. It is not necessary to remove all the soil containing fine hair like roots but only the rather heavy mats are to be removed. In localities where most of the available embankment fill materials are not conducive to plant growth or when so directed by the Engineer, the top soil suitable for plant growth existing over the embankment foundation areas shall be stripped to specified depths not exceeding 150mm and stored for covering the embankment slopes where revegetation is desired.

3.03.04 Compacting Original Ground

In all cases, the original ground after stripping shall be compacted by rolling with a minimum six passes of 8-10 tonne roller and as directed by the Engineer.

Where the height of the proposed embankment is less than 0.5m and the original ground does not already have a relative compaction of atleast 95 percent of Standard Proctor density (maximum dry density), the same shall be loosened upto a depth of 0.5m and filled in layers not exceeding 250mm in loose thickness and each layer shall be watered and compacted to 100% maximum dry density of the fill material determined in accordance with IS:2720, Part-VII. However before relaying and compacting the loosened material, the surface below this level shall be suitably compacted as directed by the Engineer with a minimum six passes of 8 - 10 tonne roller.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced with approved materials suitably compacted. Embankment work shall not proceed until the foundation soil of the embankment is inspected by the Engineer and approved.

3.03.05 Filling

The embankment material shall be spread uniformly over the entire width of the embankment in layers not exceeding 250mm in loose thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down hereunder. Moisture content of the fill material shall be checked at the source of supply and if found less than that specified for compaction, the same shall be made good either at the source or after spreading

the soil in loose thickness for compaction. In the latter case water shall be sprinkled directly from a hose line or from a truck mounted water tank and flooding shall not be permitted under any circumstances. After adding required amount of water, the soil shall be processed by means of harrows, rotary mixers or by any other approved method until the layer is uniformly wet.

If the material delivered to the road bed is too wet, it shall be dried by aeration and exposure to the sun till the moisture content is acceptable for compaction. Should circumstances arise where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended.

Moisture content of each layer shall be checked in accordance with IS:2720, Part-II and unless otherwise specified shall be so maintained making due allowance for evaporation losses that during compaction, the moisture content shall be in the range of 1 percent above to 2 percent below the optimum moisture content as determined in accordance with IS:2720, Part-VII.

Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the lower layers of the embankment and a maximum size of 60mm when being placed in the top 0.5m portion of the embankment below sub-base.

Hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer to minimise rutting or uneven compaction.

Where the embankment is to be constructed across a low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed layer to a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

3.03.06 Compaction

Compaction equipment approved by the Engineer shall only be employed for construction. If directed by the Engineer, the Contractor shall demonstrate the efficiency of the plant he intends to use by carrying out compaction trials.
Each layer shall be thoroughly compacted to the density as specified in Table-III. Subsequent layers shall be placed only after the finished layer has been tested and accepted by the Engineer.

Table - III

Compaction Requirements For Embankment

Sl. No.	Type of work/material	Field dry density as a percentage of maximum laboratory dry density as per IS : 2720, Part-VII
1.	Top 0.5m portion of embankment below sub-base and shoulders	Not less than 100
2.	Other portions of embankment	Not less than 95

When density measurements reveal any soft area in the embankment, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft area shall be removed and replaced with approved material and compacted to the density requirements and satisfaction of the Engineer.

3.03.07 Drainage

The surface of the embankment at all times during construction shall be maintained at such a cross fall as will shed water and prevent ponding.

3.03.08 Finishing Operations

Finishing operations shall include the work of shaping and dressing the shoulders, road bed and side slopes to conform the alignment, levels, cross sections and dimensions as shown on the drawings or as directed by the Engineer. Both the upper and lower ends of the side slopes shall be rounded off to improve the appearance and merge the embankment with the adjacent terrain.

3.04.00 Turfing With Sods

3.04.01 General

This work shall consist of furnishing and laying live sod of perennial turf forming grass on embankment slopes, shoulders or other locations as shown on the drawings or as directed by the Engineer. Unless otherwise specified the work shall be taken up following the construction of embankment provided the season is favourable for establishment of the sod.

3.04.02 Materials

The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically free from weeds and other undesirable matters. At the time the sod is cut, the grass shall have a length of approximately 50mm and the sod shall be free from any debris.

Thickness of the sod shall be as uniform as possible with about 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that practically all the dense root system of the grass are retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than 250mm x 300mm in size but not so large so that it is convenient to handle and transport without damage. During wet weather the sod shall be allowed to dry sufficiently to prevent rearing during handling and during dry weather it shall be watered before lifting to ensure its vitality and to prevent dropping of soil during handling.

3.04.03 Placing The Sods

The area to be sodded shall be previously constructed to the required slope and cross section. Soil in the area shall be loosened, freed from all stones larger than 50mm size, sticks, stumps and any other undesirable foreign matters etc and brought to a reasonably granular texture to a depth not less than 25mm for receiving the sod.

Where required, top soil shall be spread over the slopes. Prior to placing the top soil, the slopes shall be roughened and wetted in order to have a satisfactory bond. The depth of top soil (to be spread) shall be 75mm.

Following soil preparation and top soiling (if required), fertilizer and ground limestone when specified shall be spread uniformly. After spreading, the materials shall be incorporated in the soil by discing or other means. The prepared sod bed shall be moistened if not already sufficiently moist and the sod shall be placed thereon within 24 hours after the same has been cut. Each sod strip shall be laid in close contact with each other and shall be lightly tamped with suitable wooden or metal tampers so as to eliminate air pockets and to press it into the underlying soil. At points where water may flow over the sod, the upper edges of the sod strips shall be turned into the soil below the adjacent area and a layer of earth shall be placed over it followed by thorough compaction.

3.04.04 Staking the Sods

Where the side slope is 2 to 1 or steeper and the distance along the slope is more than 2m, the sods shall be staked with pegs or nails spaced approximately 500 to 1000mm along the longitudinal axis of the sod strips. Stakes shall be driven approximately plumb through the sods and to be almost flushed with them.

3.04.05 Top Dressing

After the sods have been laid in position, the surface shall be cleaned of any loose sod, excess soil and other foreign materials. Thereafter a thin layer of top soil shall be scattered over the top dressed surface and the area shall be thoroughly moistened by sprinkling water.

3.04.06 Watering and Maintenance

The turfing so laid shall be well watered and protected until final acceptance. Watering shall be done in such a way that no erosion or damage to the sodded areas/embankment occur. The Contractor shall erect necessary warning signs and barriers, repair or replace the sods which are failing to show uniform growth of grass or damaged by his operation and shall maintain the sod at his own cost until final acceptance.

3.05.00 Shoulder Construction

3.05.01 Description

This work shall consist of constructing shoulder on either side of the pavement in accordance with the requirements of this specification and in conformity with the lines, grades and cross sections shown on the approved drawings and as directed by the Engineer.

3.05.02 Materials

Shoulder shall be made of selected earth or granular material as specified conforming to relevant IRC standards.

3.05.03 Construction Operations

Except in the case of bituminous pavements, the shoulders shall be constructed in advance to the laying of pavement courses. The compacted thickness of each layer of shoulder shall correspond to the compacted layer of pavement course to be laid adjacent to it. After compaction, the inside edges of shoulders shall be trimmed vertical and the area enclosed between the shoulders shall be cleaned of all spilled materials before proceeding with the construction of the pavement layer.

In the case of bituminous pavements, shoulder shall be constructed only after the pavement courses have been laid and compacted.

Regardless of the method of laying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface

shall be immediately removed without any damage to the pavement and the area so affected shall be thoroughly cleaned. During all stages of shoulder construction, the required crossfall shall be maintained to drain off surface water.

3.06.00 Kerb

3.06.01 Material

Kerb if required for the construction of footpath shall consist of precast concrete blocks with concrete grade of M-20. The blocks shall be of 100mm thick and of suitable length. The depth of blocks unless otherwise mentioned elsewhere shall be 375mm considering 225mm height of footpath above the road level.

3.06.02 Laying

The kerb shall be laid by cutting trenches of 150mm deep. The width of the trench shall be minimum and just sufficient to insert the kerbs. The inside faces of the kerbs shall be in plumb and the gap between the block shall not be more than 10mm.The gap shall be filled with cement mortar as specified.

The kerbs shall be thoroughly packed with a mixture of stone chips (50%) and moorum (50%) at the outside face. The laying and packing shall be done in a proper workmanlike manner acceptable to the Engineer.

3.07.00 Sub-base (Granular Sub-base)

3.07.01 Description

This work shall consist of laying and compacting well graded material on the prepared sub-grade in accordance with the specification. The material shall be laid in one or more layers as shown on the drawings and shall conform to the lines, grades and cross sections shown on the drawings and as directed by the Engineer.

3.07.02 Materials

The materials to be used for the work shall be natural sand, moorum, gravel, crushed stone, crushed slag, crushed concrete, brick metal, laterite, kankar etc or combinations thereof depending upon the grading required. The mixed materials shall be free from organic and other deleterious constituents and conform to one of the three grading given in Table - IV below.

Table - IV
Grading for Granular Sub-base Material

Sieve designation	Percent by weight passing the sieve		
	Grading 1	Grading 2	Grading 3
80 mm 63 mm 4.75 mm 75 micron	100 90 - 100 35 - 70 0 - 20	100 90 - 100 40 - 90 0 - 25	100 90 - 100 50 - 100 0 - 30
Minimum CBR value for the fraction of material passing 20 mm sieve.	30 %	25%	20%

Note : The materials passing 425micron sieve for all the three gradings when tested according to IS : 2720, Part V shall have liquid limit and plasticity index not more than 25 percent and 6 percent respectively.

3.07.03 Physical Requirements

The fraction of materials passing 20mm sieve shall give a CBR value as specified in Table – IV when tested in accordance with IS : 2720, Part XVI after preparing the samples at maximum dry density and optimum moisture content corresponding to IS : 2720, Part VII and soaking the same in water for 4 days.

3.07.04 Spreading and Compacting

Immediately prior to laying of sub-base, the sub-grade already finished shall be prepared by removing all vegetations and other extraneous matters, lightly sprinkled with water if necessary and rolled with one pass of 8 - 10 tonne smooth wheeled roller.

The sub-base material shall be spread on the sub-grade with the help of a drag spreader, motor grader or other approved means. The thickness of loose layers shall be so regulated that the maximum thickness of each layer after compaction shall not exceed 150mm.

Moisture content of the loose material shall be checked in accordance with IS : 2720, Part II and shall be suitably adjusted by sprinkling additional water from a hose line, truck mounted water tank or other approved means so that at the time of compaction it shall be from 1 percent above to 2 percent below the optimum moisture content. While adding water, due allowance shall be made for evaporation losses. After water

has been added, the material shall be processed by mechanical or other approved means if so directed by the Engineer until the layer is uniformly wet.

Immediately thereafter, rolling shall be done with 8 to 10 tonne smooth wheeled rollers or with any other approved plant. Rolling shall commence from the edges and progress towards the centre longitudinally except on super elevated portions where it shall progress from the lower to the upper edge parallel to the centre line of the pavement. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and camber shall be checked and any high spots or depressions which become apparent shall be corrected by removing or adding fresh material.

Rolling shall be continued till the density achieved is at least 100% of the maximum dry density of the material determined as per IS : 2720, Part VII. The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction plant and from compaction planes, ridges, cracks or loose materials. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and recompacted.

3.08.00 Water Bound Macadam Sub-base/Base Course

3.08.01 Description

Water bound macadam shall consist of clean crushed aggregates mechanically interlocked by rolling and bonded together with screenings, binding material wherever necessary and water, laid on the prepared sub-grade or sub-base as the case may be and finished in accordance with the specification and in conformity with the lines, grades and cross-sections shown on the approved drawings.

3.08.02 Materials

a) Coarse Aggregates - General Requirements

Coarse aggregates shall be either crushed or broken stone. The aggregates shall conform to the physical requirements set forth in Table - V.

Table – V

Physical Requirements of Coarse Aggregates for Water Bound Macadam

Sl.No.	Type of Construction	Test	Test method	Requirements
1.	Sub-base	Los Angeles Abrasion Value *	IS : 2386 (Part IV)	50 percent maximum
		or		
		Aggregate Impact Value	IS : 2386 (Part IV) or IS : 5640**	40 percent maximum
2.	Base	a) Loss Angeles Abrasion value*	IS : 2386 (Part IV)	50 percent maximum
		or		
		Aggregate Impact Value	IS : 2386 (Part IV) or IS : 5640 **	40 percent maximum
		b) Flakiness Index ***	IS : 2386 (Part I)	15 percent maximum

* Aggregates shall satisfy requirements of either of the two tests.

** Aggregates like brick metal, kankar and laterite which get softened in presence of water shall be tested for impact value under conditions in accordance with IS : 5640.

*** The requirements of Flakiness Index shall be enforced only in case of crushed or broken stone and crushed slag.

b) Crushed or Broken Stone

Crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other objectionable matters.

c) Grading Requirements of Coarse Aggregates

The coarse aggregates shall conform to one of the gradings given in Table – VI. However the use of Grading-1 shall be restricted to sub-base courses only.

Table - VI
Grading Requirements of Coarse Aggregates

Grading	Size range	Sieve designation	Percent by weight passing the sieve
1.	90mm to 40 mm	100 mm 80 mm 63 mm 40 mm 20 mm	100 65 - 85 25 - 60 0 - 15 0 - 5
2.	63 mm to 40 mm	80 mm 63 mm 50 mm 40 mm 20 mm	100 90 - 100 35 - 70 0 - 15 0 - 5
3.	50 mm to 20 mm	63 mm 50 mm 40 mm 20 mm 10 mm	100 95 - 100 35 - 70 0 - 10 0 - 5

d) Screenings

Screenings to fill the voids in the coarse aggregate shall generally consist of the same material as the coarse aggregates. However where permitted, predominantly non-plastic material such as moorum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material is below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 percent.

As far as possible, screenings shall conform to the grading set forth in Table-VII. Screenings of Type-A in Table-VII shall be used with coarse aggregates of Grading-1 in Table-VI. Screenings of Type-A or B shall be used with coarse aggregates of Grading-2. Screenings of Type-B shall be used with coarse aggregates of Grading-3.

Table - VII
Grading For Screenings

Grading classification	Size of screenings	Sieve designation	Percent by weight passing the sieve
A	12.5 mm	12.5 mm 10.0 mm 4.75 mm 150 micron	100 90 - 100 10 - 30 0 - 8
B	10 mm	10 mm 4.75 mm 150 micron	100 85 - 100 10 - 30

e) Binding Material

Binding material to be used for water bound macadam construction shall comprise of a suitable material approved by the Engineer having plasticity index value less than 6 as determined in accordance with IS : 2720,Part V. Application of binding material may not be necessary when the screenings used are of crushable type such as moorum or gravel.

3.08.03 Construction Operations

a) The sub-grade/sub-base to receive the water bound macadam coarse shall be prepared to the specified grade and camber and made free of any dust and other extraneous materials. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm. Where water bound macadam is to be laid over an existing black topped surface, 50mm x 50mm furrows shall be cut at an angle of 45 degrees to the centre line of the road at 1m intervals in the latter before laying the coarse aggregates.

b) Inverted Choke

If water bound macadam is to be laid directly over the sub-grade without any other intervening pavement course, a 25mm course of screenings (Grading-B) shall be spread on the prepared sub-grade before application of coarse aggregates is taken up.

c) Spreading Coarse Aggregates

The coarse aggregates shall be spread uniformly over the prepared surface in such quantities that the thickness of each compacted layer is limited to 100mm for Grading-1 and 75 - 100mm for Grading-2 and 3. The spreading shall be done from stockpiles along the side of the roadway or directly from the vehicles. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregates nor shall hauling over permitted. The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregates as spread shall be of uniform gradation with no pockets of fine material. The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operation.

d) Rolling

Immediately following the spreading of the coarse aggregates, rolling shall be started with three wheeled power rollers of 8 to 10 tonne capacity or with tandem or vibratory rollers of approved type. The weight of the roller shall depend upon the type of the aggregate and be indicated by the Engineer.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centre line of the road. Each pass of the roller shall uniformly overlap not less than one half the width of the track made in the preceding pass.

Rolling shall continue until the aggregates are thoroughly keyed and the creeping of aggregates ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wavelike motion in the sub-grade or sub-base course.

The rolled surface shall be checked transversely and longitudinally with templates and any irregularities found shall be corrected by loosening the surface, adding or removing necessary amount of aggregates and rerolled until the entire surface conform to the desired camber and grade. In no case shall the use of screenings be permitted to make up the depressions.

e) Application of Screenings

After the coarse aggregate has been rolled, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time

of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregates. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanical spreader or directly from trucks. Trucks operating for spreading the screenings shall be so driven as not to disturb the coarse aggregates.

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms or hand brooms or with both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregates.

The spreading, rolling and brooming of screenings shall be carried out in only such lengths of road which could be completed within one day's operation.

f) Sprinkling and Grouting

After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to seep the wet screenings into the voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued with additional screenings applied as necessary until the coarse aggregates are thoroughly keyed, well bonded and firmly set to its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or sub-grade does not get damaged due to the addition of excess quantity of water during construction.

g) Application of Binding Material

After the application of screenings, the binding material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water and the resulting slurry shall be swept in with hand brooms or mechanical brooms to fill the voids properly and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling the voids form a wave ahead of the wheels of the moving roller.

h) Setting and Drying

After the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding

material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam is set. The Engineer shall have the discretion to stop hauling traffic from using the complete water bound macadam course if in his opinion it would cause excessive damage to the surface.

3.09.00 Tack Coat

3.09.01 Description

The work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction.

3.09.02 Materials

The binder used for tack coat shall be bitumen of a suitable grade as approved by the Engineer and conforming to IS-73, IS-217 or IS-454 as applicable or any other approved cutback.

3.09.03 Construction Operations

a) Preparation of Base

The surface on which the tack coat is to be applied shall be thoroughly swept and scraped clean of dust and any other extraneous materials before the application of the binder.

b) Application of Binder

Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer and sprayed on the base at the rate specified below. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be supplied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction.

3.10.00 Bituminous Macadam Binder Course

3.10.01 Description

This work shall consist of construction in a single course of 50mm/75mm thickness of compacted crushed aggregates premixed with a bituminous binder laid immediately after mixing on a base prepared previously in accordance with the specification and in conformity with the lines, grades and cross sections shown on the approved drawin

3.10.02 Materials

a) Binder

The Binder shall be straight run bitumen of a suitable grade as directed by the Engineer complying with IS : 73.

b) Aggregates

The aggregates shall consist of crushed stone, crushed gravel (shingle) or other stones. They shall be clean, strong, durable, fairly cubical in shape and free from any disintegrated pieces, organic and other deleterious matter and adherent coats. The aggregates shall preferably be hydrophobic and of low porosity.

The aggregates shall satisfy the physical requirements set forth in Table - VIII.

Table – VIII
Physical Requirements of Aggregates For Bituminous Macadam

Sl. No.	Test	Test method	Requirements
1.	Los Angeles Abrasion Value *	IS : 2386 (Part IV)	35 percent maximum
2.	Aggregate Impact Value *	IS : 2386 (Part IV)	30 percent maximum
3.	Flakiness Index	IS : 2386 (Part I)	35 percent maximum
4.	Stripping Value	IS : 6241 (Part IV)	25 percent maximum
5.	Water Absorption	IS : 2386 (Part III)	2 percent maximum

*Aggregates may satisfy requirements of either of the two tests.

The aggregates for bituminous macadam for different thickness shall conform to Grading- A or B as given in Table-IX or X as the case may be.

Table-IX
Aggregates Grading For 75mm Compacted Thickness Of Bituminous Macadam

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
63 mm	100	
50 mm	90 - 100	
40 mm	35 - 65	100
25 mm	20 - 40	70 - 100
20 mm	-	50 - 80
12.5 mm	5 - 20	-
4.75 mm	-	10 - 30
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

Table-X
Aggregates Grading For 50mm Compacted Thickness Of Bituminous Macadam

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
50 mm	100	
40 mm	90 - 100	
25 mm	50 - 80	100
20 mm	-	70 -100
12.5 mm	10 - 30	-
10 mm	-	35 - 60
4.75 mm	-	15 - 35
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

c) Proportioning of Materials

The binder content for premixing shall be 3.5 and 4.0 percent by weight of the total mix for aggregate Grading-A and B respectively unless directed otherwise by the Engineer. The quantity of aggregates to be used shall be sufficient to yield the specified thickness after compaction.

d) Variation in Proportioning of Materials

The Contractor shall have the responsibility for ensuring proper proportio-

ning of materials and producing a uniform mix. A variation in binder content upto ± 0.3 percent by weight of total mix shall however be permissible for individual specimens taken for quality control tests.

3.10.03 Construction Operations

a) Weather and Seasonal Limitations

Bituminous macadam shall not be laid during rainy weather or when the base course is damp or wet.

b) Preparation of Base

The base on which the bituminous macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross sections as shown on the drawings and as directed by the Engineer. The surface shall be thoroughly swept and scraped clean and free of any dust and foreign matter.

c) Tack Coat

A tack coat shall be applied over the base.

d) Preparation and Transport of Mix

Hot mix plant of adequate capacity shall be used for preparing the mix. The temperature of binder at the time of mixing shall be in the range 150 Deg. - 165 Deg. C and to that of aggregates shall be in the range 125 Deg. - 150 Deg. C provided the temperature difference between the binder and the aggregate at no time exceeds 25 Deg. C. Mixing shall be thorough to ensure that a homogenous mixture is obtained in which all particles of the aggregates are coated uniformly. The mixture shall be transported from the mixing plant to the point of use in a suitable vehicle. The vehicle employed for transport shall be clean and be covered over in transit if so directed by the Engineer.

e) Spreading

After mixing, the mix shall be spread immediately by means of a self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix to the specified lines, grade and cross sections. However in restricted locations and in narrow widths where the available plants cannot operate in the opinion of the Engineer may permit

manual laying of the mix. The temperature of mix at the time of laying shall be in the range 110 Deg. - 135 Deg. C.

In multilayer construction, the longitudinal joint in one layer shall offset into the layer below by about 150mm. However, the joint in the topmost layer shall be at the centre line of the pavement.

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

f) Rolling

After spreading of mix, the rolling shall be done with 8 to 10 tonne power roller or with any other approved plant. Rolling should start as soon as the materials are spread. Rolling shall be done with care to avoid any undulation in the pavement surface.

Rolling on the longitudinal joint shall be done immediately after the paving operation. After this, the rolling shall commence at the edges and progress towards the centre longitudinally except on superelevated portions where it shall progress from the lower to the upper edge parallel to the centre line of the pavement.

The initial or breakdown rolling shall be done as soon as it is possible to roll the mixture without cracking the surface and no mix pick up on the roller wheels. The second or intermediate rolling shall follow the break down rolling as early as possible and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while the material is still workable enough for removal of roller marks.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding fresh materials. The rolling shall then be continued till the entire surface has been rolled to compaction and there is no crushing of aggregates and till all the roller marks are eliminated. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheels shall be kept damp if necessary to avoid the bituminous material from sticking on the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose.

Rolling operation shall be completed in every respect before the temperature of the mix fall below 80 Deg. C.

Rollers shall not stand on the newly laid material as it may lead to undue deformation. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

The bituminous macadam shall be provided with a final surfacing without any delay. If there is to be any delay the course shall be covered by seal coat before allowing any traffic over it.

3.11.00 Open Graded Premix Carpet

3.11.01 Description

This work shall consist of laying and compacting open graded carpet of specified thickness in a single course of suitable small sized aggregates premixed with bituminous binder on a previously prepared base to form wearing course in accordance with the specification.

3.11.02 Materials

a) Binder

The binder shall be bitumen of suitable grade as approved by the Engineer and satisfying the requirements of IS: 73, 217, 454 or any other approved cutback as applicable.

b) Aggregates

The aggregates shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be obtained by crushing rock, gravel or river shingle and be free of elongated and flaky pieces, soft and disintegrated materials, vegetable and any other deleterious matter etc. They shall preferably be hydrophobic type. The aggregates shall satisfy the quality requirements set forth in Table-VIII except that the flakiness Index shall be limited to a maximum of 30.

c) Proportioning of Materials

The materials shall be proportioned as per the quantities given in Table-XI for 20mm thick open graded premix carpet.

Table - XI

Quantity of Materials Required For 10 Sq. M of Road Surface For 20mm Thick Open Graded Premix Carpet

Aggregates for Carpet		
i)	Stone Chippings - 12mm size ; passing 20 mm sieve and retained on 10 mm sieve	0.18 Cu.m
ii)	Stone Chippings - 10 mm size; passing 12.5 mm sieve and retained on 6.3 mm sieve	0.09 Cu.m
	Total	0. 27 Cu.m
Binder for premixing (quantities in terms of straight run bitumen)		
i)	For 0. 18 Cu.m of 12 mm size stone Chippings at 52 Kg per Cu.m	9.5 Kg
ii)	For 0.09 Cu. M of 10mm size stone Chippings at 56 Kg per Cu.m	5.1 Kg
	Total	14.6 Kg

3.11.03 Construction Operation

a) Weather and Seasonal Limitations

Open graded premix carpet shall not be laid during rainy weather or when the base course is damp or wet or when the atmospheric temperature in shade is 16 Deg. C or below.

b) Preparation of Base

The underlying base on which the bituminous carpet is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section in accordance with the drawing, specification and as directed by the Engineer. The surface shall be well cleaned by removing caked earth and other foreign matters with wire brushes, sweeping with brooms and finally dusting with sacks as necessary.

c) Tack Coat

A tack coat complying with clause 3.09.00 shall be applied over the base preparatory to laying of the carpet. However application of tack coat shall not be necessary when the laying of carpet follows soon after laying the bituminous course.

d) Preparation of Premix

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated to the temperature appropriate to the grade of bitumen approved by the Engineer in boilers of suitable design avoiding local overheating and ensuring a continuous supply. The aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before these are placed in the mixer. After about 15 seconds of dry mixing, the heated binder shall be distributed over the aggregates at the rate specified. The mixing of binder with chipping shall be continued until the chippings are thoroughly coated with the binder. The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or wheel barrows. The vehicles employed for transport shall be clean and be covered over in transit if so directed.

e) Spreading and Rolling

The premixed material shall be spread on the road surface with rakes to the required thickness and camber or distributed evenly with the help of a drag spreader without any undue loss of time. The camber shall be checked by means of camber boards and inequalities evened out. As soon as sufficient length of bituminous material are laid, rolling shall be commenced with 6 to 8 tonne power rollers preferably with smooth wheel tandem type or with any other approved plant. Rolling shall begin at the edges and progress toward the centre longitudinally except on the superelevated portions where it shall progress from the lower to upper edge parallel to the centre line of the pavement.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled to compaction and all the roller marks have been eliminated. In each pass of the roller, preceding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose. Rollers shall not stand on newly laid material as it may lead to undue deformations.

The edges along and transverse of the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of approved binder before the new mix is placed against it.

f) Seal Coat

A seal coat conforming to clause 3.12.00 shall be applied to the surface immediately after laying the carpet. No traffic shall be allowed on the road till the seal coat has been placed.

3.12.00 Seal Coat

3.12.01 Description

This work shall consist of application of a seal coat as specified for sealing the voids in the bituminous surface laid to the specified levels, grade and camber.

Type-A : Liquid seal coat comprising of an application of a layer of bituminous binder followed by a cover of stone chippings.

Type-B : Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder.

3.12.02 Materials

a) Binder

The binder shall be bitumen of suitable grade as directed by the Engineer and conforming to the requirements of IS : 73, 217 or 454 as applicable or any other approved cutback.

The quantity of binder to be adopted in terms of straight run bitumen shall be 9.8 Kg and 6.8 Kg per 10 square metre area for Type-A and Type-B seal coat respectively.

b) Stone Chippings for Type A Seal Coat

The stone chippings shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be free of elongated or flaky pieces, soft or disintegrated stone, vegetable or other deleterious matters etc. Stone chippings shall be of 6mm size defined as 100 percent passing through 10mm sieve and retained on 2.36mm sieve. The quantity used for spreading shall be 0.09 cu.m per 10 sq.m area. The chippings shall satisfy the quality requirements spelled out in Table-VIII except that the upper limit for flakiness Index shall be 30.

c) Fine Aggregate for Type B Seal Coat

The fine aggregate shall be sand or fine grit and shall consist of clean, hard, durable, uncoated dry particles and shall be free from dust, soft or flaky material, organic matter

or other deleterious substances. The aggregate shall pass 1.7 mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.06 cubic metre per 10 square metre area.

3.12.03 Construction Operations

a) Preparation of Base

The seal coat shall be applied immediately after laying the bituminous course which is required to be sealed. Before application of seal coat, the surface shall be cleaned free of any dust or other extraneous matters.

b) Construction of Type-A Seal Coat

The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer and sprayed on the dry surface in a uniform manner preferably with the help of mechanical sprayers. Excessive deposits of binder caused by stopping or starting of the sprayer or through leakage or due to any other reason shall be suitably corrected before the stone chippings are spread.

Immediately after the application of binder, stone chippings in a dry and clean state shall be spread uniformly on the surface preferably by means of a mechanical grittier or otherwise manually so as to cover the surface completely. If necessary the surface shall be broomed to ensure uniform spread of chippings. Immediately after the application of the cover material, the entire surface shall be rolled with a 8 - 10 tonne smooth wheeled roller. Rolling shall commence from the edges and progress towards the centre except in superelevated portions where it shall proceed from the inner edge to the outer. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. While rolling is in progress additional chippings shall be spread by hand in whatever quantities required to make up the irregularities. Rolling shall continue until all aggregate particles are firmly bedded in the binder and present an uniform closed surface.

c) Construction of Type-B Seal Coat

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer. Also the aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before the same are placed in the mixer. Mixing of binder with aggregates to the specified proportions shall be continued till the latter is thoroughly coated with the former. The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed. As soon as sufficient length has been covered with the premixed material, the surface shall be

rolled with 6 - 8 tonne smooth wheeled power rollers. Rolling shall be continued till the premixed material completely seals the voids in the bituminous course and a smooth uniform surface is obtained.

3.12.04 Opening to Traffic

In case of Type-B Seal coat, traffic may be allowed soon after the final rolling when the premixed materials are cooled down to the surrounding temperature. However in case of Type- A seal coat, the traffic shall not be permitted until the following day.

3.13.00 Repair of Existing Water Bound Macadam Surfaces

Pot holes or patches and ruts in the water bound macadam base or surface course which is to be surface treated shall be repaired by removing all loose materials by cutting in rectangular patches and replacing with suitable materials. The repair shall be done as under.

Pot holes, patches and ruts shall be drained of any water and cut to regular shape with vertical sides and then be filled either with i) coarse aggregates and screenings conforming to the specification for water bound macadam and compacted with rollers or other approved rammer etc or with ii) premixed material conforming to the specification for open graded premix carpet and compacted with rollers or other approved means after painting the sides and bottom of the holes with a thin application of bitumen or a combination of both as directed by the Engineer.

3.14.00 Road Side Drains

3.14.01 Drains

The road side drains shall be made in sizes and slopes as shown on the approved drawings. The sides and bottom shall be neatly dressed after excavation. Proper connections shall be made to the culverts outside the plant area as per the drawings and instructions of the Engineer.

The excavated spoils other than that required for backfilling shall be transported and filled in low areas within the plant area or in embankments as instructed by the Engineer. The lining for drains shall be as per the drawings. Lining of drains may be of bricks or cement concrete blocks of specified grade as shown on the approved drawing or as directed by the Engineer. If shown on approved drawing, drains shall be of R.C.C. construction with necessary slopes.

3.15.00 Culverts

Excavation in trenches for foundation of culverts and wing walls shall be done with side slopes as per the drawings and instructions of the Engineer after clearing the site etc. As described in the "Specification for Earthwork in Excavation and Backfilling", backfilling in layers with watering and compaction shall be done after the construction of foundations. The construction of culverts shall be done true to the lines and levels as shown on the drawings. The specification for Masonry and/or Plain and Reinforced Cement concrete shall be followed as applicable.

3.16.00 Pipe Culverts and Drainage Pipes

3.16.01 Materials

The drainage pipes shall be made of R.C.C and shall be either class NP-2 or NP-3 as shown on the approved drawings. Pipe culverts shall be made of reinforced concrete pipe and shall be of class NP4 or RDSO class for railways as shown in the drawing. All pipes shall meet the requirements of IS : 458 and shall be procured from approved manufacturers with collars as per manufacturer's specification. The tenderer shall specifically mention the particular manufacturer's product he proposes to use.

Cement shall be ordinary Portland Cement as per IS:269. Coarse Aggregates shall be as per IS:383. Maximum size shall not exceed one third the thickness of the pipe or 20 mm whichever is smaller. Fine aggregates for concrete shall be as per IS:383.

3.16.02 Laying of Pipes

Laying of concrete pipes shall correspond to IS:783 and as per the specification given below.

a) The foundation bed for pipe shall be excavated true to lines and grades shown on the drawings and as directed by the Engineer. When trenching is involved, its width on either side of the pipe shall not be less than 150mm and not more than one third the diameter of pipe unless otherwise instructed/permitted by the Engineer. The sides of the trench shall be as nearly vertical as possible. Side slope, shoring, bailing out water etc as required shall be done by the Contractor.

Side slips if there be any shall be removed by the Contractor. After laying of the pipes are completed, backfilling of the trenches shall be done as per "Specification for Earthwork in Excavation and Backfilling" to the satisfaction of the Engineer. The surplus spoils shall be transported and filled in low areas within the plant area as instructed by the Engineer.

When bedrock or boulder stratum is encountered during excavation, the excavation shall be taken down to at least 200mm below the bottom of the pipe with prior permission of the Engineer and all rock/boulders in the area shall be removed and space filled with approved earth free from stone or fragmented materials, shaped to the requirements and thoroughly compacted to provide adequate support for the pipe.

Filling of trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur and shall be done as per the "Specification for Earthwork in Excavation and Backfilling". When two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to a minimum of 450 mm. Laying of pipes shall start from the outlet and proceed towards inlet. All pipes and fittings shall be gradually lowered into the trench or placed on the supports by approved means taking due care to avoid any damage. Under no circumstances the pipes shall be dropped into the trench or on supports from heights.

b) Pipe bedding shall be first class projection bedding for positive projecting pipes as per IS : 783 having a projection ratio not greater than 0.70. The pipe shall be carefully laid on bedding made up of fine granular materials in an earth foundation; the bedding shall be carefully shaped to fit the lower part of the pipe exterior for at least ten percent of its overall height and in which the fill material is thoroughly compacted in layers not exceeding 150mm in depth around the pipe for the remainder of the pipe laid in trench.

When indicated on the drawings or directed by the Engineer, the pipe shall be bedded on a cradle constructed of concrete having a mix not leaner than M-15. The shape and dimension of the cradle shall be as indicated on the drawing or as directed by the Engineer. The pipe shall be laid on the concrete bedding before the concrete is set.

c) The drop walls shall be made with first class brickwork in 1:4 cement mortar.

d) The pipe culverts shall be made with proper care with respect to the invert of the pipe, gradient if any etc as specified on the drawings and as instructed by the Engineer.

e) Where R.C.C pipes are encased in concrete at road crossings or at other places the pipes need be suitably supported avoiding reinforcements of concrete blocks, joints properly done before concreting is taken up. Concreting of total height of block may be done in a single operation or may be done upto some height for pipes to be properly laid in position and the balance height of the block shall be concreted subsequently.

f) The R.C.C. pipes shall be joined with cement mortar. Cement mortar shall consist of 1 part of cement and 2 part of clean sand with only enough water for workability. Procedure of jointing shall be as per IS : 783.

3.16.03 Relation With Water Supply Pipeline

Unless specifically cleared by the Engineer, under no circumstances shall the drainage pipes be allowed to come close to water supply pipelines.

3.17.00 Manholes and Inspection Chambers

The maximum distance between the manholes shall be 30m unless specifically permitted otherwise. In addition, at every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The distance between the manhole or inspection chamber and gully chamber shall not exceed 6 meters unless permitted otherwise. Manhole shall be constructed so as to be water tight under test. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide a smooth flow. Connection to the existing pipelines shall be through a manhole. Manholes shall be provided with standard covers usually of C.I. or as directed by the Engineer. The cover shall be closely fitted so as to prevent gases from coming out.

4.00.00 Testing And Acceptance Criteria

All testing as mentioned in the specification and as mentioned in Clause No. 900 of the "Specification for Roads and Bridge Works, 1983" published by IRC on behalf of Ministry of Shipping and Transport (Roads Wing) shall be carried out by the Contractor as per the direction of the Engineer.

5.00.00 MEASUREMENT

Method of measurement shall be as per the latest version of IS:1200, Part-17 and as directed by the Engineer.

SECTION - D

SUB-SECTION – D17

FABRICATION OF STRUCTURAL STEEL WORK

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	GENERAL
3.00.00	WORKMANSHIP
4.00.00	INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY
5.00.00	INFORMATION TO BE SUBMITTED
6.00.00	RATES AND MEASUREMENTS

SUB-SECTION – D XVII

FABRICATION OF STRUCTURAL STEEL WORK

1.00.00 SCOPE

This specification covers supply, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and rivets, bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork covered under the scope of the contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Contractor

The work to be provided for by the Contractor, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following

a) Preparation of complete detailed fabrication drawings and erection marking drawings required for all the structures covered under the scope of the contract based on the approved design drawings. As decided by the Engineer, some or all of these detailed drawings will have to be submitted for approval.

b) To submit revised design with calculations and detailed fabrication drawings in case any substitution of the designed sections are to be made.

c) To submit design calculations for joints and. connections developed by the contractor along with detailed fabrication drawings.

d) Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary rivets, bolts, nuts, washers, tie rods and welding electrodes for field connections,

e) Furnish shop painting of all fabricated steelwork as per requirements of this Specification.

f) Suitably mark, bundle, and pack for transport all fabricated materials.

g) Prepare and furnish detailed Bill of Materials, Drawing Office Dispatch lists, Rivet and Bolt List and any other list of bought out items required in connection with the fabrication and erection of the structural steelwork.

h) Insure, load and transport all fabricated steelwork field connection materials to site.

i) Maintain a fully equipped workshop at site for fabrication, modification and repairs of steelwork at site as may be required to complete the works in accordance with the Contract.

2.02.00 Work by others

No work under this specification will be provided for by any agency other than the contractor, unless specifically mentioned otherwise elsewhere in the contract.

2.03.00 Codes and standards

All work under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard specification, any other standard practice, as may be specified by the Engineer shall be followed:

IS : 226 - Structural steel (Standard Quality)

IS : 800 - Code of Practice for general construction in steel.

IS : 806 - Code of practice for use of steel tubes in general building construction.

IS : 808 - Rolled steel beams, channels, and angle sections

IS : 813 - Scheme of symbols for welding

IS : 814 - Covered electrodes for metal arc welding of structural steel

IS : 815 - Classification and coding of covered electrodes for metal arc welding of structural steels.

IS : 816 - Code of practice for use of metal arc welding for general construction in mild steel

IS : 817 - Code of practice for training and testing metal arc welders

IS : 818 - Code of practice for safety and health requirements in electric and gas welding and cutting operations

IS : 822 - Code of practice for inspection of welds

IS : 919 - Recommendations for limits and fits for Engineering
IS : 961 - Structural Steel (High Tensile)

IS : 1148 - Rivet bars for structural purposes

IS : 1149 - High tensile rivet bars for structural purposes

IS : 1161 - Steel Tubes for structural purposes

IS : 1200 - Method of measurement of steelwork and ironwork (Part 8)

IS : 1239 - Mild Steel Tubes

IS : 1363 - Black hexagon bolts, nuts and lock nuts (dia. 6 to 30 mm) and black hexagon screws (dia 6 to 24 mm)

IS : 1364 - Precision and semi-precision hexagon bolts, screws, nuts and l locknuts (dia, range 6 to 39 mm)

IS : 1367 - Technical supply conditions for threaded fasteners

IS : 1442 - Covered electrodes for the metal are welding of high tensile structural steel

IS : 1608 - Method for tensile testing of steel products other than sheet strip, wire and tube

IS : 1730 - Dimensions for steel plate, sheet, and strip for structural and general engineering purposes.

IS : 1731 - Dimensions for steel flats for structural and general engineering purposes

IS : 1852 - Rolling and cutting tolerances for hot-rolled steel products

IS : 1977 - Structural steel (ordinary quality) St-42-0

IS : 2062 - Steel for General Structural Purposes

IS : 2074 - Ready mixed paint, red oxide Zinc chromate priming

IS : 2595 - Code of Practice for Radiographic Testing

IS : 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and Steel

IS : 2633 - Method for testing uniformity of coating on Zinc Coated Articles
IS : 3757 - High strength structural bolts

IS : 4759 - Specifications for Hot-Dip Zinc Coatings on Structural Steel and other allied products

IS : 7205 - Safety Code for Erection of Structural Steelwork

IS : 7215 - Tolerances for fabrication of steel structures

IS : 7280 - Bare wire electrodes for submerged arc welding of structural steels.

IS : 9595 - Recommendations for metal arc welding of carbon and carbon manganese steels.

2.04.00 Conformity with Designs

The contractor shall design all connections, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Engineer keeping in view the maximum Utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Engineer. Provision of all relevant Indian Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract.

2.05.00 Materials to be used

2.05.01 General

All steel materials required for the work will be supplied by the contractor unless otherwise specified elsewhere in the contract. The materials shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance. All materials shall be of tested quality only unless otherwise permitted by the Engineer and/or Consultant. If desired by the Engineer, Test Certificates in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks, if permitted by the Engineer, a random sample shall be tested at an approved laboratory from each lot of 50 tones or less of any particular section.

The arc welding electrodes shall be of approved reputed manufacture and conforming to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric.

With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and amperage (Polarity in case of D.C. supply) for which the electrodes are suitable.

2.05.02 Steel

All steel materials to be used in construction within the purview of this specification shall comply with any of the following Indian Standard Specifications as may be applicable:

a) IS : 2062 - Steel for general structural purposes

b) IS : 961 - Structural steel High Tensile

c) IS : 1977 - Structural steel (Ordinary quality) St-42-0

In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable.

2.05.03 Rivet Steel

All rivet steel used in construction within the purview of this Specification shall comply with one of the following Indian Standard Specifications as may be applicable:

a) IS : 1148 - Rivet Bars for structural purpose

b) IS : 1149 - High tensile rivet bars for structural purposes. Where high tensile steel is specified for rivets, steps shall be taken to ensure that the rivets are so manufactured that they can be driven and heads formed satisfactorily without the physical properties of steel being impaired.

2.05.04 Electrodes

All electrodes to be used under the Contract shall be of approved reputed manufacture and shall comply with any of the following Indian Standard Specifications as may be applicable

a) IS : 814 - Covered electrodes for metal arc welding of structural steel

b) IS : 815 - Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel

c) IS : 1442 - Covered electrodes for the metal arc welding of high tensile structural steel

d) IS : 7280 - Bare wire electrodes for submerged arc welding of structural steels

2.05.05 Bolts and Nuts

All bolts and nuts shall conform to the requirements of Indian Standard Specification IS: 1367 - Technical Supply Conditions for Threaded Fasteners.

Materials for Bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable.

a) Mild Steel

All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 Kg/mm² and a minimum elongation of 23 per cent on a gauge length of 5.6 _/A, where "A" is the cross sectional area of the test specimen

i) IS: 1367: Technical supply conditions for threaded fasteners

ii) IS: 1608: Method for tensile testing of steel products other than sheet, strip, wire and tube

b) High Tensile Steel

The material used for the manufacture of high tensile steel bolts and nuts shall have the mechanical properties appropriate to the particular class of steel as set out in IS: 1367 or as approved by the Engineer.

2.05.06 Washers

Washers shall be made of steel conforming to any of the following Indian Standard Specifications as may be applicable under the provisions of the Contract:

a) IS : 2062 - Steel for general structural purposes

b) IS : 961 - Structural Steel (High Tensile Quality)

c) IS : 1977 - Structural steel (Ordinary Quality) St-42-0

d) IS : 6649 - Hardened washers

2.05.07 Paints

Paints to be used for shop coat of fabricated steel under the purview of this contract shall conform to the Indian Standard Specification IS: 2074 - Ready mixed Paint, Red oxide Zinc Chromate Priming.

2.06.00 Coal Bin

2.06.01 Shape of bins shall be circular, polygonal, square, or rectangular in plan. Bottom hopper portion may have be conical-cum-hyperbolic or any other profile shape as shown in the drawing. Bin shall be termed as bunkers or silos according to their shape and plane of rupture of coal.

2.06.02 For general requirements, fabrication and construction details IS: 9178 (Pt.l & 11) shall be followed as general guidance. The bins shall be fabricated and erected in segments.

2.06.03 The Coal bins shall be made of mild steel plates joined together with full strength butt weld and provided with stiffeners at regular interval. Stiffeners shall be provided on the external face and it may be welded with external face.

2.06.04 Bending of plates and rolled sections to the required shape for fabrication shall be done by plate bending machine or cold bending process Without resorting to heating, hammering, angle smithy and black smithy process.

2.06.05 Poking hole (manual or pneumatic) and striking plate shall be provided to facilitate coal flow. Poking holes shall have circular MS pipe and cover cap as detailed in the drawing.

2.07.00 New Erection Marks

2.07.01 Additional structures involving new erection marks may be required to be added at any stage of work.

2.07.02 All such new erection marks shall be detailed and included in marking schemes and fabrication carded out thereafter.

2.07.03 All such new erection marks shall be considered under item of original fabrication work. As a result of additional structures becoming necessary if the work is delayed beyond the time schedule stipulated, the Engineer shall give suitable extension of time provided he is satisfied about the reasonableness of the delay involved. However, no claim for extra payments or revision of rates due to delay shall be entertained.

2.08.00 ELECTRO FORGED STEEL GRATINGS

2.08.01 Factory made fabricated electro forged gratings unit with steel conforming to IS: 2062 shall be supplied, fabricated, transported, erected and aligned in floorings, platforms, drain and trench covers, walkways, passages, staircases with edge binding strips and anti skid nosing in treads etc.

2.08.02 All grating units shall be rectangular in pattern and electro forged. The size and the spacing of the bearing bars and cross bars shall be as detailed in fabrication drawings. The contractor shall submit the grating design for different spans and load intensities along with fabrication drawings. The depth of the grating unit shall be 40 mm, unless specified otherwise.

2.08.03 The gratings shall be made up in panel units designed to coincide with the span of the structural steel framing or openings as indicated in the design/ scope drawings. Maximum possible standardization of the grating panel sizes shall be tried and designed.

2.08.04 The grating unit shall be accurately fabricated and finished, free from wraps, twists, or any defects that would impair their strength, serviceability, and appearance.

2.08.05 Grating work shall include cut outs and clearance opening for all columns, pipes, ducts, conduits or any other installation penetrating through the grating work. Such cut outs and clearances shall be treated as specified in subsequent clauses.

2.08.06 The gratings shall be notched, trimmed and neatly finished around flanges and webs of the columns, moment connections, cap plates, and such other components of the steel structures encountered during the placement of the gratings. In all such cases, the trimming shall be done to follow the profile of the components encountered. After trimming, the binding strip shall be provided on the grating to suit the profile so obtained.

2.08.07 Opening in gratings for pipes or ducts that are 150mm in size or diameter or larger shall be provided with steel bar toe plates of not less than 5mm thickness and appropriate width, set flush with the bottom of the bearing bars.

2.08.08 Penetrations in gratings that are more than 50mm but less than 150mm in size or diameter shall be welded with plates of size shown in the detailed drawings set flush with the bottom of the grating panel.

2.08.09 Unless otherwise indicated on the drawings, grating units at all penetrations shall be made up in split section, accurately fitted and neatly finished to provide for proper assembly and erection at the job site.

2.08.10 Grating units shall be provided with all necessary clips, bolts, nuts and lock washers required for proper assembly and rigid installation and fastening to abutting units supporting structural steel framing members.

2.08.11 The gratings shall be of reputed make and manufacturer, as approved by Engineer. The unit rate quoted by him for this item shall be inclusive of transport of gratings to the project site, all taxes, duties etc. He shall also provide all facilities and access to the Engineer or his representative to carry out inspection during all stages of manufacturing of gratings.

2.08.12 Maximum deviation in linear dimension from the approved dimension shall not exceed 12mm.

2.08.13 All fabricated grating section and accessories shall be blast cleaned to near white metal surface (Sa 2½) followed by either of the following two:

(a) Two coats of red lead primer and two coats of black enamel finish paint.

(b) Hot dipped galvanization at 610 gm/sq.m.

in the shop prior to erection at site, as the approved drawing.

2.08.14 Prior to finishing all surfaces shall be cleaned, free from rust, mill scale, grease, oil, or any other foreign matter by blast cleaning. BS: 4232 shall be followed for blast cleaning.

2.08.15 Primer can be applied by spray guns or by brushes, however the finish paint shall necessarily be applied by means of spray guns. The applied coatings shall be uniform, free from voids and streaks; drilled or punched holes shall be touched up prior to erection or assembly.

2.09.00 GALVANIZATION OF GRATINGS

2.09.01 Purity of Zinc to be used-for galvanizing shall be 99.5% as per IS: 2 15

2.09.02 After the shop work is complete, the structural material shall be punched with erection mark and be hot double dip galvanized. Before galvanizing the steel section shall be thoroughly blast cleaned to near white metal surface (Sa 2½).

2.09.03 The weight of the zinc coating shall be at least 610 gm/m² - unless noted otherwise.

2.09.04 The galvanized surface shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be cleaned and smooth and shall be free from defects like discoloured patches, bare spots, unevenness

of coating, spelter that is loosely attached to the steel, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

2.09.05 There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized steel member shall withstand minimum four one minute dips in copper sulphate solution as per IS: 2633.

2.09.06 When the steel section is removed from the galvanizing kettle, excess spelter shall be removed by 'bumping'. The processes known as 'wiping' or 'scrapping' shall not be used for this purpose.

2.09.07 Defects in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specifications or lack of quality control in any manner in the galvanizing plant, shall render the entire, production in the relevant shift liable to rejection.

2.09.08 All structural steel shall be treated with sodium dichromate or an approved equivalent solution after galvanizing; so as to prevent white storage stains.

2.09.09 If the galvanizing of any member is damaged, the Engineer shall be shown of the extent of damage, if so directed the galvanizing may have to the redone in the similar manner as stated above at no extra cost to the Owner.

2.10.00 STAINLESS STEEL HOPPERS

2.10.01 Material

Stainless steel hopper of grade SS 304/409 M as manufactured by SAIL or equivalent shall be provided in the lower portion of bunker hopper.

2.10.02 Fabrication

The fabrication, erection, alignment and welding shall be carried out as per the accepted practice and in accordance with relevant I.S. and international specification as well as stipulations contained herein. Fabrication drawings shall be prepared by the contractor on the basis of the design / scope drawings furnished by Engineer. The fabrication and erection works shall be done as per the approved fabrication drawings.

2.10.03 Fabrication Drawings

a) Fabrication drawing shall give the cutting plan for each hopper plate. Such, cutting plan shall be based on the size of the Stainless Steel plate available at store. In order to reduce the wastage and ensure the maximum utilization of stainless steel

plate, the cutting plan shall take in the consideration of the reverse curvature and place the various elements of hopper plate in opposite fashion to reduce the end wastage. Similarly the hopper plate element having different radii shall be placed one inside the other, to optimize the stainless steel plate use. Such optimization may also required adjustment in the size of the each element of hopper plate and also additional weld joints.

b) The bill of material of hopper plate shall indicate the inner surface area of the hopper, weight of the hopper based on the inner surface area, weight of each of the cut plate of hopper fabrication, weight of cut and scrap pieces generated. Contractor shall return to the Owner's store all unutilized (surplus) stainless steel plates and all waste and cut pieces generated. Non return of any part of the surplus/waste steel pieces to the Owner's store will call for the penal recovery at three (03) times the maximum procurement rate for the weight of stainless steel pieces not returned to the store.

c) In case the contractor does the cutting of the stainless steel without approved cutting plan then all the wastage (i.e. the difference between the weight of stainless steel plate cuts and the actual finished weight considered for the measurement for payment) shall be subjected to the penal recovery at the rate mentioned above.

2.10.04 Cuffing

Cutting may be affected by shearing, or by using plasma. The cut edges of all plates shall be perfectly straight and uniform through out. Cutting shall be done as per the cutting plan shown in the fabrication drawing. Should the Engineer find it necessary, the edges shall be ground smooth afterwards by contractor within the unit rates quoted by him. All the edge s shall be ground smooth before they are welded.

2.10.05 Jointing

Welding shall join stainless steel. All weld joints (along the inclined plane) shall be staggered. Any common welding process can weld stainless steel viz. MIG, metal arc or plasma using the covered compatible electrodes as per IS: 5206 or by inert gas arc welding as per IS: 2811. Shielding gas shall be Argon + Hydrogen mixture or Argon + Oxygen mixture. However, Argon + Oxygen mixture shall be preferred. Carbon-di-oxide mixture shall be avoided. 308L and 315L electrodes/fillers shall be used for the welding of Stainless Steel to Stainless Steel and Stainless Steel to Mild Steel respectively. However, the welding process and the type of the electrodes to be used for welding shall be as per welding procedure, as approved by the Engineer. On the basis of the welding procedure, the Contractor shall conduct qualification test.

2.10.06 Bending

The stainless steel plates shall be subjected to cold forming and bending in order to get the desired shape and profile.

2.10.07 Welding sequence

The type of electrodes, welding sequence, preheat and interpass temperature and post weld heat treatment shall be as approved by the Engineer.

2.10.08 Acceptance Criteria of Fabricated Structures

The acceptance of the fabricated structure work shall depend upon correct dimensions and alignment, absence of distortion in the structure, satisfactory results from the inspection and testing of the welded structure joints and the test specimens, general workmanship being good meeting the tolerance requirements given in IS: 7215.

2.11.00 BEARINGS

2.11.01 PTFE (Poly tetra fluorethylene) slide bearing

a) General

The bearings shall consist of upper and lower units. The upper unit shall include a sole plate with mirror finish stainless steel facing bonded to the bottom surface of the sole plate. The lower unit shall consist of a relevant laminated elastomers pad surfaced with PTFE. A rigid confining medium substructure bonds the PTFE to the pad. When the upper and lower units are mated the stainless steel slides on the PTFE surface with an extremely low coefficient of friction. These bearings shall be designed as per the performance requirements. The bearing shall be of reputed make and manufacturer as approved by Engineer, for required vertical loads, as per the construction drawings and for a maximum displacement of ± 50 mm.

b) Material

PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/cm². In order to prevent cold flow in the PTFE surface it shall be rigidly bonded by a special high temperature resistant adhesive to the stainless steel sub-strata. The stainless steel surface, which slides against the PTFE, is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of the stainless steel shall be between 1.0 to 1.5mm.

The resilient bearing pad shall consist of multiple layers of lightweight fabric impregnated with a high quality elastomer compound vulcanized into slabs of uniform standard thickness as per the requirement. This shall withstand vertical (compressive) load not less than 500 kg/cm² and shear loads upto 40 kg/cm².

c) Installation

The seating area for PTFE bearing shall be prepared accurately level and furnished with a thin layer of epoxy resin mortar. The bearing will be placed on this layer while it is still workable and the bearing is levelled. The bearing should not be displaced as the beam is lowered into position. When the mortar and adhesive are fully set and the beam slightly above the top of the bearing. The upper surface of the bearing shall then be coated with sufficient thickness of epoxy resin mortar so that when the beam is lowered on to the temporary supports it comes into full contact with the mortar and some is squeezed out. The surplus shall be troweled off and after the mortar is fully set the temporary supports removed.

2.12.00 Storage of material

2.12.01 General

All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged, shall be removed from the contractor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed and the cost incurred thereof shall be realised from the Contractor. The Contractor shall maintain upto date accounts in respect of receipt, use, and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks.

2.12.02 Steel

The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground section wise and lengthwise so that they can be easily inspected, measured, and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather.

2.12.03 Electrodes

The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The

electrodes shall be kept in a dry and warm condition if necessary by resorting to heating.

2.12.04 Bolts, Nuts and Washers

Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length, and quality.

2.12.05 Paints

Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.

2.13.00 Quality Control

The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer's representative shall be made at the Contractor's fabrication shop whether located at Site or elsewhere. The Contractor shall co-operate with the Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing free of cost all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Contractor.

Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work.

The quality control procedure shall cover but not be limited to the following items of work

a) Steel: Quality manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used.

b) Rivets, Bolts, Nuts & Washers : Manufacturer's certificate, dimension checks, material testing.

c) Electrodes : Manufacturer's certificate, thickness and quality of flux coating.

d) Welders : Qualifying Tests

e) Welding sets : Performance Tests

f) Welds : Inspection, X-ray, Ultrasonic tests

g) Paints : Manufacturer's certificate, physical inspection reports

h) Galvanizing : Tests in accordance with IS 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products.

2.14.00 Standard dimensions, forms and weights

The dimensions, forms, weights and tolerances of all rolled shapes rivets, bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards.

2.15.00 Fabrication Drawings

The contractor shall within thirty (30) days after the award of the Contract submit to the Engineer the Schedule of Fabrication and erection of structural Steelworks, for approval. Within one week after receipt of approval on design of any steel structure (part or full) based on the approved design. As decided by the Engineer, six (6) copies each of some or all of the detailed fabrication drawings will have to be submitted for approval.

The sequence of preparation of fabrication drawings shall match with the approved fabrication and erection schedule. The above-mentioned approval for fabrication drawings will be accorded only towards the general conformity with the design requirements as well as specifications. The approval of drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents.

The fabrication drawings shall include but not limited to the following:

a) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.

b) Dimensional drawings of base plates, foundation bolts location etc.

c) Comparison sheets to show that the proposed alternative section, if any, is as strong as the original sections shown on the Design Drawings.

d) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.

e) Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof.

These drawings shall give all the necessary information for the fabrication, erection, and painting of the steelwork in accordance with the provisions of this Specification. Fabrication drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Fabrication drawings shall give complete information necessary for fabrication of the various components of the steelwork, including the location, type, size, and extent of welds. These shall also clearly distinguish between shop and field rivets, bolts, and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the fabrication drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked up stresses and distortion. Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification. IS: 813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length.

The Contractor shall be responsible for and shall carry out at his cost any alterations of the work due to any discrepancies, errors or omissions on the drawings or other particulars supplied by him, whether such drawings or other particulars have been duly approved or not in accordance with the Contract.

3.00.00 WORKMANSHIP

3.01.00 Fabrication

3.01.01 General

All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS: 800 - Code of Practice for general construction in steel and other relevant Indian Standards or equivalent.

3.01.02 Straightening Material

Rolled materials before being laid off or worked, must be clean, free from sharp kinks,

bends or twists and straight within the tolerances allowed by the Indian Standard Specification on IS: 1552 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600°C.

3.01.03 Cutting

Shearing, cropping, or sawing shall affect cutting. Use of a mechanically controlled gas-cutting torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under expert hand, subject to the approval of the Engineer.

To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld metal deposited on them, shall be reasonably free from gouges, occasional notches or gouges not more than 4 mm deep will be permitted. Gouges greater than 4 mm that remain from cutting shall be removed by grinding. All re-entrant corners shall be shaped notch free to a radius of at least 12 mm. Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion.

3.01.04 Planning of edges

Planning or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer.

3.01.05 Clearances

The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams web shall be not more than 3 mm at each end, but where for practical reasons greater clearance is necessary, suitably designed cheatings shall be provided.

3.02.00 Riveted and bolted construction

3.02.01 Holes

Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of rivet or bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter.

Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the rivet or bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the rivet or black bolt passing through them.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of BS as specified in IS: 919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

Holes for rivets or bolts shall not be formed by gas cutting process.

3.02.02 Assembly

All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the rivets or bolts shall be reamed. Poor matching of holes shall be cause for rejection .The component parts shall be so assembled that they are neither twisted not otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained.

Rivets shall ordinarily be hot driven, in which case their finished heads shall be approximately hemispherical in shape and shall be of uniform size throughout the work for rivets of the same size full, neatly finished and concentric with he holes. Rivets shall be heated uniformly to a temperature not exceeding 1 125°C they shall not be driven after their temperature has fallen below 540°C.

Rivets shall be driven by power riveters, of either compression or manually operated type, employing pneumatic, hydraulic or electric power. Hand driven rivets shall not

be allowed unless in exceptional cases specifically approved by the Engineer. After driving, rivets shall be tight, shall completely fill the holes and their heads shall be in full contact with the surface. In case of countersunk rivets, the countersinking shall be fully filled by the rivet, any proudness of the countersunk head being dressed off flush, if required.

Riveted members shall have all parts firmly drawn and held together before and during riveting and special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole.

All loose, burnt, or otherwise defective rivets shall be cut out and replaced and special care shall be taken to inspect all single riveted connections. Special care shall also be taken in heating and driving long rivets. The Contractor shall prove the quality of riveting by cutting some rivets chosen at random by the Engineer. No extra payment will be made to the Contractor for such cutting and replacing. Riveting work, for any particular section or group, will be considered satisfactory when at least 90% of the corresponding cut rivets is found to be sound. If the ratio is below 75%, all the rivets in the particular section or group shall be cut, removed and replaced and tested again at the Contractor's expense. For cases between 75% and 90% the engineer shall have the option to instruct cutting and replacing any number of further rivets at the Contractor's cost as he deems necessary.

Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if shown on drawing or directed by the Engineer.

Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project trough the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer one spring washer or lock nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified on the Drawings.

3.03.00 Welded Construction

3.03.01 General

Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS: 817.

3.03.02 Preparation of material

Surface to be welded shall be free from loose scale, slag, rust, grease, paint, and any other foreign material except that mill scale, which withstands vigorous wire brushing, may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by a mechanically guided torch.

3.03.03 Assembling

Parts to be fillet welded shall be brought in, as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces, which are not completely sealed by, welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2°).

The work shall be positioned for flat welding whenever practicable.

3.03.04 Welding Sequence

In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shod splicing not more than three sub-sections, each made in accordance with this paragraph.

When required by the Engineer, welded assemblies shall be stress relieved by heat-treating in accordance with the provisions of the relevant Indian Standard or any other Standard approved by the Engineer.

3.03.05 Welding technique

All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 m thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross-section. Groove welds made with the use of the backing of the same material, as the base metal shall have the weld metal thoroughly fused with the backing material.

Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness.

Groove welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates need not be removed upon completion of the weld unless otherwise specified elsewhere in the contract.
To get the best and consistent quality of welding, automatic submerged arc process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall all conform to the relevant Indian Standards.

3.03. 12 Temperature

No welding shall normally be done on parent material at a temperature below (-) 5°C. However, if welding is to undertaken at low temperature, adequate precautions as recommended in relevant Indian Standard shall be taken. When the parent material is less than 40 mm thick and the temperature is between (-) 5°C and 0°C, the surface around the joint to a distance of 100 mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is hand warm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20°C. All requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard.

3.03. 13 Peening

Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool, peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening.

3.03. 14 Equipment

These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufacturers of electrodes or as may be approved by the engineer.

3.04.00 Finish

Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butted over the whole

section with a clearance not exceeding 0.1 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc; after welding/riveting together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles of channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 1.0 mm.

3.05.00 Slab bases and caps

Bases and caps fabricated out of steel slabs, except when cut material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face, which is to be grouted direct to a foundation, need not be machined if such face is true and parallel to the upper face.

To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air.

3. 12.00 Lacing bars

The ends of lacing bars shall be neat and free from burns.

3. 13.00 Separators

Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used.

3.14.00 Bearing Plates

Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings.

3.15.00 Floor Grating

All grating units shall be rectangular in pattern and of pressure locked assembly. The size and spacing of bearing bars and cross bars shall be as approved in detailed drawings. Alternatively diamond pattern grating if approved may be used.

The grating shall be made in panel units designed to span as indicated in structural steel framing drawing or as directed by the Engineer.

The grating units shall be finished free from warps, twists, or any other defects. Grating work shall include cutouts and clearance openings for all columns, pipes,

ducts, conduits etc. The gratings shall be notched, trimmed, and neatly finished around components of the steel structures encountered. Binding strip shall be provided on the grating to suit the profile. Openings in gratings shall be provided with steel bar toe plates of not less than 5 mm thickness and 100 mm width.

Unless otherwise indicated on drawings, all penetrations of grating units shall be made up in split section, accurately fitted, and neatly finished. Grating units shall be provided with all necessary clips, bolts, lock washers etc. for proper assembly and installation on supporting steel members. Maximum deviation in linear dimension shall not exceed 12 mm.

3.10.00 Chequered Plates

Minimum thickness of chequered plate floorings, covers etc. shall be 6 mm O/P. Chequered plate shall be accurately cut to the required sizes and shapes and the cut edges properly ground. Stiffeners shall be provided wherever required from design consideration.

3.11.00 Architectural Clearances

Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances.

3.11.00 Shop connections

a) All shop connections shall be otherwise riveted or welded as specified on the Drawings.

b) Heads of rivets on surfaces carrying brick walls shall be flattened to 10 mm thick projection.

c) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the contractor will have to make the desired changes at no extra cost to the exchequer.

3.13.00 Castings

Steel castings shall be annealed.

3.14.00 Shop erection

The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before dispatch. The parts shall be shop-erected with a sufficient number of parallel drifts to bring and keep the parts in

place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in such a way as will facilitate the check of interchange ability.

3.15.00 Shop painting

3.15.01 General

Unless otherwise specified, steelwork, which will be concealed by interior building finish, need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Engineer.

After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other methods of loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by the solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by trough sweeping with a fibre brush.

3.15.02 Inaccessible parts

Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, Positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

3.15.03 Contact surfaces

Contact surface shall be cleaned in accordance with sub-clause 3.13.1 before assembly.

3.15.04 Finished surfaces

Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

3.15.05 Surfaces adjacent to field welds

Unless otherwise provided for, surfaces within 50 of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

3.16.00 Galvanizing

3.16.01 General

Structural steelwork for switchyard or other structures as may be specified in the contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS: 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.

3.16.02 Surface Preparation

All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing. Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

3.16.03 Procedure

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested in accordance with IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS: 4759 - Specification for Hot-dip zinc coatings on Structural Steel & other allied products.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanizing and shall not be clogged with zinc. The threads of nuts may be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after leaving been dipped twice, it shall be rejected. Special care shall be taken not to injure the skin on galvanized surfaces during transport, handling, and erection. Damages, if

occur, shall be made good in accordance or as directed by the Engineer.

4.00.00 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

4.01.00 Inspection

Unless specified otherwise, inspection to all, work shall be made by the or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification.

The Contractor shall provide free of charge, such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract. The Contractor shall guarantee compliance with the provisions of this Specification.

4.02.00 Testing and Acceptance Criteria

4.02.01 General

The Contractor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own Cost. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.

4.02.02 Steel

All steel supplied by, the Contractor shall conform, to the relevant Indian Standards. Except otherwise mentioned in the contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 M.T or less of any particular section for tests to conform to relevant Indian Standards. Cost of all tests shall be born by the contractor.

All material shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance.

4.02.02 Welding

a) The weld surface shall be cleaned with steel wire brush to remove spatter metal, slag etc. and 100% of welds shall be inspected visually for size, length of weldment and external defects. Weld gauges shall be used for checking weld sizes. The surface shall be clean with regular beads and free from slags, cracks, blow-holes etc.

b) Non-destructive examination shall be carried out to determine soundness of weldments as follows:

i) 10% at random on fillet-joints.

ii) 100% on all butt-joints.

c) Should the ND tests indicate defects like improper root penetration, extensive blowholes, slag intrusion etc., such welds shall be back gauged, joints prepared again and rewelded. All defects shall be rectified by the Contractor at no extra costs.

d) All electrodes shall be procured from approved reputed manufacturers with test certificates. The correct grade and size of electrode, which has not deteriorated in storage, shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tones of welded fabrication, the Engineer may ask for 1(one) test-destructive or non-destructive including X -ray, ultrasonic test or similar, the cost of which shall be borne by the Contractor.

4.02.04 Rivets, bolts, nuts and washers

All rivets, bolts, nuts, and washers shall be procured from M/s. Guest Keen William Ltd. or equivalent and shall confirm to the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards. Cost of all such testing shall have to be borne by the Contractor. In addition to testing the rivets by hammer, 2% (two per cent) of the rivets done shall have to be cut off by chisels to ascertain the fit, quality of material and workmanship. The removal of the cut rivets and re-installing new rivets shall be done by the Contractor at his own cost.

4.02.05 Shop painting

All paints and primers shall be of standard quality and procured from approved manufacturers and shall conform to the provisions of the relevant Indian Standards.

4.02. 12 Galvanizing

All galvanizing shall be uniform and of standard quality when tested in accordance with IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles and 15: 4759 - specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products.

4.03.00 Tolerance

The tolerances on the dimensions of individual rolled steel components shall be as specified in IS: 1852 - specification for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures shall be as specified in IS: 721 - Tolerances for Fabrication of Steel Structures.

4.04.00 Acceptance

Should any structure or part of a structure be found not to comply with any of the provisions of this specification, the same shall be liable to rejection. No Structure or part of the structure once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check some of the tests at an appropriate laboratory at the contractors cost.

When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue acceptance certificate, upon receipt of which, the items will be shop painted, packed and dispatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract.

4.05.00 Delivery of materials

4.05.01 General

The Contractor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work. The Owner may prescribe or control the sequence of delivery of materials, at his own discretion.

4.05.02 Marking

Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection.

4.05.03 Shipping

Shipping shall be strictly in accordance with the sequence stipulated in the agreed Programme. Contractor shall dispatch the materials to the e worksite securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All parts shall be adequately braced to prevent damage in transit.

Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and such distinct marking (all previous irrelevant markings being carefully obliterated) shall show the following:

a) Name and address of the consignee

b) Name and address of the consignor

c) Gross weight of the package in tonnes and its dimensions

d) Identification marks and/or number of the package

e) Custom registration number, if required

All markings shall be carried out with such materials as would ensure quick drying and indelibility.

Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and corresponding piece numbers.

Each packing case shall contain in duplicate in English a packing list pasted on to the inside of the cover in a water-proof envelope, quoting especially -

a) Name of the Contractor

b) Number and date of the Contract

c) Name of the office placing the contract

d) Nomenclature of stores
e) A schedule of parts or pieces, giving the parts or piece number with reference to

assembly drawings and the quantity of each.

The shipping dimensions of each packing shall not exceed the maximum dimensions permissible for transport over the Indian Railways/Roads.

After delivery of the materials at site, all packing materials shall automatically become the property of the Owner.

Notwithstanding anything stated hereinbefore, any loss or damage resulting from inadequate packing shall be made good by the Contractor at no additional cost to the Owner. When facilities exist, all shipments shall be covered by approved Insurance Policy for transit at the cost of the Contractor.

The contractor shall ship the complete materials or part on board a vessel belonging to an agency approved by the Owner or on rail and/or road transport as directed. The Contractor shall take all reasonable steps to ensure correct appraisal of freight rates, weights and volumes and in no case will the Owner be liable to pay any warehouse, wharfage, demurrage and other charges.

If, however, the Owner has to make payment of any of the above-mentioned charges, the amount paid will be deducted from the bills of the Contractor.

Necessary advise regarding the shipment with relevant details shall reach the Engineer at least a week in advance.

5.00.00 INFORMATION TO BE SUBMITTED

5.01.00 With Tender

The following information is required to be submitted with the Tender:

a) Progress Schedule

The Contractor shall quote in his Tender a detailed schedule of progress of work and total time of completion, itemizing the time required for each of the following aspects of work.

i) Preparation and approval of fabrication drawing

ii) Procurement of Materials

iii) Fabrication and shipping of all anchor bolts

iv) Fabrication and shipping of main steelwork.

v) Fabrication and shipping of steelwork for bunkers, tanks and/or silos as applicable.

vi) Fabrication and shipping of all other remaining steelwork including miscellaneous steelwork.

vii) Final date of completion of all shipments.

b) Shop

Location of the Tenderer's fabrication workshop giving details of equipment, manpower, the total capacity, and the capacity that will be available exclusively for this contract shall be submitted.

5.02.00 After Award

After award of the Contract the successful Tenderer is to submit the following:

a) Complete fabrication drawings, material lists, cutting lists, rive and bolt lists, field welding schedules based on the approved design drawings prepared by him in accordance with the approved schedule.

b) Monthly Progress Report with necessary photographs in six (6) copies to reach the Engineer on or before the 7th day o. each month, giving the up-to-date status of preparation of detailed shop drawings, bill of materials, procurement of materials, actual fabrication done, shipping and all other relevant information.

c) Detailed monthly material reconciliation statements relevant to the Work done and reported in the Progress Report, giving the stock at hand of raw steel, work in progress, finished materials.

d) Results of any test as and when conducted and as require by the engineer.

e) Manufacturer’s mill test report in respect of steel materials, rivets, bolts, nuts, and electrodes as may be applicable.

6.00.00 RATES AND MEASUREMENT

6.01.00 Rates

6.01.01 The items of work in the Schedule of items describe the work in brief. The various items of the Schedule of items shall be read in conjunction with these specifications

including amendments and additions, general conditions of contract, special conditions of contracts, and other tender documents, if any. For each item of Schedule of Items, the bidder's rates shall include the activities covered in the description of the item as well as all necessary operations described in the Specifications.

6.01.02 The bidder's rates shall include cost of all minor details which are obviously and fairly intended and which may not have been included in the description in these documents but are essential for the satisfactory completion of the work. Rates shall also include for taking all safety measures.

6.01.03 The bidder's -rates for all items of schedule of items shall include complete cost towards plant, equipment, erection and dismantling of scaffolding, men, materials and consumables, skilled and unskilled labour, levies, taxes, royalties, duties, transport, storage, repair/rectification/maintenance until handing over, contingencies, overhead and all incidental items not specifically mentioned but reasonably implied and necessary to complete the work.

6.01.04 No claims shall be entertained, if the details shown on the `Released for Construction' drawings differ from those shown on the bid/tender drawings.

6.01.05 Rates shall be inclusive of all leads and lifts/elevation.

6.01.06 The bidder's rates for Structural Steel shall include for fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, erection scheme, alignment, welding, including preheating and post heating, testing of welders, inspection of welds, visual inspection, non destructive and special testing, rectification and correction of defective welding works, production test plate, inspection and testing, erection scheme, protection against damage in transit, stability of structures, etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus/waste steel materials including cut pieces/waste steel, provision of additional butt/weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work.

6.01.07 The bidder's rates for foundation bolts assembly shall include fabrication erection, installation, and alignment of complete bolt assembly with nuts, locknuts, anchor plates, stiffener plates, protective tape, etc. This shall also include the cost of materials not issued by the Owner.

6.01.08 The bidders rates for application of inorganic primer shall include surface preparation to near white metal surface by blast cleaning, abrasives, touch up painting, suitable enclosure to avoid contamination and the necessary statutory approval from the factory inspector/pollution control board etc. regarding the method of blast cleaning

and abrasives used, and getting approval of the specialized agency supplying the zinc silicate primer.

6.01.09 The bidder's rates for application of finish painting system shall include surface preparation, application of intermediate (under) coat, finish coat and final finish coat, and getting approval of the specialized agency supplying the finish paint.

6.01.10 The bidder's rates for electro-forged gratings (if specified) shall include supply, fabrication, transportation to the site, erection and alignment of factory made electro-forged gratings, all taxes, duties thereon etc. The rates shall also include preparation of grating design for different spans and load intensifies, preparation of design and fabrication drawings, edge preparation, blast cleaning followed by finish paint.

6.01.11 The bidder's rates for galvanization of factory made electro-forged gratings (if specified) shall include the application of hot dipped galvanization as finish over the fabricated gratings and the treatment to be given for prevention of white storage stains, as per the technical Aspiration.

6.01.12 The bidder’s rates for permanent mild steel bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types of Structural Steel works, as per the technical specification.

6.01.13 The bidder’s rates for high strength structural bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types, of Structural Steel works, as per the technical specification.

6.01.14 The bidder’s rates for dismantling, additions to, alterations in and/or modifications shall be inclusive of all operations such as lowering of material, carriage etc., as mentioned in the technical specification. Unutilised steel pieces cut/removed shall be returned to the project stores free of charge. Non-return of unublized steel pieces to the Owner's store would be considered as wastage and recovery would be affected as per the provision of contract for structural steel consumption. This shall not include the weight of temporarily dismantled/supported members, connected member.

6.01.15 The bidder's rates for re-erection of erection marks after additions to, alterations in and/or modifications shall be inclusive of all operations mentioned in technical specification for the calculated weight of the rectified/modified erection mark rejected at site. This shall not include the weight of temporarily dismantled/supported members, connected member. All the operations mentioned above for restoring such members shall be carried out at no extra cost. The work of erection of any erection mark which has not been dismantled but have been modified/rectified before erection shall not be paid under this item but shall be paid under relevant item of fabrication and erection of steel work of Schedule of items for the modified weight.

6.01.16 The bidder's rates for PTFE shall include design, supply, transportation of the complete assembly with guides and dust protection cover and installation of bearings in position drilling, bolting, erecting aligning etc. along with any taxes, duties thereon etc.

6.01.17 The bidder's rates for Stainless Steel hopper (if specified) shall include fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, all other operations mentioned in the technical specification. The rates shall also include for erection scheme, alignment, making cutting plan, cutting, jointing, bending, rolling, grinding, drilling, bolting, assembly, edge preparation, welding including pre-heating, post-heating, testing of welders, inspection of welds, inspection and testing, protection against damage in transit, stability of structures, installation of temporary structures etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus / waste steel materials including cut pieces/waste steel, provision of additional butt / weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work.

6.01.18 The bidders rates for preformed flexible open ended bellow strap of neoprene (if specified) shall include supply and transportation, installation in position, drilling, bolting, aligning etc. complete along with any taxes, duties thereon etc.

6.01.19 The bidder's rates for Stainless Steel Hand Rail (if specified) shall include complete Hand Rail including, stainless steel beading, stainless steel cleats, stainless steel fasteners, neoprene gaskets, preparation of shop drawing but excluding the cost of glazing. The Owner for this item of work shall supply no material.

6.02.00 MODE OF MEASUREMENT

6.02.01 The measurement for the item of foundation bolts assembly including that of nuts; locknuts shall be based on the calculated weight of steel installed in Metric Tonne, corrected to second place of decimal. The weight of the foundation bolt shall be calculated in the same way as that done for the item of fabrication, erection, alignment of structural steel. The weight of the nut / locknut shall be taken as per actual weight supplied by the contractor and accepted by the Engineer.

6.02.02 The measurement for the item of fabrication, erection, alignment, welding, etc. of structural steel work shall be based on the approved weight of steel nearest to a Kg, by applying the unit weight as adopted at the time of issue of structural steel on the measurements worked out as given below.

6.02.03 For ISMB, ISMC, ISA, flats, round bars, square bars and pipes, length shall be taken as per distance between planes normal to the axis of the member passing through the

extreme points of the section.

6.02.04 Gussets plates in trusses, and bracings, brackets plates, stiffeners, and skew cuts if any in plates for butt welds the area shall be assumed as the minimum circumscribed rectangle.

6.02.05 For bunker wall plates the minimum-circumscribing rectangle of the individual plate/pieces out of which these wall plates are assembled by butt-welding, shall be measured. Care shall be taken to ensure maximum utilization of cut-pieces generated by providing extra butt joints (for which no extra payment shall be made).

6.02.06 For all other plates, where the area of any notch/skew cut in the plate is less than 0.2 sq.m. the area of the plate shall be assumed as that of the minimum circumscribing rectangle for the purpose of measurement and calculation of area for the purpose of payment. However, if the area of any notch/skew cuts in a plate is more than 0.2 sq.m. the actual profile of the plate shall be considered for the purpose of payment.

6.02.07 No deduction shall be made for the hole in the members, if the area of individual hole is less than 0.2 sq.m. The weight shall be calculated by deducting the area of holes, if area of individual hole is more than 0.2 sq.m.

6.02.08 All cut-pieces and scrap generated due to cutting of holes, skew-cuts of plates, gussets, brackets, stiffeners, etc. shall be stacked separately and handed over to the project stores without being considered for material accounting as the circumscribing rectangle has been considered for payment.

6.02.09 The splice plate shown in the fabrication drawing or approved by the Engineer shall only be measured for payment.

6.02.10 The weight of permanent bolts, washers and nuts and welds shall not be included in the weights of the members. No extra payment shall be made for welding/bolting.

6.02.11 The bolts and nuts required for erection purpose shall not be paid for and may be taken away by the Contractor after final welding for members. Erection boltholes left after removal of erection bolts shall be suitably plugged with welds.

6.02.12 The measurement for the item of application of inorganic primer including blast cleaning of steel surfaces shall be based on the weight on which the zinc silicate primer is applied, after blast cleaning in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works.

6.02.13 The measurement for the item of application of finish primer system shall be based on the weight on which the epoxy based finish primer is applied in Metric Tonne,

corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works.

6.02.14 The measurement for the item of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor, and accepted by the Engineer. Nothing extra shall be payable for making cutouts, notches, openings of any profile, trimming profiles etc. in the grating units.

6.02.15 The measurement for the item of hot dipped galvanization of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal of gratings galvanized by the Contractor and accepted by the Engineer.

6.02.16 The measurement for the item of permanent bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules.

6.02.17 The measurement for the item of High Strength Structural bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules.

6.02.18 The measurement for the item of the work of dismantling, additions, alterations, reerection etc. shall be as given below

6.02.19 For dismantling, the unmodified weight of the actually dismantled erection marks shall only be measured.

6.02.20 For the work of addition to, alteration in and / or modification of 'erection marks' either in erected position or in the fabrication yard, measurement of weight for payment purpose shall be calculated as the arithmetic sum of weight of steel cut and removed from the erection mark, weight of steel reutilised out of such cut and removed pieces and weight of additional new steel pieces added to the erection mark.

6.02.21 For re-erection the weight of the modified erection mark shall only be measured.

6.02.22 The weight shall be measured nearest to kg. and shall be arrived in a manner similar to the measurement for the item of fabrication, erection, alignment and welding of structural steel.

6.02.23 The measurement for the item of PTFE bearings shall be based on the actual weight in MT, corrected to third place of decimal, supplied by the contractor and as accepted by the Engineer and as per the approved bearing schedule, for the total vertical load

carrying capacity, for all bearings.

6.02.24 The measurement for the item of stainless steel hopper shall be based on the actual finished weight of hopper weight in Kgs, corrected to second place of decimal. The hopper weight shall be arrived by multiplying of the inner surface area of the hopper with the unit weight of the hopper plate.

6.02.25 The measurement for the item of flexible open-ended bellows straps of neoprene shall be based in running meter, corrected to second place of decimal. Bellow Straps shall be supplied as per the requirement of the approved drawings. The measurement shall be done for the inner circumference of the bunker on which neoprene has been fixed and for the length supplied by the Contractor 'and as accepted by the Engineer.

6.02.26 The measurement for the item of Stainless Steel Hand Railing shall be based in Kgs corrected to second place of decimal. The weight shall also include the weight of Stainless Steel fasteners, Stainless Steel beading, Stainless Steel cleats etc. The weight shall be the finished weight of Hand Rail, as accepted by the Engineer.

SECTION - D

SUB-SECTION – D 18

ERECTION OF STRUCTURAL STEELWORK

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	GENERAL
3.00.00	WORKMANSHIP
4.00.00	TESTING AND ACCEPTANCE CRITERIA
5.00.00	INFORMATION TO BE SUBMITTED

SUB-SECTION – D XVIII

ERECTION OF STRUCTURAL STEELWORK

1.00.00 SCOPE

This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at site, installing the same in position, painting and grouting the stanchion bases all complete as per Drawings, this Specification and other provision of the Contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Contractor, unless otherwise specified in the Contract, shall include but not be limited to the following:

a) The Contractor shall provide all construction and transport equipment, tools, tackle, consumables, materials, labour, and supervision required for erection of the structural steelwork.

b) Receiving, unloading, checking, and moving to storage yard at Site including prompt attendance to all insurance matters as necessary for all fabricated steel materials arriving at Site. The Contractor shall pay all demurrage and/or wharfage charges etc. on account of default on his part.

c) Transportation of all fabricated structural steel materials from Site storage yard, handling, rigging, assembling, riveting, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Engineer. If necessary suitable temporary approach roads to be built for transportation of fabricated steel structures.

d) Checking center lines, levels of all foundation blocks including checking line, level, position and plumb of all bolts and pockets. Any defect observed in the foundation shall be rectified with Engineer's approval. The Contractor shall fully satisfy himself regarding the correctness of the foundations before installing the fabricated steel structures on the foundation blocks.

e) Aligning, plumbing, leveling, riveting, bolting, welding and securely fixing the fabricated steel structures including floor gratings, chequered plates etc. in accordance with the Drawings or as directed by the Engineer.

f) Painting of the erected steel structures.

g) All minor modifications of the fabricated steel structures as directed by the Engineer including but not limited to the following:

i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling.

ii) Cutting, chipping, filling, grinding, etc. if required for preparation and finishing of site connections.

iii) Reaming of holes for use of higher size rivet or bolt if required.

iv) Refabrication of parts damaged beyond repair during transport and handling or refabrication of parts, which are incorrectly fabricated.

v) Fabrication of parts omitted during fabrication by error, or subsequently found necessary.

vi) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.

vii) Carry out tests in accordance with this specification.

2.02.00 Work by Others

No work under this Specification will be provided for by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.03.00 Codes and Standards

All work under this Specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specification and codes of Practice of equivalent:

IS: 800 - Code of practice for general construction in steel.

IS: 456 - Code of practice for main or reinforced concrete.

2.04.00 Conformity with Designs

The Contractor will erect the entire fabricated steel structure, align all the members, complete all field connections and grout the foundations all as per the provisions of this specification and the sequence and the design criteria laid down by the Engineer. All work shall conform to the provisions of this specification and /or instructions of the engineer. The testing and acceptance of the erected structures shall be in

accordance with the provisions of this Specifications and/or the instructions o the Engineer.

2.05.00 Material

2.05.01 General

All fabricated steel structures and connection materials shall be supplied by the Contractor to the site. The Contractor shall take delivery from railway wagons or trucks at site, and unload the materials and perform all formalities like checking of materials and attend to insurance matters in accordance with Sub-Clause 2.01.00 and as specified hereinbefore.

2.05.02 Materials to conform to Indian standards

All materials required to be supplied by the Contractor under this contract shall conform to the relevant Indian Standard specifications.

2.06.00 Storage of Materials

2.06.01 General

All material shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use shall be removed immediately from the site, failing which, the engineer shall be at liberty to get the materials removed by agency and the cost incurred thereof shall be realised from the Contractor's dues.

2.06.02 Yard

The Contractor will have to establish a suitable yard in an approved location at site for storing the fabricated steel structures and other raw steel materials such as structural sections and plates as required. The yard shall have facilities like drainage, lighting, and suitable access for large cranes, trailers, and other heavy equipments. The yard shall be fenced all around with security arrangement and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved Programme of work.

The Tenderer must visit the site prior to submission of his tender to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc. all of which shall be carried out by the Contractor at his own cost as directed by the Engineer.

2.06.03 Covered Store

All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in a properly covered store building to be built at the cost of the Contractor.

2.07.00 Quality Control

The contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Engineer to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the Following items of work :

i) Erection: Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.

ii) Grouting: Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency, and strength of grout.

iii) Painting: Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

2.08.00 Taking Delivery

The Contractor shall take delivery of fabricated structural steel and necessary connection materials from railhead/trucks as may be necessary and as directed by the Engineer. He shall check, unload; transport the materials to his stores for proper storing at his own cost. The Contractor shall submit claims to insurance or other authorities and pursue the same in case of loss or damage during transit and handling and all loss thereof shall be borne by him.

The Contractor shall also take all precautions against damage of the materials in his custody after taking delivery and till the same are erected in place and accepted. The Contractor shall salvage, collect, and deliver all the packing materials to the Owner free of charge.

3.00.00 WORKMANSHIP

3.01.00 Erection

3.01.01 Plant and Equipment

The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be thoroughly verified. They shall be efficient, dependable, in good working condition and shall have the approval of the Engineer.

3.01.02 Method and sequence of erection

The method and sequence of erection shall have the prior approval of the Engineer. The Contractor shall arrange for most economical method and sequence available to him consistent with the drawings and specifications and other relevant stipulations of the contract.

3.01.03 Temporary Bracing

Unless adequate bracing is included as a part of the permanent framing, the erector during erecrtion shall install, free of cost to the Owner, temporary guys and bracings where needed to secure the framing against loads such as wind or seismic forces comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well as loads due to erection equipment and erection operations.

If additional temporary guys are required to resist wind or seismic forces acting upon components of the finished structure installed by others during the course of the erection of the steel framing, arrangement for their installation by the erector shall be made free of cost to the Owner.

The requirement of temporary bracings and guys shall cease when the structural steel is once located, plumbed, levelled, aligned, and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Engineer.

The temporary guys, braces, false work, and cribbing shall not be the property of the Owner and they may be removed immediately upon completion of the steel erection.

3.01.04 Temporary Floors for Buildings

It shall be the responsibility of the Contractor to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of Parliament and/or bylaws of state, Municipal or other local authorities.

3.01.05 Setting Out

Positioning and levelling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance with the approved Drawings and to the satisfaction of the Engineer. For heavy columns, etc. the Contractor shall set proper screed bars to maintain proper level. No extra payment shall be made for this.

Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance under this Specification.
No permanent field connections by riveting, bolting or shall be carried out until proper alignment and plumbing has been attained.

3.01.06 Field Riveting

All rivets shall be heated and driven with pneumatic tools. Hand passing or "throwing" of rivets are desirable. Any other method of conveying hot rivets from the furnace to the driving point must be approved by the engineer. No-cold rivets shall be driven. All other requirements of riveting including quality and acceptance criteria shall be in accordance with the relevant portions of the Specification for Fabrication of Structural Steelwork of the Project.

3.01.07 Field Bolting

All relevant Portions in respect of bolted construction of the Specification for Fabrication of Structural Steelwork applicable to the Project shall also be applicable for field bolting in addition to the following:

Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burns, and other, defects that would prevent solid seating of the parts. Contact surfaces within friction type joints shall be free of oil, paint, lacquer, or galvanizing.

All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods.

a) Turn-of-nut Method

When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the Joint are brought into good contact with each other. 'Snug tight" is defined as the

tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table-I with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

TABLE-I

Bolts length not exceeding 8 times dia or 200 mm	Bolt length exceeding 8 times dia or 200 mm	Remarks
1/2 turn	2/3 turn	Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation-30° over or under.

Bolts may be installed without hardened washers when tightening is done by the turn -of-nut -method. However, normal washers shall be used.

Bolts tightened by the turn-of-nut method may have the outer face of the match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

b) Torque Wrench Tightening

When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torques specified in TABLE-II (See Note below the Table). Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

TABLE-II

Nominal Bolt Diameter (mm) for bolt class 8.8 of IS:1367	Torque to be applied (Kg.M)
20	59.94
22	81.63
24	103.73

Note: The above torque values are approximate for providing tensions of 14. 7 T for 20 mm dia.; and 21.2 T for 24 mm dia. bolts under moderately lubricated condition. The torque wrench shall be calibrated at least once daily to find out the actual torque required to produce the above required tension in the bolt by placing it in a tension indicating device. These torques shall be applied for tightening the bolts on that day with the particular wrench.

In either of the above two methods, if required, for bolt entering and wrench operation clearances, tightening may be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds. Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications. All other requirements regarding assembly and bolt tightening shall be in accordance with this sub clause.

3.01.08 Field Welding

All field assembly and welding shall be carried out in accordance with the requirements of the specification for fabrication work applicable to the project, excepting such provisions therein which manifestly apply to shop conditions only. Where the fabricated structural steel members have been delivered painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints.

3.01.09 Holes, Cutting and Fitting

No cutting of sections, flanges, webs, cleats, rivets, bolts, welds etc. shall be done unless specifically approved and /or instructed by the Engineer.

The erector shall not cut, drill, or otherwise alter the work of other trades, unless such work is clearly specified in the Contract or directed by the Engineer. Wherever such work is obtain specified the Contractor shall obtain complete information as to size, location and number of alterations prior to carrying out any work. The Contractor shall not be entitled for any payment on account of any such work.

3.02.00 Drifting

Correction of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge holes as necessary to make connections. Reaming, that weakens the member or makes it impossible to fill the holes properly or to adjust accurately after reaming, shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited.

3.03.00 Grouting of stanchion bases and bearings of beams and girders on stone, brick or concrete (Plain or reinforced)

Grouting shall be carried out with Ordinary Cement grout as described below:

The mix shall be one (1) part cement and one (1) part sand and just enough water to make it workable. The positions to be grouted shall be cleaned thoroughly with compressed air jet and wetted with water and any accumulated water shall be removed. These shall be placed under expert supervision, taking care to avoid air locks. Edges shall be finished properly. If the thickness of grout is 25 mm or more, two (2) parts of 6 mm down graded stone chips may be added to the above noted cement-sand grout mix, if required, by the Engineer or shown on the drawings.

No grouting shall be carried out until a sufficient number of bottom lengths of stanchions have been properly lined, leveled, and plumbed and sufficient floor beams are tied in position.

Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally levelled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall be thoroughly cleaned.

If required by the Engineer, certain admixtures like aluminium powder, “ironite” or equivalent, may be required to be added to the grout to enhance certain desirable properties of the grout. Approved non-shrink pre-mixed grout having required

flowability and compressive strength may also be used with Engineer's approval.

3.04.00 Painting after Erection

Field painting shall only be done after the structure is erected, levelled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. Normally, final painting shall be done only after the floor slabs are concreted and masonry walls are built. However, touch up painting, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the Contractor free of cost to the Owner. The materials and specification for such painting in the field shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable for the project.

Painting shall not be done in frosty or foggy weather or when humidity is such as to cause condensation on the surfaces to be painted. Before painting of steel, which is delivered unpainted, is commenced, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust.

All field rivets, bolts, welds, and abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Wherespecified, surfaces, which will be in contact after site assembling, shall receive a coat of paint (in addition to the shop coat, if any) and shall be brought together while the paint is still wet.

Surface, which will be inaccessible after field assembly shall receive the full, specified protective treatment before Bolts and fabricated steel members who are galvanized or otherwise treated and steel members to be encased shall not be painted.

The final painting shall be of tow coats of Synthetics Enamel painting or Aluminium paint of approved manufacture as per the approved “Schedule of Painting”. The shades shall also be as per the approved schedule. Synthetic enamel paint shall conform to IS: 2932.

3.05.00 Final cleaning up

Upon completion of erection and before final acceptance of the work by the Engineer, the contractor shall remove free of cost all false work, rubbish and all Temporary Works resulting in connection with the performance of his work.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 General

Loading tests shall be carried out on erected structures, if required by the Engineer, to check adequacy of fabrication and/or erection. Any structure or a part thereof found

to be unsuitable for acceptance as a result of the test shall have to be dismantled and replaced with suitable member as per the Contract and no payment towards the cost of the dismantled portion and any connected work shall be made to the contractor. In course of dismantling, if any damage is done to any other parts of the structure or to any fixtures, the same shall be made good free of cost by the Contractor, to the satisfaction of the Engineer. The Cost of the tests specified hereinafter shall be borne by the Owner; but if the structure fails to pass the tests, the cost of the tests shall be recovered from the Contractor. Any extra claim due to loss of time, idle labour, etc. arising out of these testing operations shall not be entertained, however, only reasonable and appropriate time extensions will be allowed.

The structure or structural member under consideration shall be loaded with its actual dead load for as long a time as possible before testing and the tests shall be conducted as indicated in the following sub-clauses 4.01.01, 4.01.02 and 4.01.03. The method of testing and application of loading shall be as approved by the Engineer.

4.01.01 Stiffness Test

In this test, the structure or member shall be subjected, addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limit. If, after removal of the test load, the member or structure does not show a recovery of at least 80 per cent of the maximum strain or deflection shown during 24 hours under load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery after this second test is not less than 90 per cent of the maximum increase in strain or deflection recorded during the second test.

4.01.02 Strength Test

The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified superimposed load, and this load shall be maintained for 24 hours.

In the case of wind load, a load corresponding to twice the specified wind load shall be applied and maintained for 24 hours, either with or without the vertical test load for more severe condition in the member under consideration or the structure as a whole. Complete tests under both conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part fails and if on the removal of the test load, the structure shows a recovery of at least 20 per cent of the maximum deflection or strain recorded during the 24 hours under load.

4.01.03 Structure of same design

Where several structures are built to the same design and it is considered unnecessary to test all of them, one structure, as a prototype, shall be fully tested, as described in previous Sub-clauses, but in addition, during the first application of the test load, particular note shall be taken of the strain or deflection when the test load 1.5 times the specified superimposed load has been maintained for 24 hours. This information is required as a basis of comparison in any check test carried out on samples of the structure.

When a structure of the same type is selected for a check test, it shall be subjected, in addition to its actual dead load, to a superimposed test load, equal to 1.5 time the specified live load, in a manner and to an extent prescribed by the Engineer. This load shall be maintained for 24 hours, during which time, the maximum deflection shall be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded in the check test does not exceed by more than 20% of the maximum strain or deflection recorded at similar load in the test on the prototype.

4.01.04 Repair for subsequent test and use after strength tests

An actual structure which has passed the “Strength Test” as specified in Sub-clause 4.1.2 hereinbefore and is subsequently to be erected for use, shall be considered satisfactory for use after it has been strengthened by replacing any distorted members and has subsequently satisfied the 'Stiffness Test' as specified in Sub-clause 4.01.01 hereinbefore.

4.02.00 Tolerances

Some variation is to be expected in the finished dimensions of structural steel frames. Unless otherwise specified, such variations are deemed to be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabricating tolerances for the finished parts and the rolling tolerances for the profile dimensions permitted under the Specifications for fabrication of structural steel work applicable to this Project and as specified below:

I. For Buildings Containing Cranes

Component	Description	Variation Allowed
1.	2.	3.
Main columns	a) shifting of column axis at foundation level with respect to building line	

	i) In longitudinal direction	i) ± 3.0 mm
	ii) In lateral direction	ii) ± 3.0 mm
	b) Deviation of both major column axis from vertical between foundation and other member connection levels:	
	i) For a column upto and including 10M height	i) ± 3.5 mm from true vertical
	ii) For a column greater than 10M but less than 40M height	ii) ± 3.5 mm from true vertical for any 10 M length measured between connection levels, but not more than ±7 mm per 30m length.
	c) For adjacent pairs of columns across the width of the building prior to placing of truss	± 9.0 mm on true span.
	d) For any individual column deviation of any bearing or resting level from levels shown on drawings.	± 3.0 mm
	e) For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating	3.0 mm
Trusses	a) Deviation at centre of span of upper chord member from vertical plane running through centre of bottom chord.	1/1500 of the span or greater than 10mm whichever is the least.
Trusses	b) Lateral displacement of top chord at center of span from vertical plane	1/250 of depth of truss or 20 mm which ever is the -

	running through center of supports.	least.
Crane Cirders	a) Difference in levels of crane rail measured between adjacent columns.	2.0 mm.
	b) Deviation to crane rail-gauge	± 3.0 mm
	c) Relative shifting of ends of adjacent crane rail in plan and elevation after thermite welding.	1.0 mm.
	d) Deviation of crane rail axis from centre line of web.	± 3.5 mm
Setting of Expansion gaps	At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or below 30°C. The coefficient of expansion or contraction shall be taken as 0.000012 per °C per unit length.	

iv) For Building without Cranes

The maximum tolerances for line and level of the steel work shall be ±3.0 mm on any part of the structure. The structure shall not be Out of Plumb more than 3.5 mm on each lox section of height and not more than 7.0 mm per 30 m section.

These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

4.03.00 Acceptance

Structures and members have passed the tests and conform to all requirements specified in the foregoing Sub-clause 4.01.00, 4.01.01, 4.01.02, 4.01.03 and 4.01.04 and other applicable provisions of this specification and are within the limits of tolerances specified in Sub-clause 4.02.00 and/or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfillment of the provisions of this contract.

5.00.00 INFORMATION TO BE SUBMITTED

5.01.00 Before Tender

5.01.01 Tentative Programme

The Tenderer shall submit a tentative programme based on the information available in the Tender Document and visit to site indicating the structure-wise erection schedule proposed to be maintained by the Contractor to complete the job in time in accordance with the Contract.

5.01.02 Constructional Plant and Equipment, Tools, Temporary works & manpower A detailed list Of all constructional plant and equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the Tenderer which he will be able to employ on the job to maintain the progress of work in accordance with the Contract shall be submitted along with the Tender. The total number of each category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be indicated.

5.01.03 Erection Yard

A site plan showing the layout and location of the erection yard proposed to be established by the tenderer shall also be attached with the tender indicating the storage space for fabricated steel materials, site-fabrication and repair shop, covered stores, offices, locations of erection equipments and other facilities. The Engineer shall have the right to modify the arrangement and location of the proposed yard to suit site conditions and the Contractor shall comply with the same without any claim whatsoever.

5.02.00 After award of the Contract

After award of the contract, the Contractor shall submit the following:

5.02.01 Detailed Programme

The Contractor shall submit a detailed erection programme within a month of the award of the Contract for completion of the work in time in accordance with the Contract. This will show the target programme, with details of erection proposed to be carried out in each fortnight, details of major equipment required, and an assessment of required strength of various categories of workers in a proforma approved by the Engineer.

5.02.02 Fortnightly Progress Report

The Contractor shall submit fortnightly progress reports in triplicate to the Engineer showing along with necessary photographs, 125 mm x 90 mm size, and all details of actual achievements against the target programme specified in Sub-clause 5.02.01 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the Contractor shall also furnish details of fabricated materials in hand at site and the strength of his workers.

SECTION - D

SUB-SECTION – D19

ROOF DECKING

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	MATERIALS
3.00.00	INSTALLATION
4.00.00	ACCEPTANCE CRITERIA
5.00.00	IS CODES
6.00.00	RATES AND MEASUREMENTS

ROOF DECKING

1.00.00 Scope

This section of the specification covers the supply, fabrication and erection of profiled light gauge Metal Decks (coated and painted) as roof decking to the main plant building and any other area as indicated in the drawings.

2.00.00 Material

2.01.01 Roof of main plant TG, Deareator bay, bunker building,cw pump house consists of permanently colour coated (on exposed face) galvanized MS trough metal sheet decking plate of approved colour over roof purlins for cast-in-situ roof slab as per IS: 14246 and conform to class 3. Thickness of deck plate shall be minimum 0.7mm and minimum trough depth of 44 mm and centre to centre of the valley shall be 130mm with minimum yield strength of 250 Mpa. Silicon modified polyester paint shall be used for permanent coating over galvanized surface with minimum rate of galvanization 275 gm/sqm. DFT of permanent colour coating shall be 20 microns on exposed surface and minimum 7 micron on other face. It shall serve as permanent shuttering for cast-in-situ roof slab. It should have adequate strength to support weight of green concrete and imposed load during construction. The thickness of the deck plate shall however be designed suitably according to the spacing of roof purlins.

3.00.00 INSTALLATION

The Contractor shall furnish all labour, equipment and materials as required for the design, fabrication, coating, erection and fixing of the decking over purlins, painting and for the complete performance of the work in accordance with the construction drawings and as described herein.

The description, which follows, gives a general indication of the nature and extent of the work but is not necessarily exhaustive and does not purport to cover all the details/operations which will be necessary in order to carry out the work.

3.01.00 Detailed Design of Roof Decking

The Contractor, in conjunction with the manufacturer, shall be responsible for the detailing of the profiled decking, fittings and fixtures and shall submit with his tender particulars of the proposed manufacturer and of the particular product proposed for use. The detailing is to be based on typical details furnished by the Engineer. The Contractor shall submit to the Engineer, two copies of the general arrangement and detailed working drawings for the proposed design, together with all calculations necessary to verify the adequacy and completeness of the design & detailing of decking sheets, fixtures, flashings and trims. After approval he shall supply further eight copies.

The Engineer will verify the correct interpretation of his requirements but may not necessarily check the design and details, and the Contractor shall be entirely responsible for the accuracy of the drawings and the correctness of the design and the suitability of the details. Manufacture of roof decking sheets shall not commence until the necessary approval of the Engineer has been obtained.

3.02.00 Erection & Fixing

3.02.01 Sequence of Manufacture/Erection

Cutting Schedules, delivery to site and stacking arrangements in store shall ensure that sheets are erected in a sequence which follows that for the manufacture. The decking sheets shall be erected using an arrangement of sheets and joints to conform with the requirements of this specification. Decking erection for each elevation or feature shall commence at one end only and proceed towards the other end, in order to ensure tight fitting laps.

3.02.02 Position and Location of Laps

Side and end laps of roof decking sheets shall be located and positioned in such a manner as to provide the maximum weather protection taking into account the direction of the prevailing wind.

The lines formed by horizontal laps and fixing shall where possible, be continuous and coincide with the edges of large openings in the roof.

3.02.03 Alignment of Sheets and Fixings

All roof decking sheets shall be fixed plumb and level with all fixings evenly spaced and accurately lined. All dirt and grease shall be removed from the surfaces of the sheets as the work proceeds.

3.02.04 Site Cutting

Approval must be obtained before the roof decking sheets are cut at site. Generally cutting of sheets to length will not be permitted, only special cutting and trimming for small openings shall allowed. Where possible, site cut edges shall be concealed at laps.

3.02.05 Damaged Sheets

Distorted, blemished or water stained sheets and any other fittings shall not be used.

3.02.06 Laps

End laps and side laps to roof decking sheets shall be sufficiently large to ensure that the decking complies with the weather tightness and other requirements of this specification. The length of each decking sheet shall be adjusted so that the end laps shall bear on the purlins. In no case end laps shall not be less than 150 mm and side laps shall not be less than 53 mm.

3.02.07 End Lap Fixings

End lap fixings shall be located at least 25 mm from the end of each sheet.

3.02.08 Side Lap Fixings

The spacing of side lap fixings shall ensure compliance with this specification regarding tightness. The spacing of these fixing screws shall not exceed 500mm. The fixing shall be located in the bottom flat of the corrugation.

3.02.09 Holes

Holes in MS decking sheets shall be punched. In case holes are drilled holes, it is to be ensured that the holes do not go oversize due to the small thickness of the sheeting. All drilling swarf shall be removed from the surfaces of decking, supporting steel work, purlins etc.

3.02.10 Location and Spacing of Fixings

Fixings shall be accurately located in position in the centre of the corrugations to ensure that the heads of bolts, nuts and washers bear squarely down on the surface of the sheeting and are not located at the edge or on the joints in supporting purlins.

3.02.11 Fixings

The tenderer shall submit with his tender details of the proposed method for securing the roofing sheets to the metal purlins. The roof decking sheets are to be fixed to the roof purlins with hex washer head white zinc plated heat treated carbon steel self drilling / self tapping screws of minimum thread diameter of 5.6mm. These self drilling screws shall be drilled through the roofing sheets and purlins supporting the roofing sheets. These purlins shall be suitably spaced as per the requirement of roofing sheets and the roofing sheets shall not sag more than span/250 for the loads likely to be imposed during concreting and in future. The self-drilling screws are to be spaced at a maximum distance of 390mm centre to centre along the length of the purlins and top chord of truss. The screws are to be located preferably in the valley only and shall

be installed in accordance with the manufacturer's recommendations using tools approved by the manufacturer which do not damage the coating of the decking sheets.

3.03.00 Protection during Construction

Precautions shall be taken during the erection of the roof decking to ensure that partially erected decking are protected during inclement weather and damage at all times.

3.04.00 Damage

Any damage to coating & primer during transportation is to redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner.

4.00.00 Acceptance Criteria

The installation shall present a neat appearance and shall be checked for water tightness. The following shall be checked :

a) Side and end laps

b) Absence of damage in the sheeting.

c) Conformity of fixings with the approved design.

5.00.00 IS Codes

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS : 513 - Specification for cold rolled carbon steel sheets.

IS : 3618 - Specification for phosphate treatment of iron and steel for protection against corrosion.

IS : 4431 - Specification for carbon & carbon manganese free cutting steel.

IS : 1573 - Electroplated Coatings of zinc on iron and steel.

6.00.0 RATES AND MEASUREMENTS

6.01.00 Rates

Rates shall be unit rate for complete item described in the Schedule of Items and shall include all wastage.

6.02.00 Method of Measurement

Roofing shall be measured for net area of the work done. Profiled sheeting (coated & painted) shall be measured in plan area of sheets and not girthed. No deduction shall be made for openings measuring up to 0.1 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size.

No payments shall be made for laps.

SECTION - D

SUB-SECTION – D20

FALSE FLOORING

C 0 N T E N T

CLAUSE NO.	DESCRIPTION
1.00.00	GENERAL
2.00.00	MATERIALS
3.00.00	INSTALLATION
4.00.00	ACCEPTANCE CRITERIA
5.00.00	IS CODES
6.00.00	RATES AND MEASUREMENTS

FALSE FLOORING

1.00.00 General

This section of the specification covers the supply, fabrication and installation of removable type false flooring system having PVC top finish fire particle board, GI supporting system, aluminium foil lining etc. as per schedule of items in the main plant building and any other area as indicated in the drawings.

The scope of contractor covers supply of all materials, fabrication & installation works required to be carried out for completion of false flooring in the area specified in the drawings.

2.00.00 MATERIAL

2.01.00 Supporting structure

Supporting pedestals shall be made of steel and will be of height as required. Supporting pedestal shall be truly vertical and located at distances to conform with size of floor panels and shall be equipped with locking devices to prevent disturbances of finished elevation. Base of pedestal shall have integral load dispersion plate of size 100x100x8mm to transmit the load evenly to the base floor. Adjustment of pedestal shall be provided by threaded vertical rod of 25mm diameter and elevating nut. The pedestal head shall provide positive interlocking of the steel grid channels supporting system and shall prevent lateral shifting.

The grid channels shall be made of galvanised steel of 40mm x 40mm x 3.15mm thick and shall be placed at 605mm centre to centre both ways to support floor panels in uniform levelled elevations. Nominal height of the false flooring system shall be 600 mm unless otherwise indicated. Pedestal head shall be equipped with conducting grounding pad if so desired by the Engineer

2.02.00 Floor Panels

The floor panels shall be made of fire resistant particle board, phenol formaldehyde bonded. Size of each panel shall be 600mm x 600mm with all panel edges finished to a tolerance of $\pm$ 0.2mm. Floor panel shall have 2mm thick non-static PVC on top, 2mm thick hard PVC strip lipping on four edges and 26 G aluminium sheet fixed with araldite at bottom. Minimum thickness of the panel shall be 35mm, unless otherwise noted. All panels shall be completely interchangeable and easily removable with a suction lift tool. Panels shall be square within a tolerance of $\pm$ 0.25 mm on the diagonal. The floor panels shall be cut, wherever required for providing suitable outlets for cables and edges shall be lipped with hard PVC sheets.

2.02.01 Strength

Each 600mm x 600 mm floor panel must be capable of withstanding the designed service load. The ultimate strength shall provide a safety factor of 3. The false flooring shall be capable of carrying a axial load of 800 kg and uniform load of 2000 kg/sq.m with maximum deflection of 1/350. If required by the Engineer, the samples shall be accepted only after carrying out load tests. The Engineer may relax the test requirements with concentrated load in case cabinets are not handled with castor fitting arrangement.

One additional pedestal shall be provided under floor stringer along front panel area of each control board for taking possible additional load that may occur from time to time.

2.02.02 Surface finish

All removable panels shall have the top surface finished with 2 mm thick flexible PVC flooring conforming to IS:3462 and shall be fixed to the surface with compatible high-creep resistant adhesive. The PVC floor tile shall be in single piece for each floor panel. Under side of panels shall also be painted with suitable epoxy or oil based paint.

2.02.03 Damaged Floor Panels

Distorted, blemished or stained floor panels shall not be used.

2.03.00 Skirting

Skirting shall be 150 mm high and 2 mm thick, completely matching with false flooring surface finish materials and shall be fixed to the wall surface as per manufacturer's installation instructions.

3.00.00 INSTALLATION

3.01.00 Base

The system shall be placed over a base of RCC floor slab and beams. Any grouting etc. that is necessary to fix the supporting structure shall be done.

The concrete sub floor shall be sealed with two coats of polyurethane paint to prevent moisture from coming in contact with cables and to minimise dust problem.

The floor panels and channels shall be completely interchangeable and remain in position without screwing or bolting under working/imposed loadings.

Any damage to the sub floor during installation of the false flooring system shall be

made good by the contractor without any extra cost to the Owner. All steel surfaces are to be protected by two coats of polyurethane paint over a compatible primer and any damage to the paint during installation shall be made good. In case the loads exerted by the weight of machines are above the stated characteristics of floor finish material, the floor shall be protected by overlaying hard board during installation of machine or equipment.

All installation work of the false flooring system shall be supervised by the manufacturer's authorised representative.

3.03.00 Painting

After fixing the false flooring supporting system the sub floor shall be given a coat of polyurethane paint.

3.04.00 Protection during Construction

All precautions shall be taken during the erection of the false flooring to ensure that partially erected flooring are protected and shall not be damaged before handing over to owner.

3.05.00 Damage

Any damage of coating to supporting system caused during transportation is to be redone with the similar type of coating as per the manufacturer’s specification at no extra cost to the Owner.

4.00.00 ACCEPTANCE CRITERIA

The false flooring system shall only be accepted after completion of following checks :

a. Level

b. Alignment of joints

c. Thickness of joints

d. Surface finish

e. Colour and texture

f. Details of edges, junctions etc.

g. Performance

h. Criteria specified for strength.

5.00.00 IS CODES

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS:5318 Laying of flexible sheet and flooring.

IS:3462 Flexible PVC flooring

IS:3087 Wood particle boards (medium density) for general purposes.

6.01.0 RATES AND MEASUREMENTS

6.01.00 Rates

Rates shall be unit rate for complete item described in the Schedule of Items and shall include, but not limited to, supply & installation of floor panels, supporting systems, paintings atc.

6.02.00 Method of Measurement

False flooring shall be measured in Sq.M for net area of the work done. No deduction shall be made for openings measuring up to 0.4 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size.

SECTION - D

SUB-SECTION – D21

BORED CAST IN - SITU PILES

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TECHNICAL SPECIFICATION FOR INSTALLATION OF BORED CAST-IN-SITU PILES

1.00.00 SCOPE

This specification covers the installation of bored cast-in-situ reinforced concrete vertical piles of specified load carrying capacity and diameter for various structures. This specification also covers carrying out initial and routine load tests on piles to assess their vertical, horizontal and pull out load carrying capacities.

2.00.00 GENERAL REQUIREMENT

2.01.00 This specification along with specific requirements under Annexure-A covers the technical requirements for piling work.

2.02.00 The work shall include supplying and providing necessary materials, mobilization of all necessary equipments (Annexure-B), providing necessary engineering supervision through qualified and technical personnel, skilled and unskilled labour, etc. as required to carryout the complete piling work, and submission of records as per schedule.

2.03.00 The Contractor shall carryout all works as mentioned in Scope above. All works shall be executed to the satisfaction of the Engineer.

2.04.00 Pile capacities in vertical compression, horizontal, pullout loads for various pile diameters are given in Annexure-A.

2.05.00 The Contractor shall confirm and guarantee the "Safe Load" capacities by conducting both initial and working load test on piles as mentioned in the specific requirements.

2.06.00 The Contractor shall submit along with tender documents his tender design of piles based on soil data furnished by the Owner along with this specification. The ultimate load capacity of a pile may be estimated using suitable static formula and the minimum factor of safety shall be 2.5. However, safe load carrying capacity shall be conformed and guaranteed by conducting initial and routine load tests.

2.07.00 In case of initial or routine load test piles, if the Contractor fails to establish the safe load capacity as per his design, the Owner has the right to either derate the pile capacity on prorata basis or insist the Contractor to modify the pile design, to achieve the desired safe load capacity at no extra cost to the Owner.

2.08.00 Derating is acceptable up to 90 percent. In such case, additional piles shall be installed as per the design requirements.

2.09.00 The Owner shall decide whether to derate or modify the design based on the design considerations such as providing additional piles in the designed pile cap, provision for extending the pile cap size, etc.

2.10.00 In case the Owner decides to modify the design instead of derating the pile, the contractor shall carry out the same and install separate test piles and test the same to guarantee the safe load at no extra cost to the Owner. However no extra shall be charged for the additional test piles as well as testing of these piles as per agreed contract conditions.

2.11.00 In case of working piles, if the pile does not meet the guaranteed capacity or rejected due to any other reason, the Contractor shall install extra piles at no extra cost to the Owner. Further, the extra cost, due to the increase in the pile cap size if any, on account of extra piles, shall be borne by the Contractor.

2.12.00 It is essential that all equipment and instruments are properly calibrated both at commencement and immediately after the completion of tests so that they represent true values. Certificates to this effect from an approved institution shall be furnished to the Engineer. If the Engineer so desires the Contractor shall arrange for having the instruments tested at an approved laboratory at no extra cost to the Owner and the test report shall be submitted to the Engineer. If the Engineer desires to witness such tests Contractor shall arrange to conduct the test in his presence.

2.13.00 The Contractor shall make his own arrangements for locating the coordinates and position of piles as per drawings supplied to him and for determining the Reduced Levels (RL) of these locations with respect to the benchmark indicated by the Engineer. Two established reference lines in mutually perpendicular direction shall be indicated to the Contractor. The Contractor shall provide at site all the required survey instruments to the satisfaction of the Engineer so that the work can be carried out accurately according to specifications and drawings.

2.14.00 The contractor shall assure the quality of piling work including cleaning of pile bore, quality of concrete, integrity of piles, etc.

2.15.00 AVAILABLE SUB-SOIL DATA

An abstract of the sub soil data is furnished in the tender document. However, the detailed soil investigation report shall be made available for reference of the bidder, if so required, at the office of the Owner. The soil data furnished is in good faith and only for the guidance of the Bidder, to arrive at design parameters and construction methods.

3.00.00 MATERIALS

3.01.00 General

All materials viz cement, steel, aggregates, water, etc. which are to be used for pile construction shall conform to relevant IS codes for properties, storage and handling of common building materials. However, aggregates more than 20 mm size shall not be used.

3.02.00 CONCRETE

Concrete shall be manufactured either by central batching plant or Ready Mix concrete. However, for initial test piles suitable method as approved by the Engineer may be used. Concrete shall conform to IS: 10262 & IS: 456.

3.02.01 Technical Specification for Cement Concrete (Plain and Reinforced) works along with IS: 2911 Part I/Sec 2 shall be followed for concrete works of piles. Use of plasticiser to control the water cement ratio shall be permitted on specific approval from the Engineer. Water cement ratio shall not be greater than 0.5.

3.02.02 Grade and minimum cement content
Minimum grade of concrete shall be as per Annexure-A conforming to IS: 456. Minimum cement content of 400 Kg/M³ of concrete shall be used for M-20 grade concrete.

3.02.03 Slump of concrete
The slump of concrete shall vary between 150 to 180 mm.

3.03.00 REINFORCEMENT

3.03.01 Longitudinal reinforcement in pile shall be high strength deformed steel bars conforming to IS: 1786 unless specified otherwise. Lateral reinforcement in pile shall be of mild steel conforming to IS: 432 Part-1 or HYSD bars as per IS: 1786.

3.03.02 The longitudinal reinforcement shall be provided considering the combination of vertical (compression and tension) and horizontal loads. However, the minimum longitudinal reinforcement shall be 0.4 percent of the sectional area calculated on the basis of nominal pile diameter. Minimum six numbers of bars shall be provided for longitudinal reinforcement. The diameter of longitudinal reinforcement bars shall not be less than 12mm. The stipulated minimum reinforcement shall be provided for the full length of pile.

3.03.03 The longitudinal reinforcement shall project 50 times its diameter above cut off level unless otherwise indicated.

3.03.04 The laterals shall be tied to the longitudinal reinforcement to maintain its shape and spacing. The laterals may in the form of links or spirals. The minimum diameter of the links or spirals shall be 6 mm and the spacing of the links or spiral shall not be less than 150 mm and in no case more than 250 mm.

3.03.05 Reinforcement cage shall be sufficiently rigid to withstand handling and installation without any deformation and damage. As far as possible number of joints (laps) in longitudinal reinforcement shall be minimum. In case the reinforcement cage is made up of more than one segment, these shall preferably be assembled before lowering into casing tube/pilebore by providing necessary laps as per IS: 456.

3.03.06 The minimum clear distance between the two adjacent main reinforcement bars shall normally be 100 mm for the full depth of cage.

3.03.07 The laps in the reinforcement shall be such that the full strength of the bar is effective across the joint and the reinforcement cage is of sound construction.

3.03.08 Laps shall be staggered as far as practicable and not more than 50% bars shall be lapped at a 'particular section. Lap joints shall be staggered by at least 1.3 times the lapped length (Centre to Centre).

3.03.09 Proper cover and central placement of the reinforcement cage in the pile bore shall be ensured by use of suitable concrete spacers or rollers, cast specifically for the purpose.

3.03.10 Minimum clear cover to the longitudinal reinforcement shall be 50 mm, unless otherwise mentioned.

3.03.11 Bundling of bars is not permitted.

4.00.00 PILE INSTALLATION

Installation of piles shall be carried out as per pile layout drawings, installation criteria, and the direction of the Engineer.

4.01.00 Equipment and Accessories

4.01.01 The equipment and accessories for installation of bored cast-in-situ piles shall be selected giving due consideration to the sub soil conditions, ground water conditions and the method of casting, etc. These shall be of standard type and shall have the approval of the Engineer.

4.01.02 List and details of equipment and accessories proposed to be used for the job shall be submitted along with the bid.

4.01.03 The capacity of the rig shall be adequate so as to reach the specified founding level.

4.01.04 Provision shall be kept for chiselling within the pilebore, as specified elsewhere in this specification. Chiselling shall be carried out only with the approval of Engineer.

4.02.00 Installation Criteria

4.02.01 For determining the founding level of piles in soil as specified elsewhere, the Contractor shall have to perform Standard penetration test (SPT) as per IS: 2131 in a separate bore hole. The SPT shall be conducted at 1.0 m interval between the depths covering 5 metres each above and below the specified founding level. The bore shall be 100 mm diameter and method of boring shall conform to IS: 1892.

4.02.02 For determining founding level of piles in rock, as specified elsewhere socketing horizon shall be established by the Contractor by collecting rock cores of NX size in a separate borehole, and testing the same for uniaxial compressive strength (UCS). Cores shall be collected by double tube core barrel attached with diamond bit. Coring shall be done upto a depth as indicated in the "specific requirements." Coring in rock shall conform to IS: 6926.

4.02.03 In case it is not possible to test the cores so obtained for uniaxial compressive strength, cores shall be tested for point load strength index and correlated to obtain uniaxial compressive strength.

4.02.04 Number of boreholes for carrying out SPT in soil or uniaxial compressive strength in rock, shall vary from one in 100 to 150 piles or pile group of 150 Sqm depending on the site condition and as decided by the Engineer. However, at the location of initial load test piles, one such borehole shall be done.

4.02.05 A protocol between contractor and BHEL site shall be maintained regarding the strata at founding level. SPT value and UCS from the nearest borehole shall be indicated therein.

4.02.06 The founding level of the pile shall be decided based on the criteria elaborated in the specific requirements under Annexure-A. Concreting shall not be done until the above conditions for founding level are satisfied.

4.02.07 Approval of founding level by the Engineer shall in no way absolve the Contractor of his responsibility to guarantee the Safe load capacity of the piles as indicated in this document.

4.03.00 Control of position and alignment

4.03.01 Piles shall be installed as accurately vertical as possible. The permissible limits for deviation with respect to position and (inclination) alignment shall conform to IS: 2911 Part I/Sec. 2, which is reproduced below for ready reference.

a) The maximum deviation of vertical piles shall not exceed 1.5 per cent in alignment.

b) Piles shall not deviate more than 75 mm or D/4 whichever is less (75mm or D/10 whichever is more in case of piles having diameter more then 750mm) from their designed position at the working level.

4.04.00 Boring

4.04.01 Boring operations shall be done by rotary or percussion type drilling rigs using reverse mud circulation (RMC) method. Rotary hydraulic pulley shall be preferred.

4.04.02 The Contractor shall satisfy himself about the suitability of the method to be adopted for site. If DMC (direct mud circulation) or RMC is used Bentonite slurry shall be pumped through drill rods by means of high-pressure pumps. The cutting tool shall have suitable ports for the bentonite slurry to flow out at high pressure. If on mobilisation, the Contractor fails to make a proper bore for any reason, the Contractor has to switchover to other boring methods as approved by the Engineer at no extra cost to the Owner.

4.04.03 Working level shall be above the cut off level. After the initial boring of about 1.0m a temporary guide casing of suitable length shall be lowered in the pile bore. The diameter of guide casing shall be of such diameter, so as to give the necessary finished diameter of the concrete pile. The centre line of guide casing shall be checked before continuing further boring. Guide casing shall be minimum of 1.0m length. Additional length of casing may be used depending on the condition of the strata, ground water level etc.

4.04.04 Use of drilling mud (bentonite slurry) for stabilizing the sides of the pile bore is necessary wherever subsoil is likely to collapse in the pile bore. Drilling mud to be used shall meet the requirement as given in Annexure-C.

4.04.05 The bentonite slurry and the cuttings, which are carried to the surface by the rising flow of the slurry, shall pass through settling tanks of adequate size to remove the sand and spoils from the slurry before the slurry is recirculated to the boring. The bentonite slurry mixing and recirculation plant shall be suitably designed and installed.

4.04.06 The bentonite slurry shall be maintained at 1.5m above the ground water level during boring operations and till the pile is concreted. When DMC or RMC method is used the bentonite slurry shall be under constant circulation till start of concreting.

4.04.07 The size of cutting tools shall not be less than the diameter of the pile by more than 75mm. However, the pile bore shall be of the specified size.

4.05.00 Chiselling

4.05.01 Chiselling may be resorted to with the permission of the Engineer below the socketing horizon. The chiselling tool or bit shall be of adequate size and weight so as to reach the desired depth.

4.06.00 Cleaning of Pile bore

4.06.01 On completion of the pile bore upto the required depth, the bottom of the hole shall be cleaned very carefully before concreting work is taken up. Cleaning shall ensure that the pile bore is completely free from sludge/bored materials, debris of rock/boulder etc. Necessary checks shall be made as given in clause 5.0 to confirm the thorough cleaning of the pile bore.

4.06.02 Pile bore shall be cleaned by fresh drilling mud through tremie pipe after placing reinforcement and just before start of concreting.

4.06.03 Pile bore spoil along with used drilling mud shall be disposed off from site as directed by the Engineer.

4.06.04 Pile bore bottom shall be thoroughly cleaned to make it free from sludge or any foreign matter before and after placing the reinforcement cage.

4.07.00 Adjacent Structures

4.07.01 When working near existing structures care shall be taken to avoid any damage to such structures.

4.08.00 Concreting

4.08.01 The Contractor shall carry out concrete mix design in accordance with IS: 10262 and submit mix design calculations and get them approved from the Engineer well in advance for installation of piles. Adequate number of tests on cubes, etc. shall be carried out as mentioned in clause 5.0 to ensure concrete of the minimum specified strength in accordance with IS: 456 at requisite workability (slump).

4.08.02 Concreting shall not be done until the Engineer is satisfied that the bearing strata (soil/rock) met with at the termination level of pile.

4.08.03 The time interval between the completion of boring and placing of concrete shall not exceed 6 hrs. In case the time interval exceeds 6 hrs the pilebore shall be abandoned. However, the Engineer may allow concreting provided the Contractor extends the pile

bore by 0.5 m beyond the proposed depth, and clean the pilebore. The entire cost of all operation and materials for this extra length shall be borne by the Contractor.

4.08.04 Proper placement of the reinforcement cage to its full length shall be ensured before concreting.

4.08.05 Concreting shall be done by tremie method as specified by IS: 2911 (Part I /Sec.2). The level of drilling mud shall be maintained sufficiently above the ground water level.

4.08.06 The concreting operations shall not be taken up when the specific gravity of bottom slurry is more than 1.2 and sand content more than 7%. The drilling mud sample shall be collected from the bottom of pilebore as mentioned in clause 5.

4.08.07 Consistency of the drilling mud suspension shall be controlled throughout the concreting operations in order to keep the bore stabilized as well as to prevent concrete getting mixed up with the thicker suspension of the mud.

4.08.08 It shall be ensured that volume of concrete poured is at least equal to the theoretically computed volume of pile shaft being cast.

4.08.09 The temporary guide casing shall be withdrawn cautiously, after concreting is done upto the required level. While withdrawing the casing concrete shall not be disturbed.

4.09.00 Cut off level (COL)

4.09.01 Cut off level of piles shall be as indicated in drawings released for construction or as indicated by the Engineer.

4.09.02 The top of concrete in pile shall be brought above the COL to remove all laitance and weak concrete and to ensure good concrete at COL for proper embedment in to pile cap.

4.09.03 When the pile cut off level is less than 1.0 metre below the working level, concrete shall be cast to the piling platform level to permit overflow of concrete for visual inspection. In case COL of pile is more than 1.0 metre below working level then concrete shall be cast to a minimum of one metre above COL.

4.10.00 Sequence of Piling

4.10.01 Each pile shall be identified with a reference number.

4.10.02 The convenience of installation may be taken into account while scheduling the sequence of piling in a group. This scheduling shall avoid piles being bored close to other recently constructed piles.

4.11.00 Building up of Piles

4.11.01 If any pile, already cast as per construction drawing, requires any extra casting due to any change in cut off level or the cast pile top level is less than the specified level or for any other reason, then the pile shall be built-up by using atleast one grade higher concrete than that used for concreting of the same pile, ensuring proper continuity with the existing concrete and to the satisfaction of the Engineer. Necessary reinforcement as per design requirement and suitable shuttering shall be provided before casting the concrete. Surrounding soil shall also be built up to the required level by proper compaction to ensure lateral capacity of the pile.

4.12.00 Breaking off of Piles

4.12.01 If any pile already cast, requires breaking due to lowering in cut off level or for any other reason, then the same shall be carried out, not before seven days of casting without affecting the quality of existing pile such as loosening, cracking etc. and to the satisfaction of the Engineer.

4.13.00 Preparation of Pile head

4.13.01 The soil surrounding the piles shall be excavated upto the bottom of the lean concrete below the pile cap, with provision for working space, sufficient enough to place shuttering, reinforcement, concreting and any other related operations.

4.13.02 The exposed part of concrete above the COL shall be removed/chipped off and made to a uniform level at COL, but not before seven days of casting of pile.

4.13.03 The projected reinforcement above COL shall be properly cleaned and bent to the required shape and level to be anchored into the pile cap.

4.13.04 The pile top shall be embedded into the pile cap by 50mm or clear cover to reinforcement, whichever is higher.

4.13.05 All loose material, like debris due to chipping/breaking of pile head to the desired level, shall be removed and disposed off as directed by the Engineer.

4.14.00 Rejection and Replacement of Defective Piles

4.14.01 The Engineer reserves the right to reject any pile which in his opinion is defective on account of load capacity, structural integrity, position, alignment, concrete quality etc. Piles that are defective shall be pulled out or left in place as judged convenient by the Engineer, without affecting the performance of adjacent piles. The Contractor shall install additional piles to substitute the defective piles as per the directions of the Engineer, at no extra cost to the Owner.

4.15.00 Recording of Piling Data

4.15.01 The Contractor shall record all the information during installation of piles. Typical data sheet for recording pile data shall be as shown in Appendix D of IS: 2911 Part I/Sec.2. The pile data shall also include all the details as in Annexure-D. On completion of each pile installation, pile record in triplicate shall be submitted to Engineer within two days of completion of concreting of the pile.

5.00.00 SAMPLING, TESTING AND QUALITY ASSURANCE

5.01.00 Facilities required for sampling and testing of materials, concrete, etc. in field and in laboratory should be provided by the Contractor. The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and this Specification. Where no specific testing procedure is mentioned the tests shall be carried out as per the prevalent accepted engineering practice and as per the directions of the Engineer. Tests shall be done in the presence of the Engineer or his authorized representative. In case the Engineer requires additional tests, the Contractor shall arrange to get these tests done and submit to the Engineer the test results in triplicate within three days after completion of any test.

5.02.00 The Contractor shall maintain records of all inspection and testing, which shall be made available to the Engineer. The Engineer at his discretion may waive some of the stipulations for small and unimportant concreting operations and other works.

5.03.00 Materials found unsuitable for acceptance shall be removed and replaced by the Contractor. The work done by this unsuitable material shell be redone as per specification requirements & and to the satisfaction of the Engineer at no extra cost to the Owner.

5.04.00 Quality Assurance Programme

a) The Contractor shall submit and finalize a detailed Field Quality Assurance Programme within 30 days from the date of award of the contract, according to the requirements of this specification. This shall include setting up of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of field quality plan, etc. On finalized field quality plan, the Owner shall identify, customer hold points, beyond which work shall not proceed without written approval from the Engineer. The testing apparatus/equipment installed in the field laboratory shall be calibrated/ corrected by the qualified persons as frequently as possible to give accurate testing results.
b) Frequency of sampling and testing, etc. and Acceptance Criteria are given in Table - 1. The testing shall be done at field laboratory or any other laboratory approved by the Engineer. However, the testing frequencies set forth are the desirable minimum and the Engineer shall have the full authority to call for tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the

appropriate specifications. The materials shall be tested to meet all the specified requirements before acceptance at manufacturers premises or at independent government approved laboratory. Tests indicated in the table are for cross checking at site the conformity of the materials to some of the specifications.

5.05.00 Testing of Concrete

5.05.01 Concrete and other materials shall be tested for quality, strength and other properties. Details of testing shall be as specified under technical specification for Cement concrete (Plain and Reinforced).

5.05.02 One sample consisting of six test cubes shall be made from the concrete used in each test pile, three to be tested after 7 days and three after 28 days.

5.05.03 For working piles, minimum one sample consisting of six test cubes shall be made from the concrete for the first ten piles, three to be tested after 7 days and three after 28 days. Thereafter, minimum one sample consisting of three test cubes for every 10 piles shall be tested for the 7-days & 28-days cube strength.

5.05.04 In preparation of test cubes or specimens vibrators shall not be used.

5.05.05 Concrete shall be tested for slump at every 1-hour interval during concreting of piles.

5.05.06 The frequency of sampling and testing of concrete and materials shall be done as per technical specification for cement concrete (Plain & Reinforced).

5.05.07 The acceptance criteria shall be as mentioned in Table-1.

5.06.00 Testing for position and alignment

5.06.01 Each pile shall be checked for its position with respect to specified location. Each pile bore shall be checked for its alignment.

5.06.02 Permissible limits for deviation shall be as specified under clause no. 4.03.

5.07.00 Properties of Drilling mud

5.07.01 Properties of drilling mud shall be checked as per requirement under Annexure C. Prior to the commencement of piling work and thereafter minimum once in a week or as found necessary by the Engineer, one sample consisting of 3 specimens shall be tested. Acceptance criteria applicable are as specified else where with 5% variation. This relaxation is not applicable for properties of drilling mud before concreting.

5.07.02 Density of the drilling mud shall be checked in each pile before concreting.

5.08.00 Check for Pile bore

5.08.01 On completion of boring and cleaning the bottom of each pilebore shall be checked from the sample collected from near the bottom of pile bore or by any other methods as approved by the Engineer, to ensure that it is free from pilebore spoil/debris and any other loose material, before concreting. Concreting shall be done only after the approval of the Engineer.

5.08.02 For sampling of drilling mud from the pilebore the following method or any other suitable method shall be adopted.

a) A solid cone shall be lowered by a string to the bottom of pilebore. A sampler tube closed at top with a central hole (hollow cylinder) is lowered over the cone, and then a top cover shall be lowered over the cylinder. Care shall be taken for proper fittings of assembly to minimize the leakage while lifting the cone assembly to the ground surface. The slurry collected in the sampler tube shall be tested for density and sand content.

b) Use of borehole camera for checking the pile bore spoil and strata is acceptable on approval of the Engineer.

5.09.00 Pile Integrity test

5.09.01 Low strain integrity test shall be conducted on 50% of the jobs piles and on all test piles or as directed by Engineer. The system shall have the computer readout facility and report on the findings of this shall be furnished to the Owner. This test shall be used to identify the job piles for routine load test.

Piles shall be trimmed to cut off level or sound concrete level. No pile cap blindage work should be undertaken prior to this test. The cast in-situ piles should not be tested before 14 days of casting.

5.09.02 The test shall be undertaken by persons trained and experienced and capable of interpreting the results with specific regard to piling. This test is limited to testing the integrity of the shaft and is not intended to replace the use of static load testing.

5.09.03 Low Strain Integrity Test Methodology:

a) In this test, a low stress wave is set up in the pile shaft and is also known as Sonic Integrity or Sonic Echo test.

b) A small metal/hard rubber hammer is used to produce a light blow on top of the pile. The shock wave travelling down the length of the pile is reflected back from the toe of the pile and recorded through a suitable transducer/ accelerometer in a computer for subsequent analysis.

c) The primary shockwave, which travels down the length of the shaft, is reflected from the toe by the change in density between the concrete and sub strata. However, if the pile has any imperfections or discontinuities within its length these will set up secondary reflections, which will be added to the return signal.

d) By analysis of the captured signal and knowledge of the conditions of the ground, age of concrete, etc. a picture of the locations of pile shaft defects can be built up. The observed signals are amplified into digital display as velocity versus length records providing information on structural integrity of piles.

e) The stress wave velocity and approximate pile lengths are provided as input for the integrity testing. The stress wave velocity is dependent on the Young's Modulus and mass density of pile concrete.

f) More than one recording of signals shall be done until repeatability of signals is achieved on the same pile.

g) The tests shall be conducted at 3-6 locations to cover the entire cross section of the pile.

6.00.00 PILE TESTING

Pile load test shall be carried out as per IS:2911 Part-4 (latest edition) or as directed by Engineer.

6.01.00 INITIAL LOAD TEST

Initial load test shall be carried out on separately cast piles for confirmation of estimated pile capacities and to fix a more accurate driving criteria viz. set/bow, total number of blows and approximate depth etc. of founding level. At least 2 nos. of tests shall be conducted for each mode (vertical compression, pull out and lateral). The maximum test load shall be as mentioned in bill of quantities.

6.02.00 ROUTINE LOAD TEST

Routine load tests shall be carried out on job (working) piles for 0.5% of total no. of piles (for each mode and type). Maximum test load shall be 1.5 times the design safe load capacity. Piles showing unsatisfactory results as per load test results shall be treated as defective piles. Defective piles shall be removed or left in place and replaced

by additional piles as directed by Engineer at no extra cost to the owner. Any additional cost towards design implications, if any, due to above shall be born by the contractor.

7.00.00 CODES AND STANDARDS

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) Codes, unless specified otherwise. In case any particular aspect of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

IS: 432 (Part 1 & 11) - Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.

IS: 456 - Code of practice for plain and reinforced concrete.

IS: 1200 (Part 23) - Measurement of Building and Civil Engineering works Piling.

IS: 1786 - Code of practice for twisted steel high strength deformed bars for concrete reinforcement.

IS: 1892 - Code of practice for Subsurface Investigation for foundation.

IS: 2131 - Method of Standard Penetration Test for Soils

IS: 2911 Part I/Sec 2 - Code of practice for design and construction of pile foundations - Bored cast-in-situ concrete piles.

IS: 2911 Part IV - Code of practice for design and construction of pile foundation - Load test on piles.

IS: 6926 - Code of practice for Diamond core Drilling for Site Investigation for River Valley Projects.

IS: 10262 - Recommended guidelines for concrete mix design.

8.00.00 RATES AND MEASUREMENTS

The clauses below shall apply for item rate contracts only. They shall not be applicable to turnkey/lump sum Contracts.

8.01.00 Rates

8.01.01 The items of work in the schedule of items, describe the work in brief. The various items in schedule of items shall be read in conjunction with the corresponding sections in the Technical Specifications, including amendments, and additions, if any. For each item in schedule of items, the unit rate shall include for the activities covered in the description of the item as well as for all necessary operations described in the specification and specific requirements.

8.01.02 The unit rates shall include for minor details which are obviously and fairly intended, and which may not have been included in the description in these documents, but are essential for the satisfactory completion of the work. Unit rates shall also include for all safety measures as required by codal provisions, local regulations, acts, bye-laws, etc. and for execution of work to the satisfaction of the Engineer.

8.01.03 The quoted rate for each item shall be inclusive of mobilization of all plant, equipment, scaffolding, labour, materials, skilled and unskilled labour, and demobilization after completion of work, supervision, establishing the level and coordinates at each work.

8.01.04 The quoted rate for piling for a particular diameter and capacity of pile shall remain valid for the actual lengths provided /to be provided irrespective of the minimum length specified elsewhere in this specification.

8.01.05 The quoted rate for piling as per description of item works shall be inclusive of providing all plant equipment, labour, materials, skilled and unskilled labour, making observations, establishing the ground level and coordinates at each location of pile by carrying levels from one established bench mark and distances from one set of grid lines furnished by the owner.

8.01.06 The quoted rate for piling shall be inclusive of bailing out all the pile bore spoil from the pilebore, keeping the borehole free from bored material/debris etc. and disposing the bored/chiselled material along with the drilling mud upto 2 Km. beyond plant boundary or as directed by Engineer, flushing the pile bore by fresh bentonite before concreting, collection of samples from bottom of pilebore, transporting to laboratory, testing and reporting of results.

8.01.07 The quoted rate for piling shall include shifting of plant and equipment from one pile location to another pile locations, providing temporary casing pipe and removal of the same after completing, concreting, supply of necessary materials, equipment and manpower, cost of boring by approved method as specified, circulation of bentonite slurry and cleaning of borehole free from sludge, as specified, etc.

8.01.08 The quoted rate for piling shall also include chiselling, if any, required for socketing the pile in rock.

8.01.09 The quoted rate for the piling shall include concreting by termite method, length of pile above COL, withdrawal of guide casing, cost for preparation of pile head and disposal of debris etc., resulting from breaking off of pile upto COL, upto a distance of 2 Km from the plant boundary or as directed by Engineer.

8.01.10 The quoted rate for piling shall also include providing reinforcement and its cleaning, straightening, cutting, bending, binding with annealed wire, welding, tackwelding, providing concrete cover blocks, spacers, placing the reinforcement cage in pile casing/bore and other cost of tools and plants, materials, labours, carting the steel from store to piling site and return of unused steel to the Owners storage point, etc.

8.02.11 Plasticiser/Admixture when used as directed by the Engineer shall be included in piling rates.

8.01.12 The quoted rate for piling shall include for all quality assurance requirements, but not limited to providing for technical inspection, transportation of samples to laboratory, testing samples, maintaining and submitting all test records, etc.

8.01.13 The quoted rate for boring in separate borehole shall be inclusive of performing of SPT at regular intervals as specified and collecting rock cores from boreholes, upto the depth as specified shall be inclusive of transporting to laboratory, testing and reporting of the results.

8.01.14 Unit rate for low integrity test shall be inclusive of mobilization of the entire set of equipment, computer readout, printer, and equipment which may not lave been included in the description but are essential for the satisfactory completion of the work as per internationally accepted practice. The rate quoted shall be inclusive of repeatability of test, preparation of pile top surface etc.

8.02.00 Measurement

8.02.01 Piling length shall be measurement by linear measurement from pile cut-off level to the tip of pile in meters upto second place of decimal separately for each diameter and capacity of pile. The length of pile to be cast above cut off level, as per specification, and as approved by Engineer, shall be considered for cement reconciliation only. Theoretical diameter of piles shall be considered for reconciliation of cement consumption. No extra payment shall be made for the length from existing ground to cut-off level.

8.02.02 Reinforcement steel shall be measured for reconciliation purpose only and the measurement shall be done for providing and placing reinforcement in piles, by weight in tones, up to third place of decimal in the following manner:

i) The weight shall be arrived at by multiplying the actual length measured alongwith standard hooks, rings or spirals, spacers, cranks, bends, authorized laps, etc. by sectional weight. These shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS code's sectional weight. Nothing extra shall be payable to the contractor on account of difference in weight, if any, due to different methods adopted for issue and measurement.

ii) Standard hooks, cranks, bend, authorized laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tones.

iii) Dowels, neither shown on the drawings nor instructed by the Engineer, but required for construction facilities shall not be measured.

8.02.03 Breaking off of piles, due to subsequent change in design cut off level, shall be measured separately. This shall be measured in cubic metres upto second place of decimal. This will be payable only when the pile is cast and on the basis of written instruction of the Engineer for lowering of COL.

8.02.04 Measurements for the item of boring in a separate borehole shall be measured in metres from ground level upto the depth as specified, upto second place of decimal. Item of work of boring in soil and coring in rock shall be measured separately for the actual length of boring in soil and coring in rock.

8.02.05 The item for pile integrity test shall be measured in terms of no. of piles tested.

ANNEXURE-A

Specific Requirements for Bored Cast-in-situ RCC Piles

A1.0 Minimum cement concrete grade M-25

Minimum cement content 400 Kg/M³

A1.1 Safe load

Diameter of Pile

Diameter of Pile (mm)	Vertical/ Compression (MT)	**Horizontal/ Lateral (MX)**	**Pul lout/Tension (MT)**
*	*	*	*
*	*	*	*

A2. Installation criteria

The installed pile(s) shall satisfy the following criteria.

A2.1 In Soil/weathered Rock

a) Minimum length of the pile shall be _____* m below COL.

b) The pile shall be terminated after penetrating through the strata having SPT penetration less than __* cm for ____* blows, for a minimum length of _____* times the diameter of the pile.

A2.2 In Rock

a) Piles shall be installed and socketed into the rocks for a length (socketing length) equal to _____* times the pile diameter subject to a minimum of _____* meter below the socketing horizon.

b) Socketing horizon shall consist of rock strata having minimum uniaxial compressive strength of _____* kg/sq.cm.

A3. Average cut-off level for tender design and initial load test can be assumed as _____* m below ground level.

A4. A protocol shall be signed between BHEL site and contractor regarding,

Strata at the founding depth

Installation criteria

Socketing depth

Density of bentonite before concreting

Slump of concrete.

Time interval between end of boring and start of concreting,

* Values shall be indicated separately depending upon subsoil strata of the site.

ANNEXURE-B

List of Equipments

SI.No	Description	Capacity No.
1.	Piling Rigs	
2.	Chisel	3 T min 6 T max
3.	High pressure Mud Pumps	10 HP min 25 HP max
4.	Bentonite mixing plants	
5.	Concrete batching plant	
6.	Soil testing equipments	

Note:

1. The no. and capacity of the piling equipment varies for each work.
2. Additional equipments shall be mobilized if required as per the directions of the Engineer to match the work schedule at no extra cost to the Owner.

ANNEXURE-C

Bentonite suspension used for piling work shall satisfy the following requirements

a) Liquid limit of bentonite when tested in accordance with IS: 2720(Part V) shall be more than 300 percent and less than 450 percent.

b) Sand content of the bentonite powder shall not be greater than 7 percent.

c) Bentonite solution should be made by mixing it with fresh water using pump for circulation. The density of the freshly prepared bentonite suspension shall be between 1.034 and 1.10 gm/ml depending upon the pile dimensions and type of soil in which the pile is to be installed. However, the density of bentonite suspension after mixing with deleterious materials in the pilebore may be upto 1.25 gm/ml.

d) The Marsh viscosity when tested by a Marsh cone shall be between 30 to 60 seconds.

e) The differential free swell shall be more than 540 percent.

f) The pH value of the bentonite suspension shall be between 9 and 11.5.

ANNEXURE-D

PILE DATA

1. Reference No. Location (Co-ordinates) _____area.
2. Sequence of Piling
3. Pile diameter & Type
4. Working level (Platform level)
5. Cut off level (COL)
6. Actual length below COL
7. Pile termination level
8. Top of finished concrete level
9. Date and time of start and completion of boring.
10. Depth of Ground water table in the vicinity.
11. Type of soil at pile tip
12. Method of boring operation
13. Details of drilling mud as used:

    i) Freshly supplied mud
    Liquid limit -

    Sand content -

    Density -

    Marsh viscosity -

    Swelling index -

    pH value -

    ii) Contaminated mud
    Density -

Sand content -

14. SPT* N values in soil (from the nearest bore hole).
+UCS** value in rock (from the nearest bore hole).

* Standard penetration Test
** Unconfined compression strength

15. Chiseling if any, from..…... m to …..... m

16. Date and time of start and completion of concreting.

17. Method of placing concrete

18. Concrete quantity
Actual

Theoretical

19. Ref. Number of test cubes

20. Grade and slump of concrete

21. Results of test cubes

22. Reinforcement details:

Main Reinforcement	Stirrups: Type
No._____	No._____
Dia. _____	Dia._____
Depth _____	Spacing _____

23. Any other information regarding obstructions, delay and other interruption to the sequence of work.

TABLE -1

FREQUENCY OF SAMPLING AND TESTING

SI. No	Type of material work	Nature of Test/ characteristics	Method of Test & frequency	No. of test	Acceptance Criteria
1.	Pilebore size a) diameter b) length		Physical measurement	each pile	as per specification
2.	Founding level	to establish socketing horizon/ and or founding level & upto depth 5m below founding level.	in separate borehole meant for the purpose a) SPT in soils/ weathered rock b) Core & UCS value of rock	1 borehole for 100-150 piles or group of 150 Sqm	Annexure - B
3.	Bentonite (Mud) properties. a) Basic proper-ties of bentonite before use. b) Contaminated mud from pile bore bottom before concreting	Liquid Limit, Marsh Viscosity, Specific gravity, sand content, swelling index, pH value. Density, sand content	in lab in lab	As per Cl. 5.7 Each Pile	As per Annexure C As per annexure C
4.	Position and Alignment	-	Physical or any Approved method	Each Pile	As per Cl. 4.3
5.	Cleaning of pilebore	-	As per Cl. 5.8	Each Pile	Pilebore be free from bored materialcuttings debris/sludge
6.	Reinforcement (R/F) Spacing of longitudinal R/F cover laps bind-ing of laterals		Physical inspection and measurement	each cage	As per approved design
7.	Concrete a) Workability b) Cubes	 Slump cone test Compressive Strength test	 Each pile As per spec.	 As per Cl. 5.5 As per Cl. 5.5	 As per specification. As per IS: 456
8.	Materials like aggregate, sand etc.	As per technical specification for concrete and relevant IS codes			
9.	Pile head		Physical	each pile	

SECTION - D

SUB-SECTION – D22

SITE LEVELLING AND GRADING

C O N T E N T

CLAUSE NO	DESCRIPTION
1.00.00	GENERAL
2.00.00	SCOPE
3.00.00	MATERIALS
4.00.00	QUALITY CONTROL
5.00.00	EXECUTION
6.00.00	RATES AND MEASUREMENTS

TECHNICAL SPECIFICATION
FOR
SITE LEVELLING AND GRADING

1.00 GENERAL

This specification cover the works to be carried out for "Site Levelling and Grading Works including Slope Protection" etc for the entire plant and associated areas. The specified formation level(s) shall be achieved either by excavation or by raising with controlled fill with excavated/borrowed earth as the case may be.

2.00 SCOPE

2.01 The scope include all works involved in levelling the site to the lines, grades, cross sections and dimensions as shown on the approved drawings and/or as directed by the engineer including site clearance, setting out, earth work in excavation, stacking, loading, transportation, unloading, dewatering, drainage, filling, watering, compaction, turfing on slopes (if required), lighting, disposal of residual/surplus earth etc. It also include supplying and providing all labour, materials, supervision, services, equipments, tools and plants, testing and all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work etc.

2.02 All tools and plants, equipments and machineries to be used in this work shall be of standard quality and manufactured by reputed concerns conforming to Indian Standard (IS) codes or equivalent thereof.

2.03 Work to be provided by the Contractor

The works to be provided by the contractor unless specified otherwise shall include but not be limited to the following.

a) Supplying and providing all labour, supervision, services including as required under statutory labour regulations, materials, equipments, tools and plants, approaches, transportation etc required for the completion of the work.

b) Preparation and submission of detailed scheme of all operations required for executing the work (material handling, placement, services, approaches etc) to the engineer for approval.

c) Carrying out sampling and testing on fill materials/fills to assess the quality/moisture content/degree of compaction and submission of the test results whenever required by the engineer.

d) Design, construction and maintenance of Magazine of proper capacity for storage of explosives for blasting work and removal of the same after completion of the work etc.

2.04 Work to be provided by others

No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract.

2.05 Codes and Standards

All work shall be carried out as per this specification and shall conform to the latest revision and/or replacements of the following or any other Indian Standard (IS) codes unless specified otherwise.

IS: 1200 Methods of measurement of building and civil engineering works, Part-1: Earth work

IS: 2720 Method of test for soils (Relevant parts)

IS: 3764 Excavation work- Code of safety

IS: 4081 Safety code for blasting and related drilling operations

IS: 4701 Code of practice for earth work on canals

IS: 6922 Criteria for safety and design of structures subject to underground blasts

In case of conflict between this specification and those (IS codes) referred to herein, the former shall prevail. In case any particular aspect of work is not covered specifically by the specification or/and by the IS codes, any other standard practice as may be specified by the engineer shall be followed.

2.06 Conformity with Designs

The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer.

3.00 MATERIALS

All materials required for the work shall be of best variety and approved by the engineer.

3.01 Materials for Excavation

For the purpose of identifying the various strata met during the course of excavation, the following classification are to be followed.

a) Soil

It include all type of soil including laterite, moorumetc with/without any percentage of kankars which can be excavated by normal means such as shovel, pick axe, crow bar, spade etc and those which do not fall underclause 3.01 (b) and (c) etc.

b) Soft Rock

It include the rocks (including weathered rock) which are removable by splitting with the help of crow bar, pick axe, wedges, pavement breakers, pneumatic tools, hammers or such implements etc and not requiring blasting (for excavation) in the opinion of the engineer.

c) Hard Rock

It includes the rocks which require blasting for excavation in the opinion of the engineer. Where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other method as approved by the engineer. The mere fact that the contractor resorts to blasting shall not classify the soft rock under hard rock.

However,the engineer's decision on the type of strata encountered during excavation shall be the final and binding on the contractor.

3.02 Materials for Filling

Any coarse grained or fine grained low plastic soil free from vegetation, roots, shingle, salts, organic matters, sod and any other harmful chemicals shall be used for filling. The contractor shall test the fill material to establish its suitability and submit the results to the engineer for approval. Fill material shall be got approved by the engineer. The following type of materials shall not be used for filling.

a) Materials from swamps, marshes and bogs
b) Expansive clays
c) Peat, logs, sod and perishable materials
d) Materials susceptible to combustion
e) Any material or industrial and domestic produce which will adversely affect other materials of work
f) Materials from prohibited areas

The earth available by cutting the high grounds within the project site and the materials (if) available from the road excavation or any other excavation under the same contract shall be used for filling depending upon its suitability as fill material. Filling with excavated rock (in the project site) shall be done only with the written permission of the engineer in the following manner. The boulders shall be broken into pieces not exceeding 150mm size in any direction and mixed with fine materials consisting of decomposed rock, moorum or any approved earth to fill the voids as for as possible and the mixture shall then be used for filling. In case the earth required for filling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc shall be borne by him. He shall obtain and submit the necessary clearances/permissions from the concerned authorities to the engineer for the borrow areas/materials acquired.

4.00 QUALITY CONTROL

All works shall conform to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

Sl. No.	Activity	Check
1	Lines, levels & grades	a) By periodic surveys b) By establishing markers, boards etc
2	Filling	(a) On quality of fill material (b) On moisture content of fill material (c) On degree of compaction achieved

5.00 EXECUTION

The contractor shall prepare and submit the detailed drawings/schemes for excavation and filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of approaches, dewatering (if any), drainage and compaction etc within 15 days of award of the contract to the engineer for approval.

5.01 Site Clearance

Before the commencement of earthwork, the entire area of cutting and filling shall be cleared of all trees, stumps, bushes, grasses, vegetation etc with their roots, fences, logs, rubbish, water, slush etc. It is not necessary to remove all the soil containing fine hair

like roots but only the rather heavy mats are to be removed. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below the existing ground level or 300mm below the formation level whichever is deeper. After the removal of roots of trees, the pot holes formed shall be filled with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The trees shall be cut in to suitable pieces as instructed by the engineer. Before earthwork is started, all the spoils, unserviceable materials and rubbish shall be burnt or removed and disposed off to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timbers, fire woods etc shall be the property of owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

5.02 Setting Out

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for the ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the same shall be rectified by the contractor at his own risk and cost. The contractor shall take spot levels of the area (with respect to the bench mark/ available source as provided by the engineer) to be excavated or to be filled at an interval of not more than 10m or as directed by the engineer before starting any earth work and shall be submitted to the engineer for prior approval.

5.03 Excavation

Levelling by excavation shall be carried out where the existing ground levels are higher than the specified formation level. Excavation shall include removal of all materials whatever nature as may be and whether wet or dry shall be carried out exactly in accordance with the line, levels, grades and curves shown on the approved drawings and/or as directed by the engineer. All excavations shall be done to the minimum dimensions as required. The contractor shall obtain prior approval of the engineer for the method he proposes to adopt for excavation in different types of strata including dimensions, side slopes and dewatering if any, stacking or disposal etc. This approval however shall not in any way make the engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to any other activities in the area. **Prior to starting the excavation, the ground level at the location shall be checked jointly with the engineer.**

The rough excavation may be carried up to a maximum depth of 150mm above the final formation level. The balance shall be excavated with special care and the final surface shall be compacted by rolling with 6 passes of 8 to 10 tonne roller. If directed by the engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The contractor shall be paid for the extra excavation and filling at the appropriate items of work.

If the excavation is done to a depth greater than that shown on the drawing or as directed by the engineer due to the contractor's fault, the excess depth shall be filled up to the required level with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer at the own risk and cost of the contractor.

Suitable slope in cutting as per the requirements and as directed by the engineer shall be adopted to withhold the face of earth. The contractor shall be held responsible for any damage to any part of the work caused by the collapse of the side of excavations.

5.03.01 Excavation in Hard Rock

Excavation in hard rock shall normally be done with blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces.

5.03.02 Blasting

a) General

Storage, handing and use of explosives shall be governed by the current explosive rules/regulations laid down by the Central and the State Governments. The contractor shall ensure that these rules/regulations are strictly adhere to. The following instructions are also to be strictly followed and the instructions wherever found in variance with the above said rules/regulations, the former (instructions) shall be superseded with the later (above said rules/regulations).

No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. The contractor shall obtain licence from the District Authorities for undertaking the blasting work as well asfor obtaining and storing the explosives as per Explosives Rules, 1940 corrected upto date. The contractor shall purchase the explosives, fuses, detonators etc only from a licensed dealer and shall be responsible for the safe custody and proper accounting of the explosive materials. The engineer or his

authorized representative shall have the access to check the contractor's store of explosives and his accounts at any time. It is the full responsibility of the contractor to transport the explosives as and when required for the work in a safe manner to the work spot.

Further, the engineer may issue modifications, alterations and new instructions to the contractor from time to time. The contractor shall comply with the same without these being made a cause for any extra claim.

b) Materials

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of the engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and shall be not less than 4 seconds per inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected. Moist, damaged or broken ones shall be discarded. When the fuses are in stock for long, the rate of burning of fuses shall be tested before use. The detonators shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded.

c) Storage of Explosives

The current Explosive Rules shall govern the storage of explosives. Explosives shall be stored in a clean, dry and well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400m of the actual work site or any source of fire. The space surrounding the magazine shall be fenced and the ground inside shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be through a single gate only and no person shall be allowed without the permission of the officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be well drained. Two lightning conductors, one at each end shall be provided to the magazine. The lightning conductors shall be tested once in every year.

Explosives, fuses and detonators shall each be separately stored. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care shall be taken to keep the floor free from any grains of explosives. Cases containing explosives shall not be opened inside the magazine and the explosives in open cases shall not be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine but must be removed without delay to a safe distance and be destroyed.

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine. Illumination shall be obtained from an electric storage battery lantern. No smoking shall be allowed within 100m distance from any magazine.

Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be provided at the magazine for this purpose and should be careful

* not to put their feet on the clean floor unless the magazine shoes on.

* not to touch the magazine shoes on ground outside the clean floor.

* not to allow any dirt or grit to fall on the clean floor.

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.
The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

d) Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefullyexamined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicleconveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation

connected with the loading, unloading and handling of explosives shall be conducted after sunset.

e) Use of Explosives

The contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his responsibilities.

Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits.Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the blast area and inspect

carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot firer shall be present during the removal of debris as it may contain unexploded explosives near the misfired hole.The workmen shall not return to the site of firing until at least half an hour after firing.

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc shall be taken during blasting operations.

5.03.04 Restrictions on Blasting

a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted.
b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted.
c) Progressive blasting shall be limited to two third of the total remaining depth of excavation.
d) No large scale blasting operations will be resorted to when the excavation reaches the last one metre and only small charge preferably black powder may be allowed so as not to shatter the parent rock.
e) The last blast shall not be more than 0.50 m in depth.
f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiselling or any other suitable method as approved by the engineer.

5.04 Sorting of Excavated Materials

The excavated material shall be carefully sorted for use in filling the areas in the project site by removing roots, grasses, organic matters and other objectionable materials and be sorted out into different types of materials for use and as directed by the engineer. The excavated material which is not considered fit for filling purpose shall be immediately removed and disposed at such a place and in such a manner as will be directed by the engineer. The material found unusable should be got approved by the engineer before actually disposing it off. The useful materials that cannot be used directly shall be heaped in separate area as stock piles. Stockpiles shall be of regular size as for as possible for ease of measurement. The materials heaped shall be utilised as and when required and as directed by the engineer. The cost of complete item of earthwork includes the cost of rehandling of the materials and temporarily heaped and reused.

5.05 Disposal of Surplus/ Waste Materials

Surplus and other waste materials shall be removed and disposed of from the construction site to the area demarcated by the engineer. No material shall be wasted unless approved by the engineer.

5.06 Earth Work in Filling

Levelling by raising with controlled fill of approved excavated/borrowed earth shall be carried out where the existing ground levels are lower than the specified formation level. After clearing site as per clause 5.01, the original ground shall be compacted by rolling subject to a minimum 6 passes of 8 to 10 tonne roller. The approved earth/fill material shall then be spread in horizontal layers not exceeding 300mm in compacted thickness. Each layer shall be watered and thoroughly compacted with proper moisture content and such equipments as may be required to obtain a minimum of 95% of its maximum dry density as determined by standard Proctor's test as per IS: 2720, part-VII. Moisture content of the fill material shall be controlled near optimum moisture content during compaction

The fill material shall be tested for its optimum moisture content and maximum dry density as per IS: 2720, part-VII. Moisture content shall be checked at the source of supply in accordance with IS: 2720 part- II and if found less than that required for proper compaction, the same shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from the hose line or from the truck-mounted water tank etc making due allowance for evaporation losses and the fill material be thoroughly mixed by means of harrows, rotary mixers or by any other suitable approved method until the layer is uniformly wet. **Flooding shall not be permitted for watering purpose under any circumstances.** If the material delivered is too wet, it shall then be dried by aeration and exposure to the sun till the moisture content is suitable for compaction. Should circumstances arise owing to wet weather the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended. Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the layers before compaction. For each of the above tests on the fill material, one sample for every 10,000cu.m shall be tested. Additional samples shall be tested whenever there is a change of source or type of material.

Before start of filling, the contractor shall submit the engineer his proposal for the methodology to be adopted for compaction. The compaction equipments as approved by the engineer shall only be employed to compact the different type materials encountered during construction. If directed by the engineer, the contractor shall demonstrate the efficacy of the plant he intends to use by carrying out compaction trials. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The compacted layer shall be tested for its dry density as per IS: 2720**,** part-XXVIII or XXIX as directed by the engineer. Samples shall be taken at the rate of one sample for every 10,000sq.m area of each compacted layer. In addition random checks shall be carried out in compacted layers by means of Proctor needle penetration test. Contractor shall submit all the test results to the engineer immediately after completion of the tests. A sample shall be deemed to have passed the test when the dry density of the compacted fill is equal to or more than 95% of its maximum dry density. When field density measurements reveal any soft areas in the fills, further compaction shall be carried out as directed by the engineer. If in spite of that, the specified compaction is not achieved, the material in the soft areas shall be replaced with approved material compacted to the density requirements and satisfaction of the engineer.

Subsequent layers shall be placed only after the finished layer has been tested and accepted by the engineer.

Where the filling is to be done across low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed layer of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

5.07 Dewatering and Drainage

It shall be ensured that the area to be excavated/filled shall be free from water. The contractor shall remove the water (if any) by pumping or by any other means as approved by the engineer. At all times, the surface of cutting/filling during execution shall be maintained at such a cross fall as will shed water and prevent ponding. All existing drains/channels (if any) in the work area shall be suitably diverted by the contractor before taking up any excavation or filling. These diversions shall be such that it shall ensure effective disposal of water without any accumulation or flooding within the project site and in adjoining areas.

5.08 Finishing Operations

Finishing operation shall include the work of shaping and dressing the excavated/filled ground to the required grades, levels, lines, side slopes, cross-sections and dimensions as shown on the approved drawings or as directed by the engineer.

5.09 Turfing

Turfing shall be provided at the slopes and other locations as shown on the drawings or as directed by the engineer. The turf shall be of approved quality of grass. The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically free from weeds or other undesirable matter. The grass on the sod shall have a length of approximately 50mm and

the sod shall be free of any debris. Thickness of the sod shall be as uniform as possible with 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that all the dense root system of the grasses are retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than about 300mm x 250mm size but not so large so that it is convenient to handle and transport without damage.

The area to be sodded shall be previously constructed to the required slope and cross section. Prior to placing the sods, the slopes shall be roughned and wetted in order to have a satisfactory bond. The strips of sod shall be laid in close contact with each other and be tamped firmly in place so as to fill and close the joints between them. The turfing so laid shall be well watered and protected until final acceptance.

5.10 Approaches

The contractor shall provide proper approaches for workmen and inspection.

5.11 Lighting

Full scale lighting are to be provided if night work is permitted or directed by the engineer. If no night work is in progress, red warning lights should be provided at the edges of excavations and fills.

6.00 RATES AND MEASUREMENTS

6.01 Rates

a) The item of work in the schedule of quantities describe the work very briefly. The various items of the schedule of quantities shall be read in conjunction with the corresponding sections in the technical specification including amendments and additions if any. For each item in the schedule of quantities, the bidder's rate shall include all the activities covered in the description of the items as well as for all necessary operations in detail as described in the technical specification.

b) No claims shall be entertained if the details shown on the released for construction drawings differ in any way from those shown on the tender drawings.

c) The unit rate quoted shall include minor details which are obviously and fairly intended and which may not have been included in these documents but are essential for the satisfactory completion of the work.

a) The bidder's quoted rate shall be inclusive of supplying and providing all labour, men, materials, equipments, tools and plants, supervision, services, approaches, schemes etc.

6.02 Measurements

Method of measurements are specified in the proceeding sections. Where not so specified, the latest version of IS: 1200, Part-1 shall be applicable.

a) The length, breadth and depth shall be measured correct to the nearest centimetre if measurements are taken by tape. Rounding of numericals shall be as per relevant IS Codes. If the measurements are taken with staff and level, the levels shall be recorded correct to 5mm. The area and volume shall be worked out in square meter and cubic meter correct to the nearest of two decimal places.

b) For earth work in excavation, the ground levels shall be taken before and after completion of the work in the actually excavated area. The quantity of earth work in cutting shall be computed from these levels in cubic meter.

c) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed.

d) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rocks so arrived shall be taken as soil.

e) For earth work in filling, the actual measurements of fill shall be calculated by taking levels of the original ground before start of the work but after site clearance and after compaction of fills. The quantity of earth work in filling shall be computed from these levels in cubic meter.

f) For turfing, the measurement shall be made on the finished work in square metre.

SECTION - D

SUB-SECTION – D23

ANTI- TERMITE TREATMENT

C O N T E N T

CLAUSE NO	DESCRIPTION
1.00.00	SCOPE
2.00.00	EXECUTION
3.00.00	ACCEPTANCE CRITERIA
4.00.00	RATES
5.00.00	METHOD OF MEASUREMENT
6.00.00	I.S. CODES

TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT

1.00.00 SCOPE

The scope of work is to set up a chemical barrier against attack by subterranean termites while the building is under construction.

2.00.00 EXECUTION

2.01.00 General

All work shall in general be executed as specified in IS: 6313 Part II-1981 and as per approved specification of the agency having special know-how for the job.
All necessary work to ensure uniform distribution and proper penetration of treatment of treating solution shall be done according to the instruction of the Engineer.
Soil treatment shall not be done when it is raining or when the soil is wet with rain or subsoil water. Once formed, the treated soil barrier shall not be disturbed.

2.02.00 Chemicals and Rate of Application

Any of the following chemicals (conforming to relevant Indian Standards) in water emulsion shall be applied by pressure pumps, uniformly over the area treated.

Chemicals		Concentration by Weight, Percentage
Chlorpyrifos Emulsifiable (IS 8944 - 1978)	:	1.0
Heptachlor Emulsifiable Concentrate (IS: 6439 - 1978)	:	0.5
Chlordane Emulsifiable Concentrate (IS: 2682 - 1984)	:	1.0

2.02.01 Treatment of Column Pits, Wall Trenches and Basement Excavations

Foundations, basements etc. may either be fully enveloped by the chemical barrier or the treatment may start 500 mm below ground level. The bottom surface and sides of excavation (upto a height of about 300 mm) for column pits, walls trenches and basements shall be treated with chemicals at the rate of 5 litres / M^2 of surface area. Backfills around columns, walls etc. shall be treated at the rate of 7.5 litres / M^2 of the vertical surface. Chemical treatment shall be done in stages following the

compaction of earth in layers. The treatment shall be carried out after the ramming operation is done by rodding the earth at 150 mm centres close to the wall surface and spraying the chemicals in the specified dose.

2.02.02 **Treatment of Top Surface of Plinth Filling**

Holes 50 mm to 75 mm deep at 150 mm centres both ways shall be made with crowbars on the surface of compacted plinth fill. Chemical emulsion at the rate of 5 litres / M^2 of surface shall be applied prior to laying soling or sub-grade. Special care shall be taken to maintain continuity of the chemical barrier at the junction of vertical and horizontal surfaces.

2.02.03 **Treatment of Soil Surrounding Pipes, Wastes and Conduits**

Special care shall be taken at the points where pipes and conduits enter the building and the soil shall be treated for a distance of 150 mm and a depth of 75 mm at the point where they enter the building.

2.02.04 **Treatment of Expansion Joints**

These shall receive special attention and shall be treated in a manner approved by the Engineer.

2.02.05 **Treatment at Junction of the Wall and the Floor**

Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surfaces from ground level up to the level of the filled earth surface.
A small channel 30 x 30 mm shall be made at all the junctions of wall and columns with the floor. Rod holes made in the channel up to the ground level 150 mm apart and the chemical emulsion poured along the channel at the rate of 7.5 litres per square meter of the vertical wall or column surface. The soil should be tamped back into place after this operation.

3.00.00 ACCEPTANCE CRITERIA

The Contractor shall give a 10-year service guarantee in writing supplemented by a separate and unilateral guarantee from the specialised agency for the job to keep the building free of termites for the specified period.

4.00.00 RATES

Rates shall be of complete work per unit area as stated in the Schedule.

5.00.00 METHOD OF MEASUREMENT

Complete work of anti-termite treatment shall be measured for plinth area treated.

This includes treatment, to foundations, walls, trenches, basements, plinth, burried pipes, conduits etc. The extended portions of foundation and like beyond plinth limit shall be the part of complete work.

6.00.00 I.S. CODE

Relevant code applicable for this Specification.

IS: 6313 (Part-II) 1981 : Code of Practice of Anti-Termite Measures in Buildings Pre-constructional chemical treatment measures.

Job No: 3369

REPORT ON
GEOTECHNICAL INVESTIGATION WORK FOR
1 x 800MW WANAKBORI TPS,
GUJARAT.

VOLUME 1
(*Main Report with Recommendations*)

Owner:

Client :

Maharatna Company

Foundation Consultant :

March – 2015

Job No: 3369

REPORT ON
GEOTECHNICAL INVESTIGATION WORK FOR
1 x 800MW WANAKBORI TPS,
GUJARAT.

VOLUME 2
(***Borelogs, Field & Laboratory Test Results, Graphs, Charts etc.***)

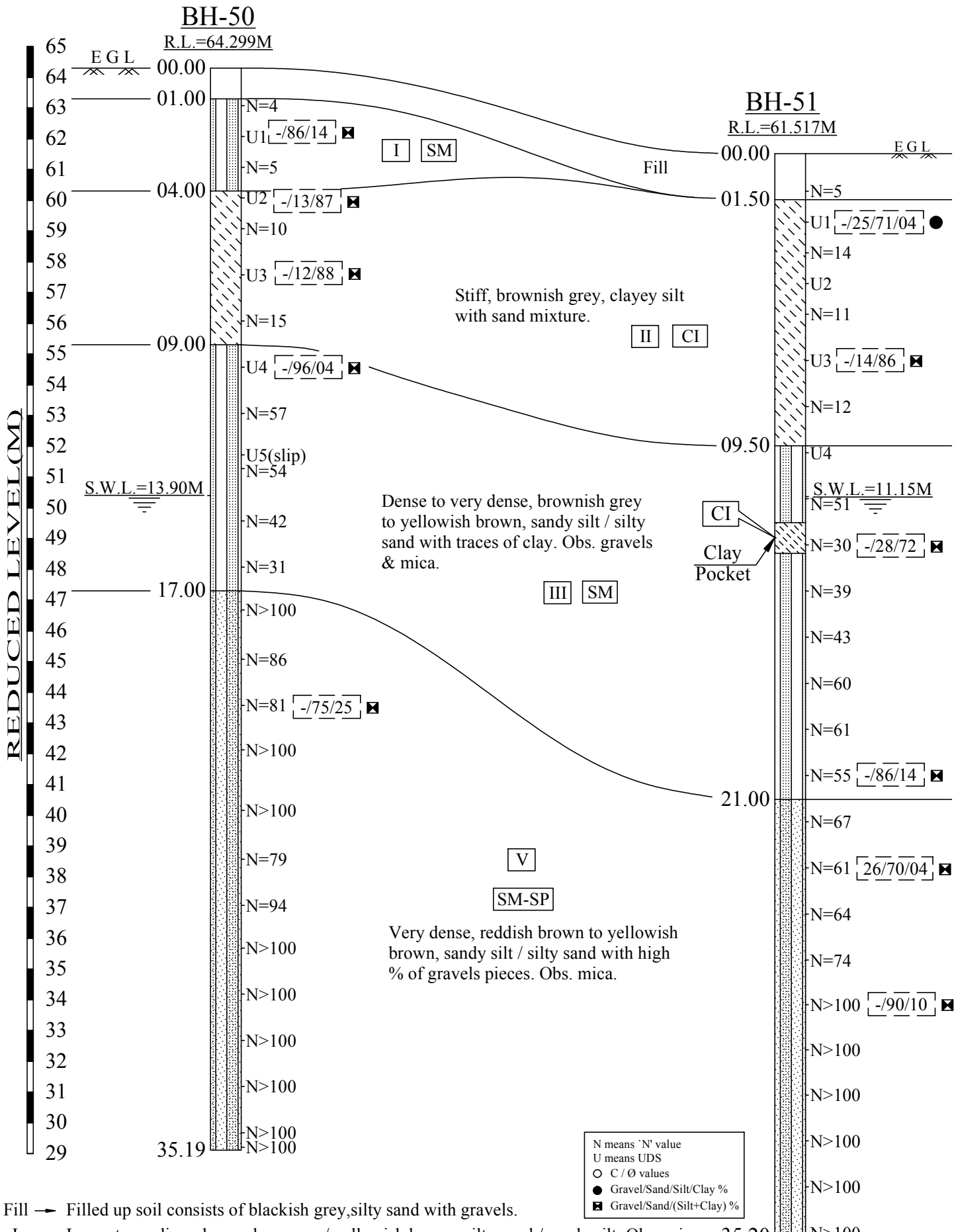
Owner:

Client :

Maharatna Company

Foundation Consultant :

March – 2015

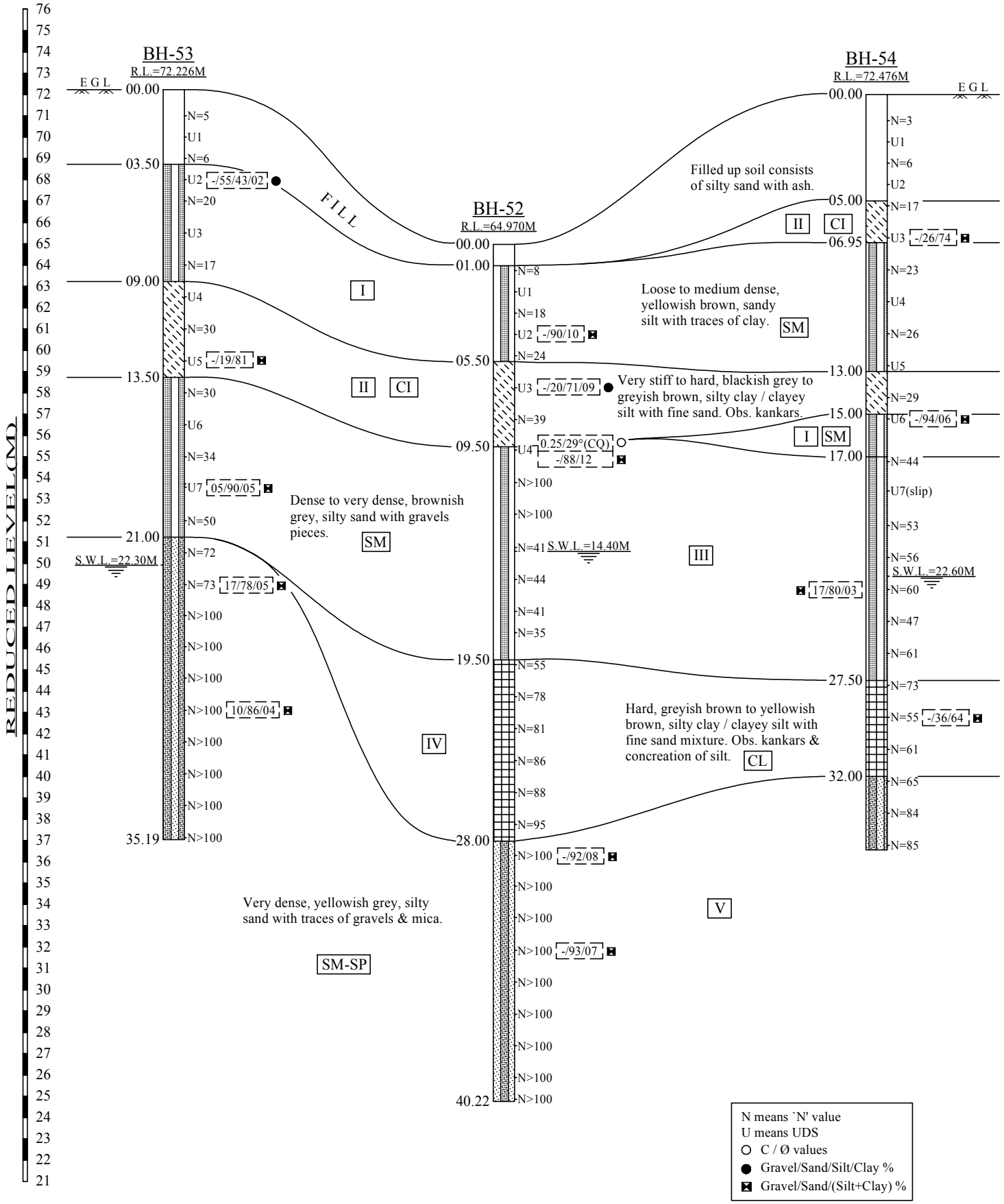


Fill → Filled up soil consists of blackish grey,silty sand with gravels.

I → Loose to medium dense, deep grey / yellowish brown, silty sand / sandy silt. Obs. mica.

(ID FAN)

FIG. 2.16 : GENERALISED SOIL PROFILE



(Chimney)

FIG. 2.17 : GENERALISED SOIL PROFILE

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 13/01/2015	Sheet No:

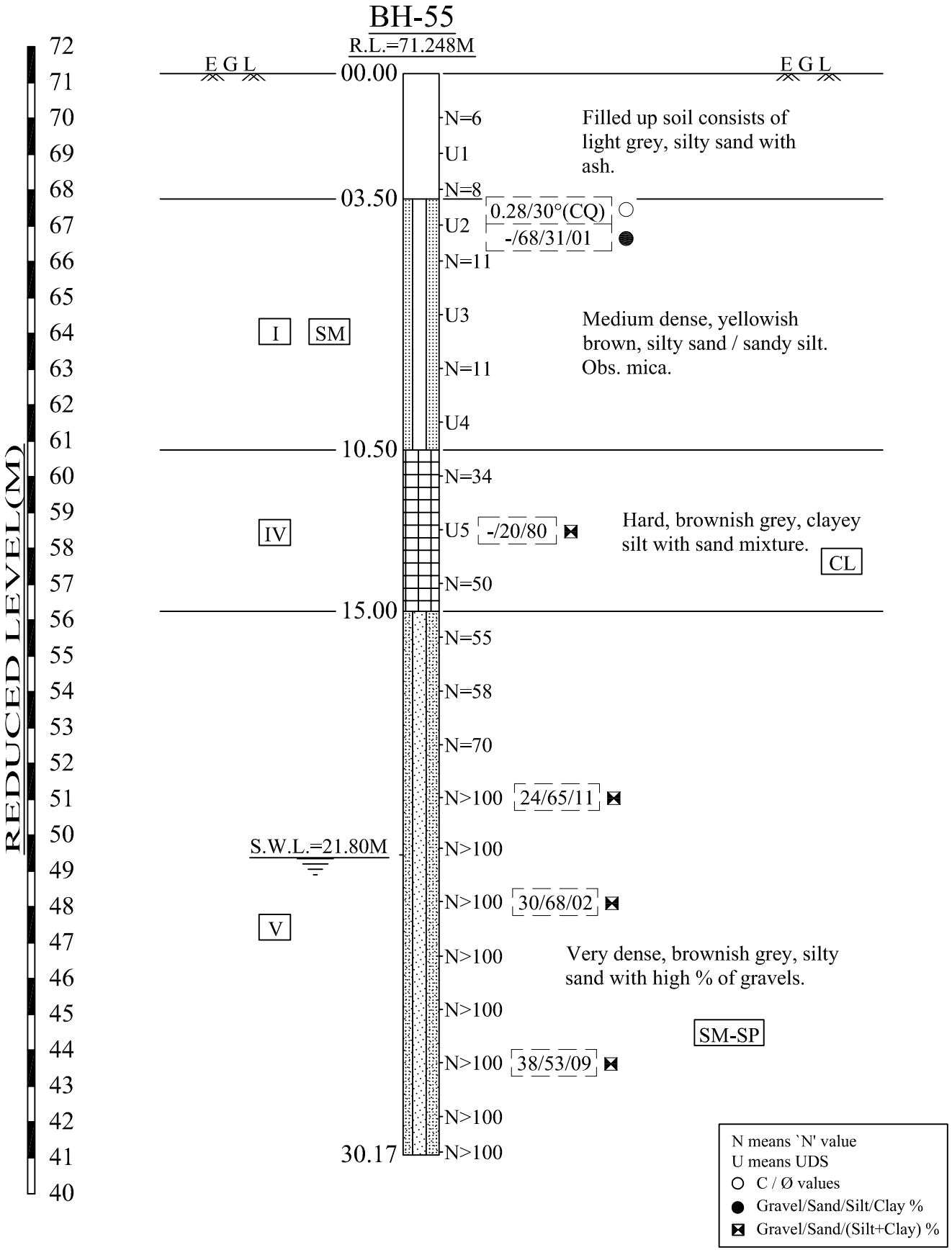


FIG. 2.18 : GENERALISED SOIL PROFILE

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.

CETEST

Job No : 3388 | Created by : Chandrani | Created on : 16 / 01 / 2015 | Sheet No:

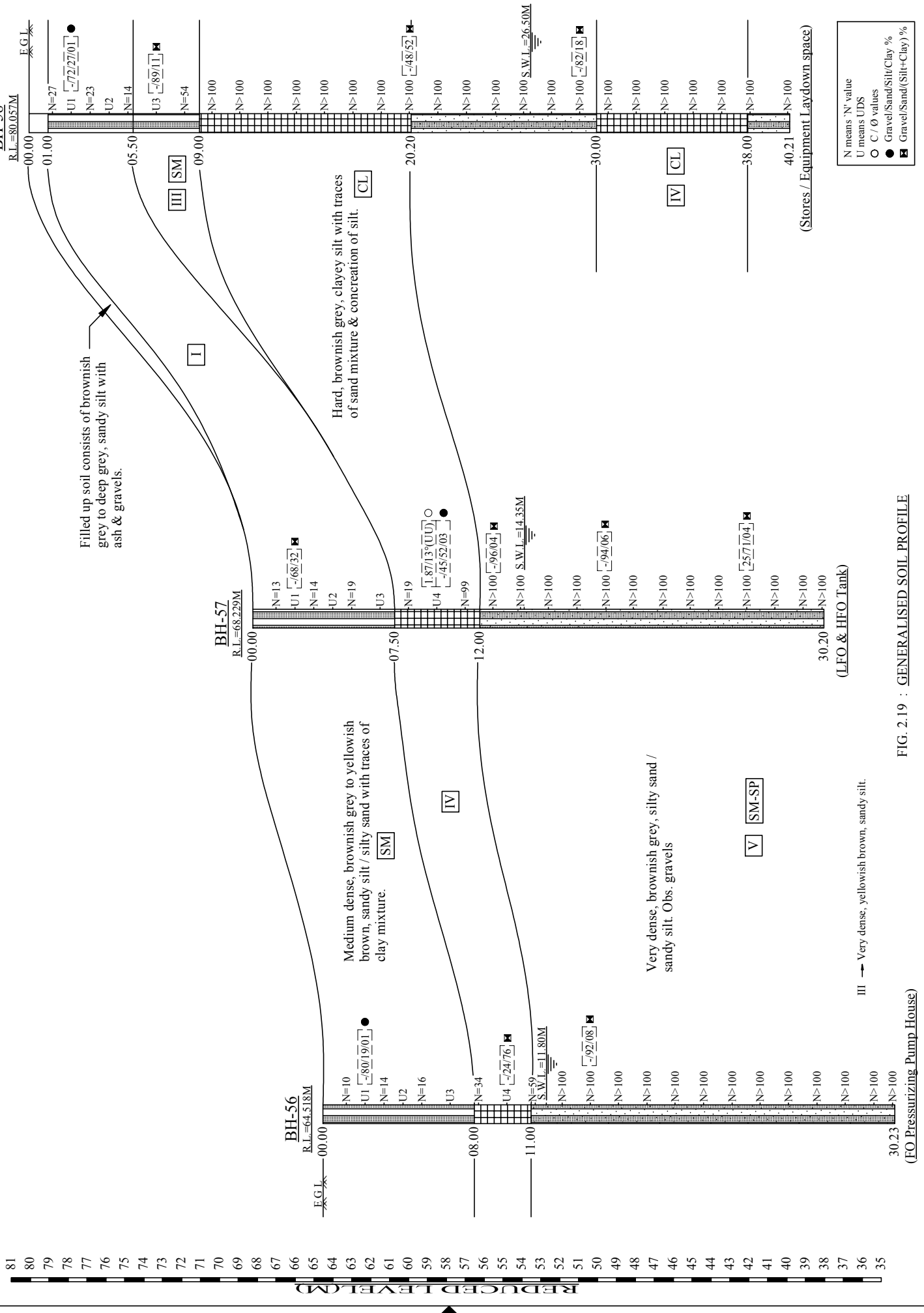
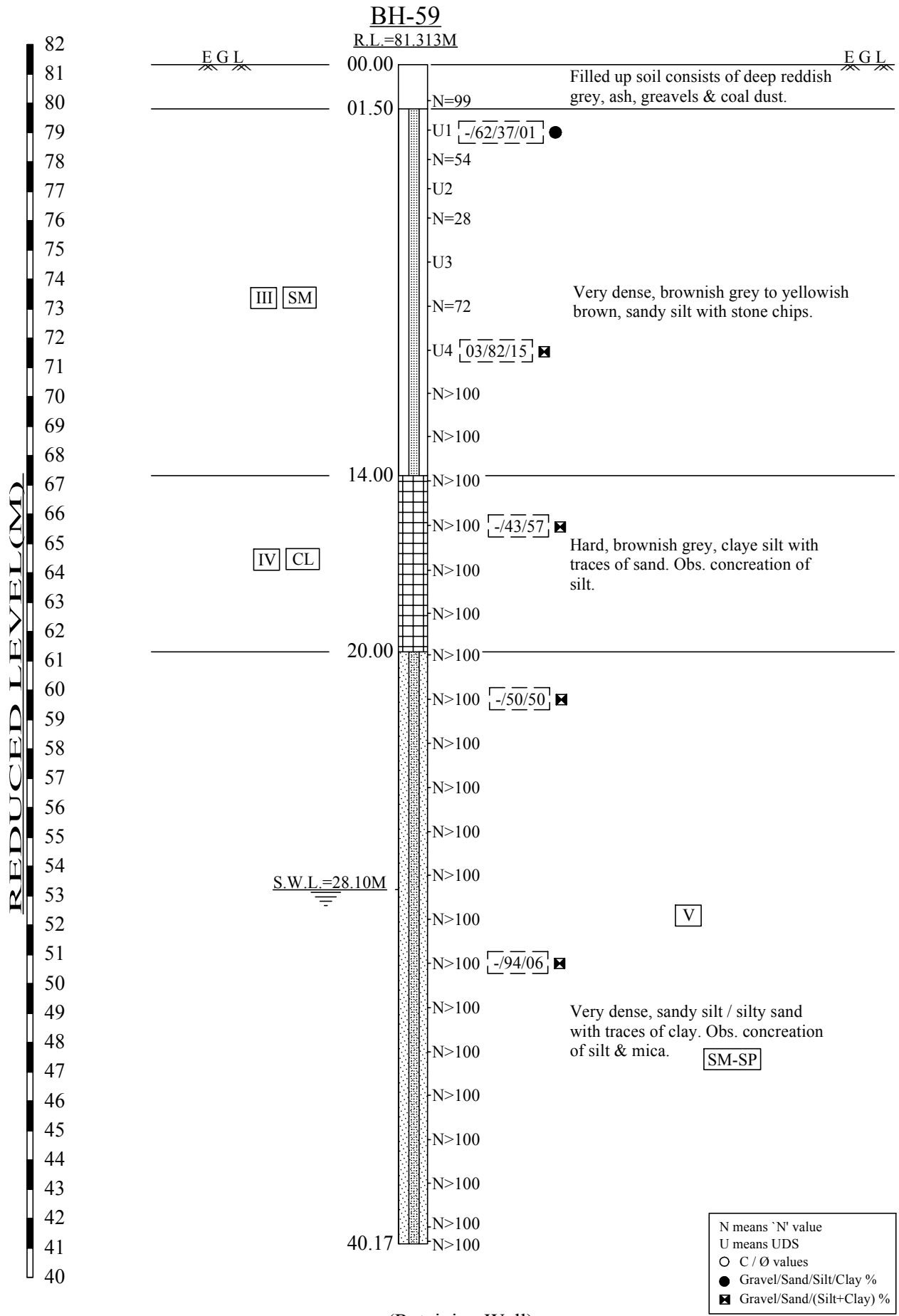
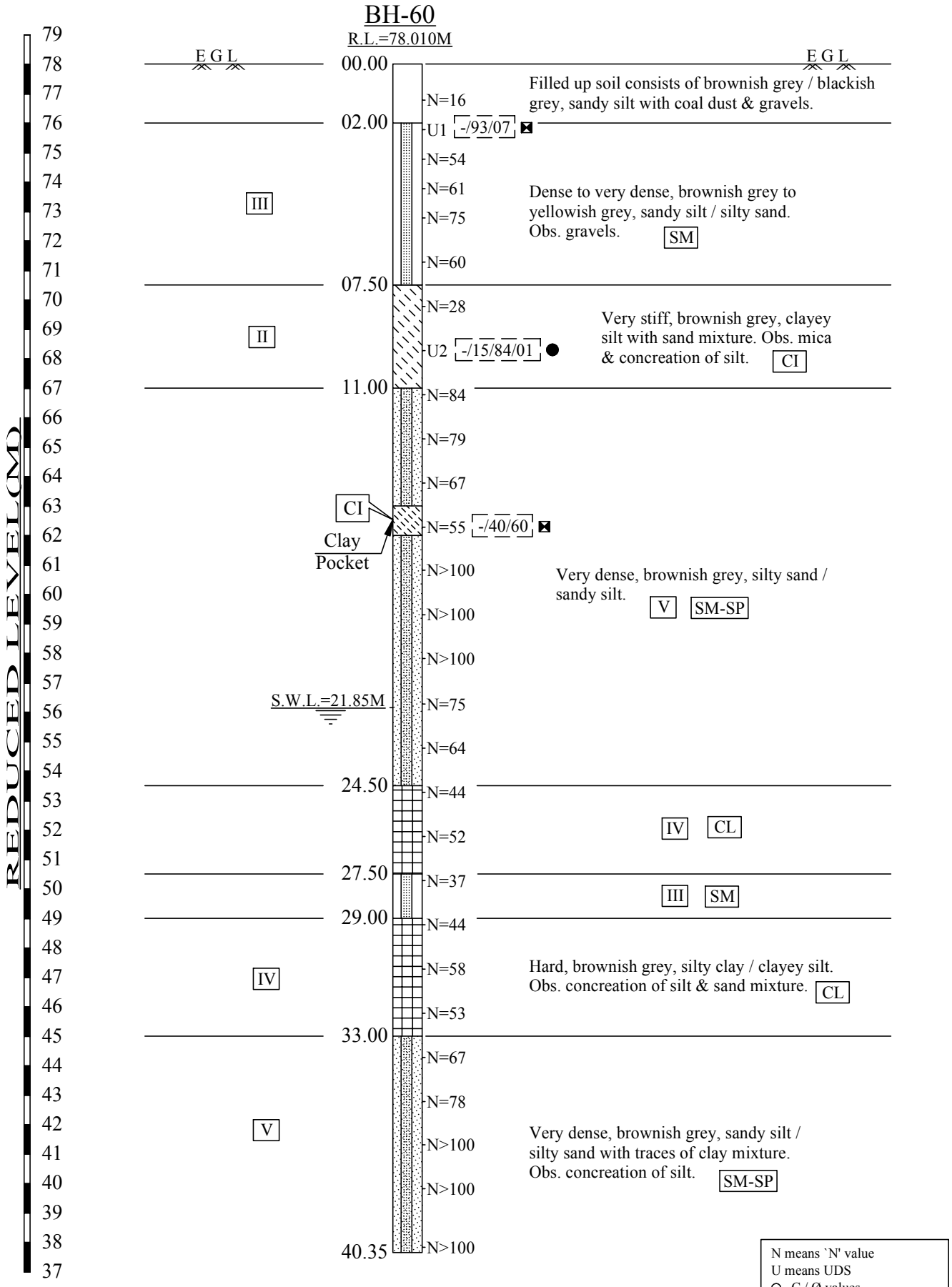


FIG. 2.19 : GENERALISED SOIL PROFILE



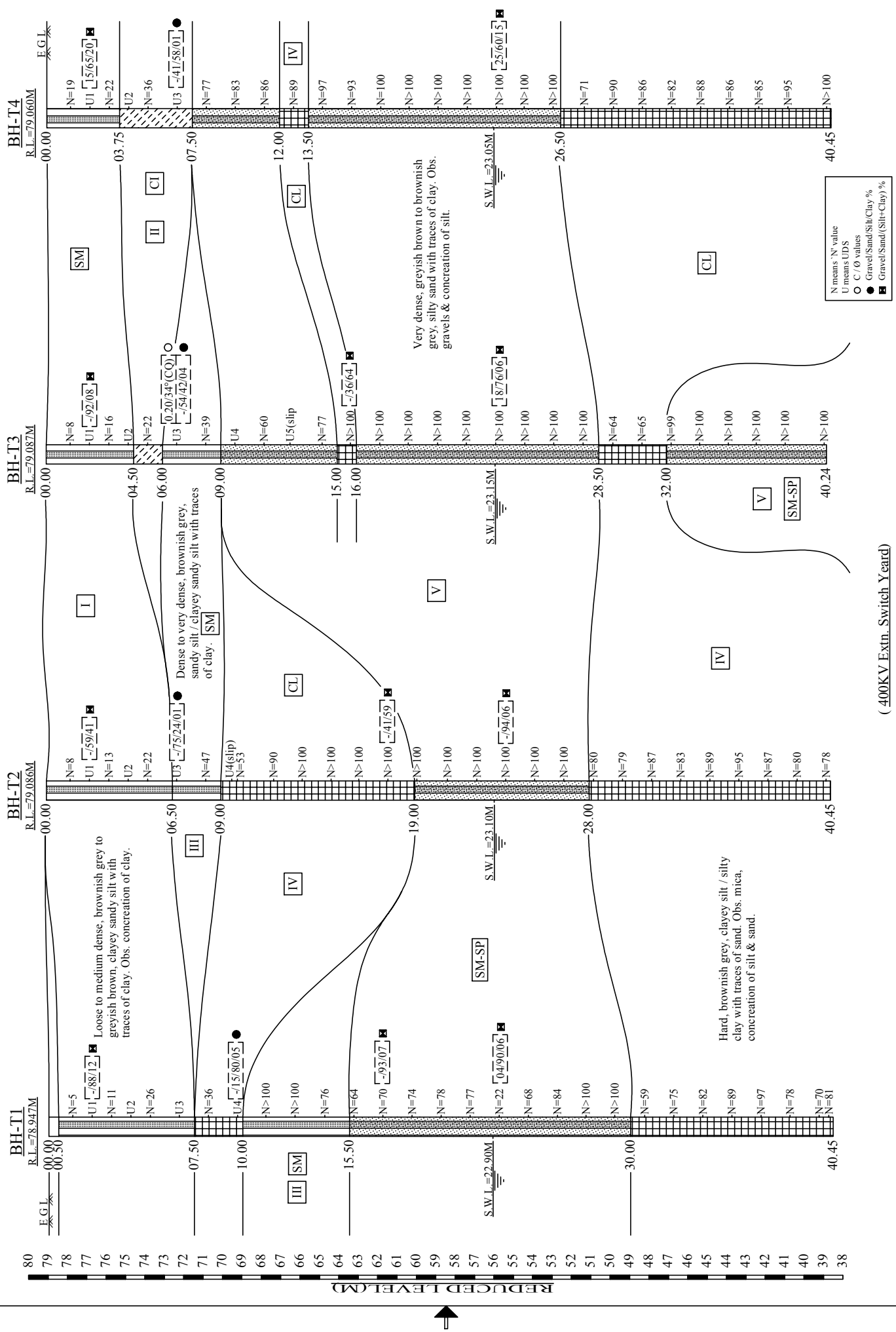
(Retaining Wall)

FIG. 2.20 : GENERALISED SOIL PROFILE



(Fo Transfer Pump House)

FIG. 2.21 : GENERALISED SOIL PROFILE



(400KV Extn. Switch Yeard)

FIG. 2.22 : GENERALISED SOIL PROFILE

4.2.3. STRATUM - IIA:

The soil in this layer consists of medium, deep grey / reddish brown / yellowish brown, silty clay / clayey silt with fine sand & kankars. The "UDS" that could be collected from this layer show the following average properties.

Bulk Density, gms/cc	1.86	Specific gravity	2.59
Dry Density, gms/cc	1.49	Liquid limit %	42
Natural Water Content %	25	Plastic Limit %	27
TRSH-UU:		**GRAIN SIZE**	
Cohesion kg/sqcm	0.68	Sand %	25
Friction angle °	28	(Silt+ Clay) %	75

4.2.4. STRATUM - II:

The soil in this layer consists of stiff to very stiff to hard, light yellowish brown to deep grey / greyish brown / brownish grey to reddish brown silty clay / clayey silt with sand mixture, kankars & mica. However, a sand pocket was observed around BH-42 & BH-49, the property of which is totally different from that of stratum-II. The "UDS" as well as SPT samples that could be collected from this layer show the following average properties.

Bulk Density, gms/cc	1.89	Void Ratio	0.651
Dry Density, gms/cc	1.55	Liquid limit %	42
Natural Water Content %	22	Plastic Limit %	24
Specific gravity	2.62	Shrinkage Limit %	18
TRSH-UU:		**DRSH-CQ:**	
Cohesion kg/sqcm	1.09	Cohesion kg/sqcm	0.25
Friction angle °	5	Friction angle °	31
Unconfined cohesion, kg/sqcm	**1.48**	**GRAIN SIZE**	
Remoulded cohesion, kg/sqcm	**1.14**	Sand %	24
SENSITIVITY, S_t	**1.30**	(Silt+ Clay) %	76

4.2.5. STRATUM - III:

This layer consists of dense to very dense, yellowish brown / brownish grey, sandy silt / silty sand with concretion of silt, mica & gravels. However, a clay pocket was observed around BH-02, 03 & 51, the property of which is totally different from that of stratum-III. The "UDS" as well as SPT samples that could be collected from this layer show the following average properties.

Bulk Density, gms/cc	1.77	Natural Water Content, %	12
Dry Density, gms/cc	1.59		
Specific gravity	2.61	**GRAIN SIZE**	
DRSH-CQ:		Gravel %	03
Cohesion kg/sqcm	0.15	Sand %	83
Friction angle °	32	(Silt+ Clay) %	14

4.2.6. STRATUM - IV:

The soil in this layer consists of hard, yellowish brown / brownish grey to greyish brown, silty clay / clayey silt with sand mixture, kankars, mica & concretion of silt. The "UDS" as well as SPT samples that could be collected from this layer show the following average properties.

Bulk Density, gms/cc	1.89	Void Ratio	0.521
Dry Density, gms/cc	1.62	Liquid limit %	34
Natural Water Content %	16	Plastic Limit %	22
Specific gravity	2.65	Shrinkage Limit %	19
TRSH-UU:		**DRSH-CQ:**	
Cohesion kg/sqcm	1.56	Cohesion kg/sqcm	0.18
Friction angle °	6	Friction angle °	34
Unconfined cohesion, kg/sqcm	**2.96***	**GRAIN SIZE**	
Remoulded cohesion, kg/sqcm	**2.52***	Sand %	34
SENSITIVITY, S_t	**1.17**	(Silt+ Clay) %	66

*** Test was done on a specific sample.**

4.2.7. STRATUM - V:

This is also a sand layer and this layer consists of very dense, light grey to brownish grey / yellowish brown silty sand with gravels, pebbles & mica. However, a clay pocket was observed around BH-06, 13, 36 & 60, the property of which is totally different from that of stratum-V. The "UDS" as well as SPT samples that could be collected from this layer show the following average properties.

Specific gravity	2.71
GRAIN SIZE	
Gravel %	17
Sand %	72
(Silt+ Clay) %	11

4.3. GRAPHICAL PRESENTATION:

The detailed Laboratory Test Results in tabular form are given in Volume-2. The back up sheets are also presented there as given in below:

1. ***Strength envelopes from Triaxial Tests.***
2. ***Normal Stress vs. Shear Stress from Direct Shear Test.***
3. ***Standard & Modified Proctor Compaction Curves.***
4. ***CBR Curves (4 days soaked).***
5. ***e-log p curves from consolidation tests.***
6. ***Grain size distribution curves for sieve and hydrometer tests.***

The consolidation test results are analysed by numerical methods and only the final output in a tabular form is given. The m_{vc} indicates the time dependent component of m_v and c_v is the co-efficient of consolidation.

4.4. VARIATION OF "N" WITH DEPTH:

The "N" values are an important governing factor in calculation of bearing capacity. The field "N" values are given in the bore logs. The corrected "N" values are given in a tabular form and also presented separately in Volume-2. The strata wise corrected "N" values are given in the following table.

Stratum No.	Corrected "N" values.		
	Average	Maximum	Minimum
Fill	18	99	3
I	15	29	3
IIA	7	7	6
1I	22	52	7
III	27	50	8
IV	71	100	32
V	45	50	12

5. DISCUSSION

5.1. PLATE LOAD TEST:

Seven nos. (7). Plate Load Tests (5 nos. routine type & 2 nos. Cyclic Type) were conducted in the site in this zone at specified depths using 600mm square plate. Load (Vs.) settlement plots is made in arithmetic scale to calculate Allowable Bearing Capacity. The calculations are presented below.

DETERMINATION OF SAFE BEARING CAPACITY:

For clayey soil, we can write, $S_p = S_f \times (B_p / B_f)$

For sandy soil, we can write, $\frac{S_p}{S_f} = \left[\frac{B_p}{B_f} \times \frac{(B_f + 30)}{(B_p + 30)}\right]^2$

PLT – 03:

B_f = Width of footing = 2m(say), B_p = Size of test plate = 0.60m

S_f = Limiting Settlement of footing = 25mm and S_p = Settlement of test plate.

Hence, $S_p = S_f \times [(B_p / B_f) \times \{(B_f + 30) / (B_p + 30)\}]^2$ = 14.69mm

From load-settlement curve, safe load = 19.00 t/sqm (considering initial correction = 1.00mm)

Based on the above data, the safe bearing capacity value for different footing size is presented below.

Test Location	Depth (M)	Recommended Safe Bearing Capacity, T/M^2							
		Foundation width = 1m		Foundation width = 2m		Foundation width = 3m		Foundation width = 4m	
		S= 25mm	S= 40mm	S= 25mm	S= 40mm	S= 25mm	S= 40mm	S= 25mm	S= 40mm
PLT-01	3.00	34	37	31	35	29	35	28	35
PLT-02	3.00	25	31	23	27	22	26	21	26
PLT-03	3.00	21	26	19	24	18	23	17	22
PLT-04	3.00	10	13	8	11	8	11	7	10
PLT-05	3.00	47	54	42	51	39	50	38	49
CPLT-01	3.00	15	20	12	17	11	16	10	16
CPLT-02	3.00	20	25	17	22	16	21	15	21

Where S = limiting settlement

SUBGRADE MODULUS:

Subgrade Modulus is obtained from Plate Load Tests as K = P/S. Where P = Plate Load corresponding to settlement S under working load. The final results values are presented in a tabular form below.

PLATE LOAD TEST NO. 01

Commenced on: 23/12/2014
Completed on: 24/12/2014
Pit size: 5.00mX5.00mX3.00m(depth)
Load on pr.guage/divn.=10Kg/sq.cm
Load on jack/divn. = 0.7091t
Plate size: 0.60mX0.60m
Load on plate/divn. = 1.97t/sq.m.
Test Type: Routine PLT

Co-ordinates:
E = 650.000M.
N = 334.000M.
RL = 64.911M.

Description of Soil :-
(EGL-0.20)m:- Brownish grey, silty sand.
(0.20-2.90)m:- Brownish grey, sandy silt.
(2.90-3.00)m:- Light blackish grey, clayey silt.

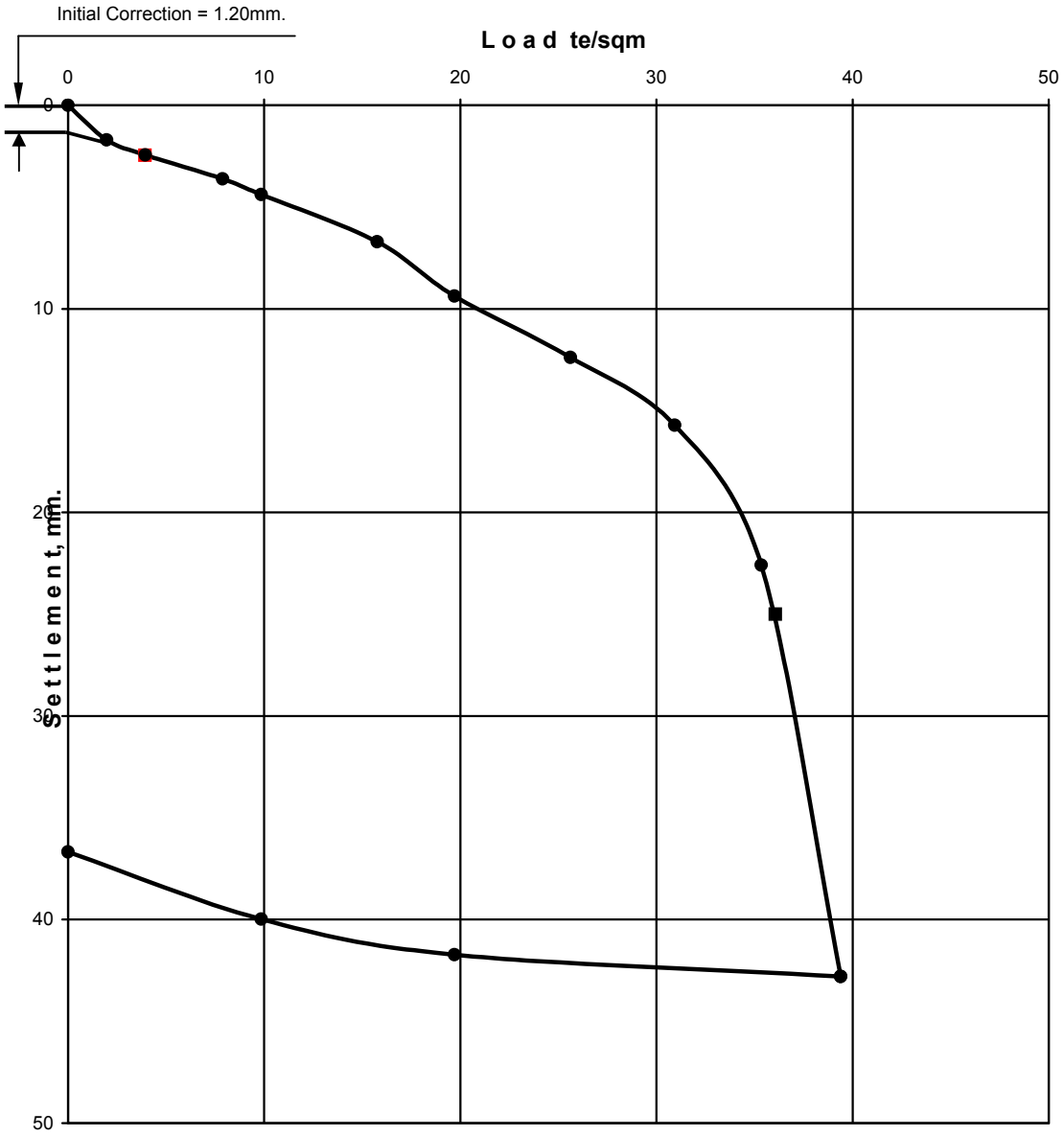


FIG. 3.1 LOAD VS SETTLEMENT GRAPH FOR PLT - 01

PLATE LOAD TEST NO. 02

Commenced on: 15/12/2014
Completed on: 16/12/2014
Pit size: 6.00mX6.00mX3.00m(depth)
Load on pr.guage/divn.=10Kg/sq.cm
Load on jack/divn. = 0.709t
Plate size: 0.60mX0.60m
Load on plate/divn. = 1.97t/sq.m.
Test Type: Routine PLT

Co-ordinates:
E = 614.000M.
N = 222.000M.
RL = 65.903M.

(EGL-0.20)m:- Brownish grey, sandy silt / silty sand.
(0.20-0.90)m:- Blackish grey, clayey silt / silty clay.

(0.90-3.00)m:- Yellowish grey / brownish grey, silty sand / sandy silt with concreation of sand.

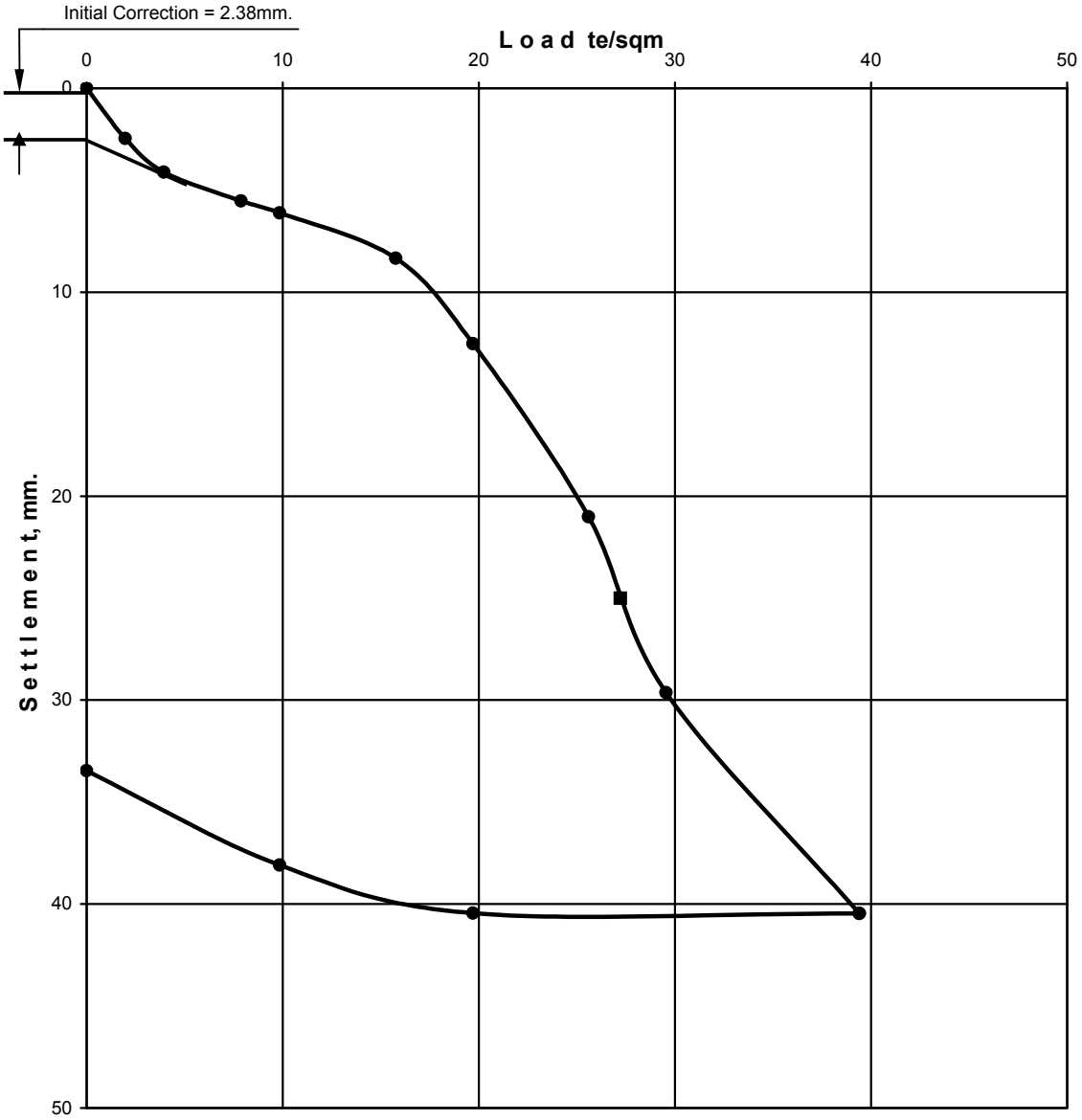


FIG. 3.2 LOAD VS SETTLEMENT GRAPH FOR PLT - 02

PLATE LOAD TEST NO.03

Commenced on: 27/11/2014
Completed on:28/11/2014
Pit size: 5.00mX5.00mX3.00m(depth)
Load on pr.guage/divn.=10Kg/sq.cm
Load on jack/divn. = 0.7091t
Plate size: 0.60mX0.60m
Load on plate/divn.=1.97t/sq.m.
Test Type: Routine PLT

Co-ordinates:
E = 569M.
N = 155M.
RL = 66.345M.

S.W.L.= Not found.

EGL-0.40m:- Filled up with ash.
0.40m-3.00m:- Yellowish grey, silty sand / sandy silt with silty clay patches.

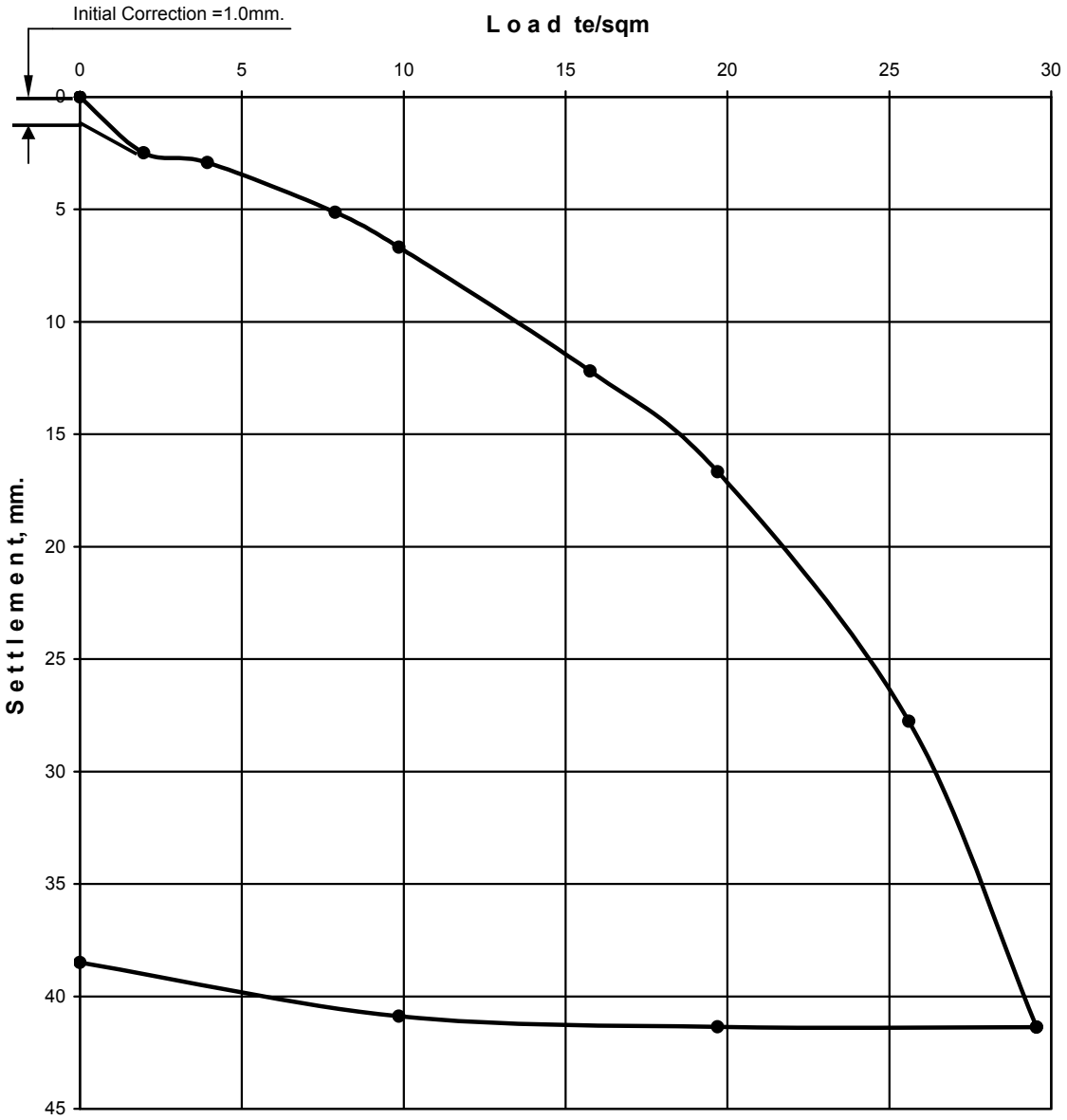


FIG. 3.3 LOAD VS SETTLEMENT GRAPH FOR PLT-03

PLATE LOAD TEST NO. 04

Commenced on: 29/12/2014
Completed on: 29/12/2014
Pit size: 5.00mX5.00mX3.00m(depth)
Load on pr.guage/divn.=10Kg/sq.cm
Load on jack/divn. = 0.7091t
Plate size: 0.60mX0.60m
Load on plate/divn. = 1.97t/sq.m.
Test Type: Routine PLT

Co-ordinates:
E = 500.000M.
N = (-)200.00M.
RL = 67.919M.

Description of Soil :-

(EGL - 3.00)m :- Light grey, ash.

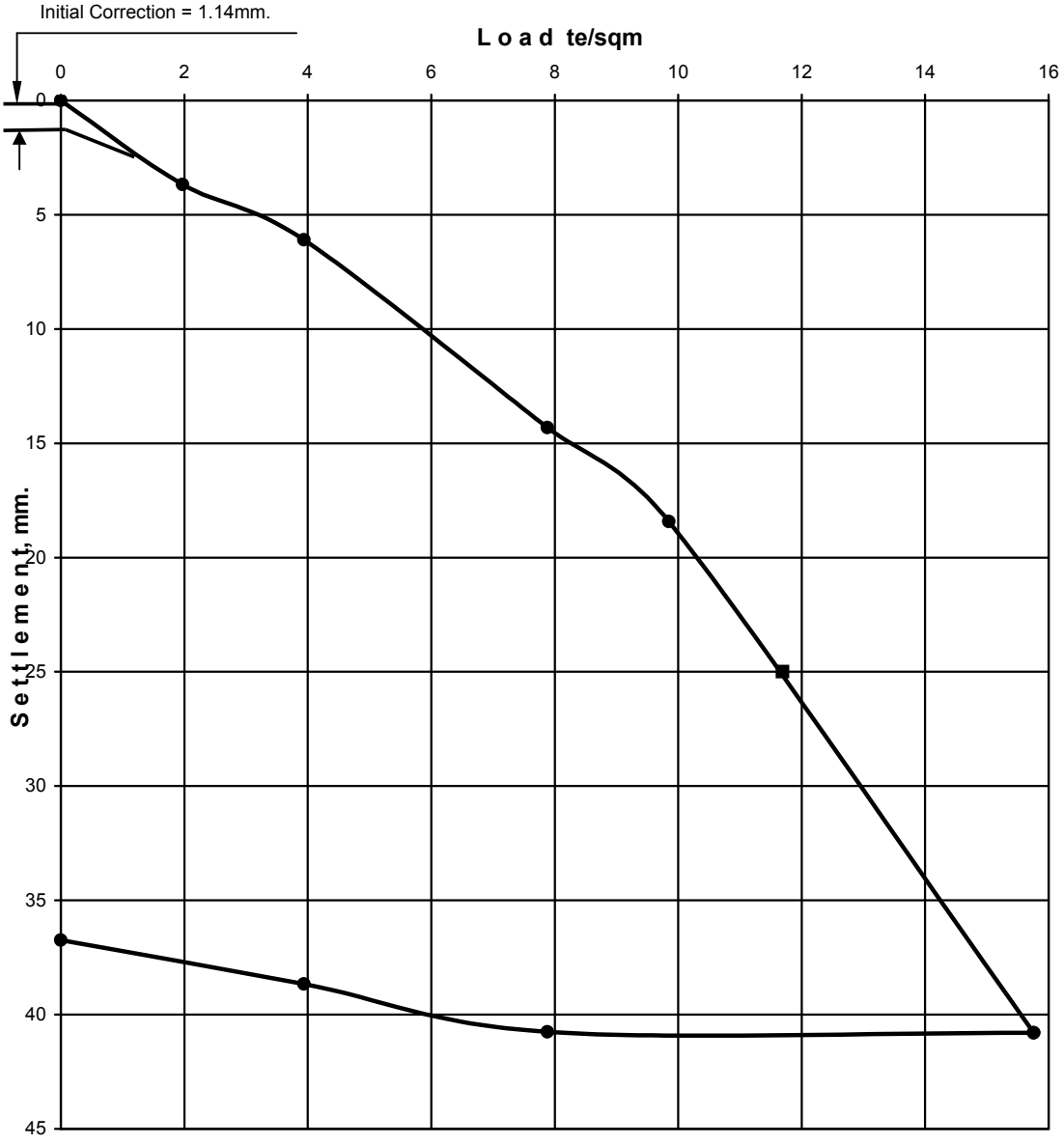


FIG. 3.4 LOAD VS SETTLEMENT GRAPH FOR PLT - 04

PLATE LOAD TEST NO.05

Commenced on: 11/11/2014
Completed on: 12/11/2014
Pit size: 3.00mX3.30mX3.30m(depth)
Load on pr.guage/divn.=10Kg/sq.cm
Load on jack/divn. = 0.7091t
Plate size: 0.45mX0.45m
Load on plate/divn. = 1.97t/sq.m.
Test Type: Routine PLT

Co-ordinates:
E = 725.000M.
N = 6.000M.
RL = 63.629M.

S.W.L.= Not found.

(EGL-0.80)m:- Top soil consists of light grey / brownish grey, ash, silty and with stone pieces.
(0.80-1.60)m:- Yellowish grey, silty sand / sandy silt.
(1.60-2.80)m:- Blackish grey, silty clay.
(2.80-3.00)m:- Brownish grey, silty clay / clayey silt with traces

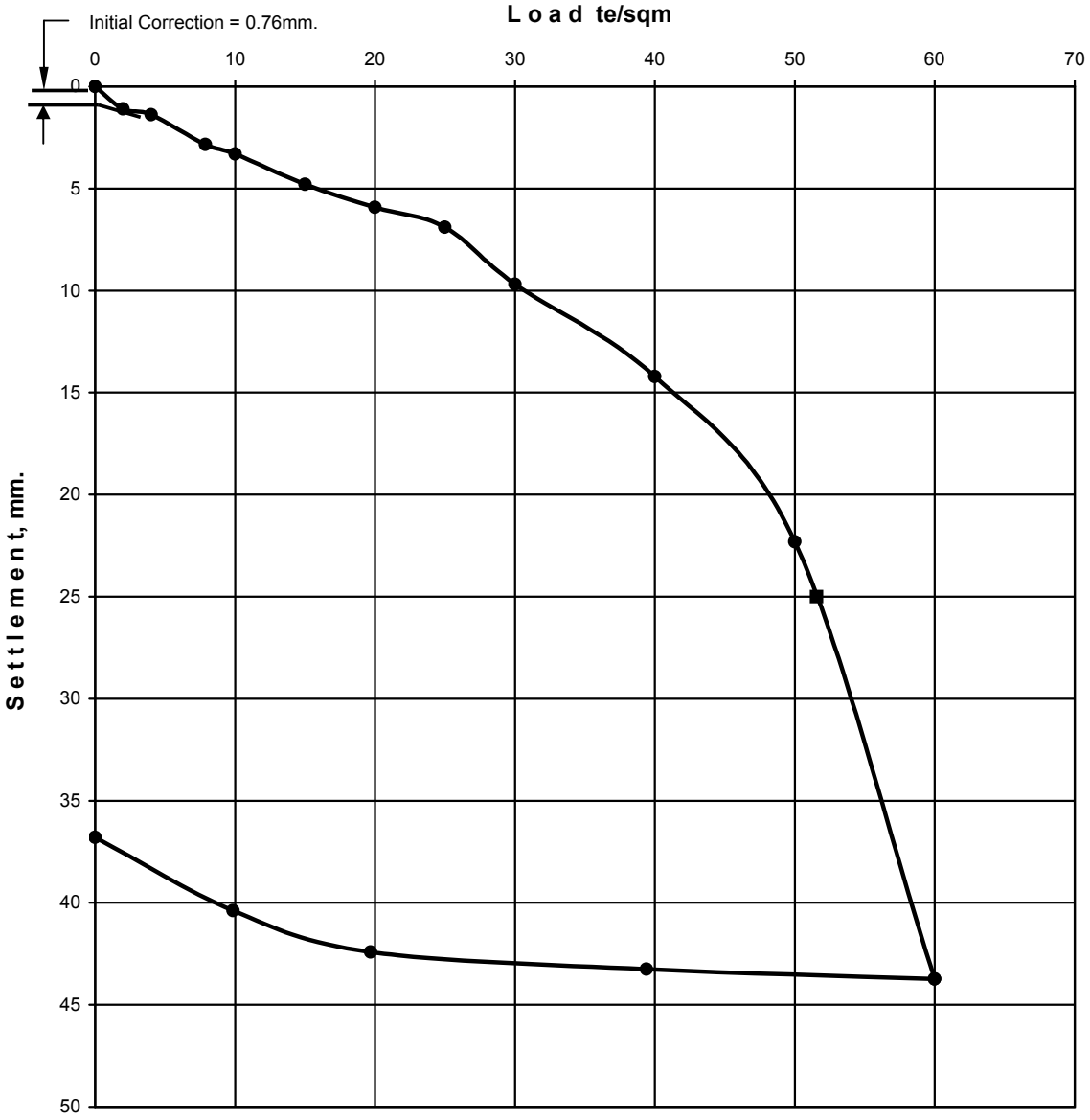


FIG. 3.5 LOAD VS SETTLEMENT GRAPH FOR PLT - 05

CYCLIC PLATE LOAD TEST NO.01

Commenced on: 21/11/2014
Completed on: 21/11/2014
Pit size: 5.00mX5.00mX3.00m(depth)
Load on pr.guage/divn. = 10Kg/sq.cm
Load on jack/divn. = 0.709t
Plate size: 0.60mX060m
Load on plate/divn. = 1.97t/sq.m.
Test Type: Cyclic PLT

Co-ordinates:
E = 615.000m.
N = (-)124.000m.
RL = 65.104m.

S.W.L. = Not Found.

(EGL-0.60)m:- Top soil consists of ash & stone pieces.
(0.60-1.80)m:- Yellowish grey, clayey silt with fine sand mixture.
(1.80-3.00)m:- Yellowish grey, sandy silt / silty sand with silty clay patches.

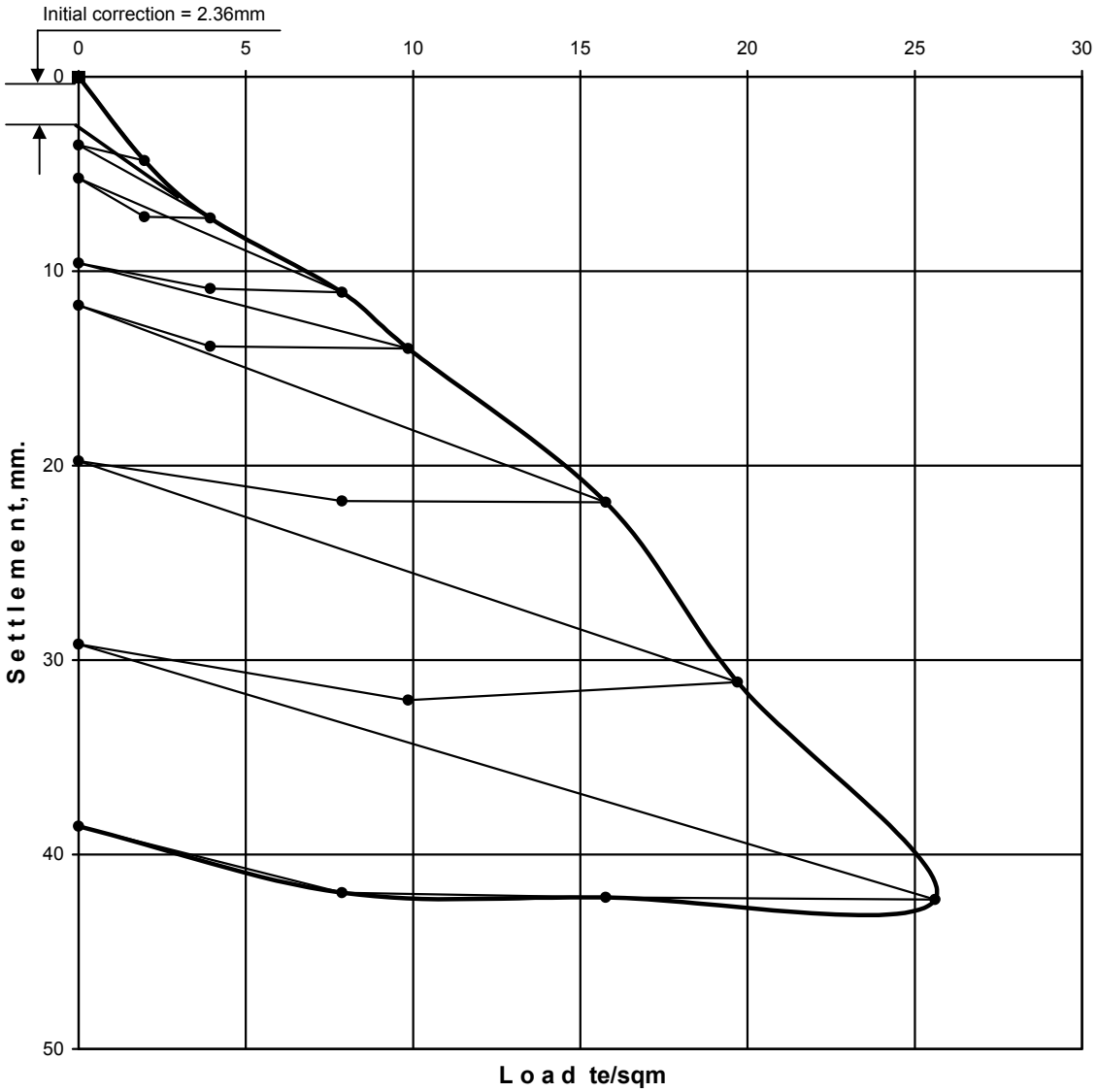


FIG.3.6 LOAD VS SETTLEMENT GRAPH FOR CPLT-01

CYCLIC PLATE LOAD TEST NO.2

Commenced on: 3/12/2014
Completed on: 3/12/2014
Pit size: 5.00mx 5.00mx3.00m(depth)
Load on pr.guage/divn.=10Kg/sq.cm
Load on jack/divn. = 0.7091te
Plate size: 0.60mX0.60m
Load on plate/divn.=1.97te/sq.m.
Test Type: Cyclic PLT

Co-ordinates:
E = 680.000M.
N = -129.000M.
RL = 64.439M.

S.W.L.= .

Description of Soil :-
(0.00m-0.20m):- Filled up with ash.
(0.20m-3.00m):- Yellowish grey, silty sand / sandy silt with laminated grey colour silty clay.

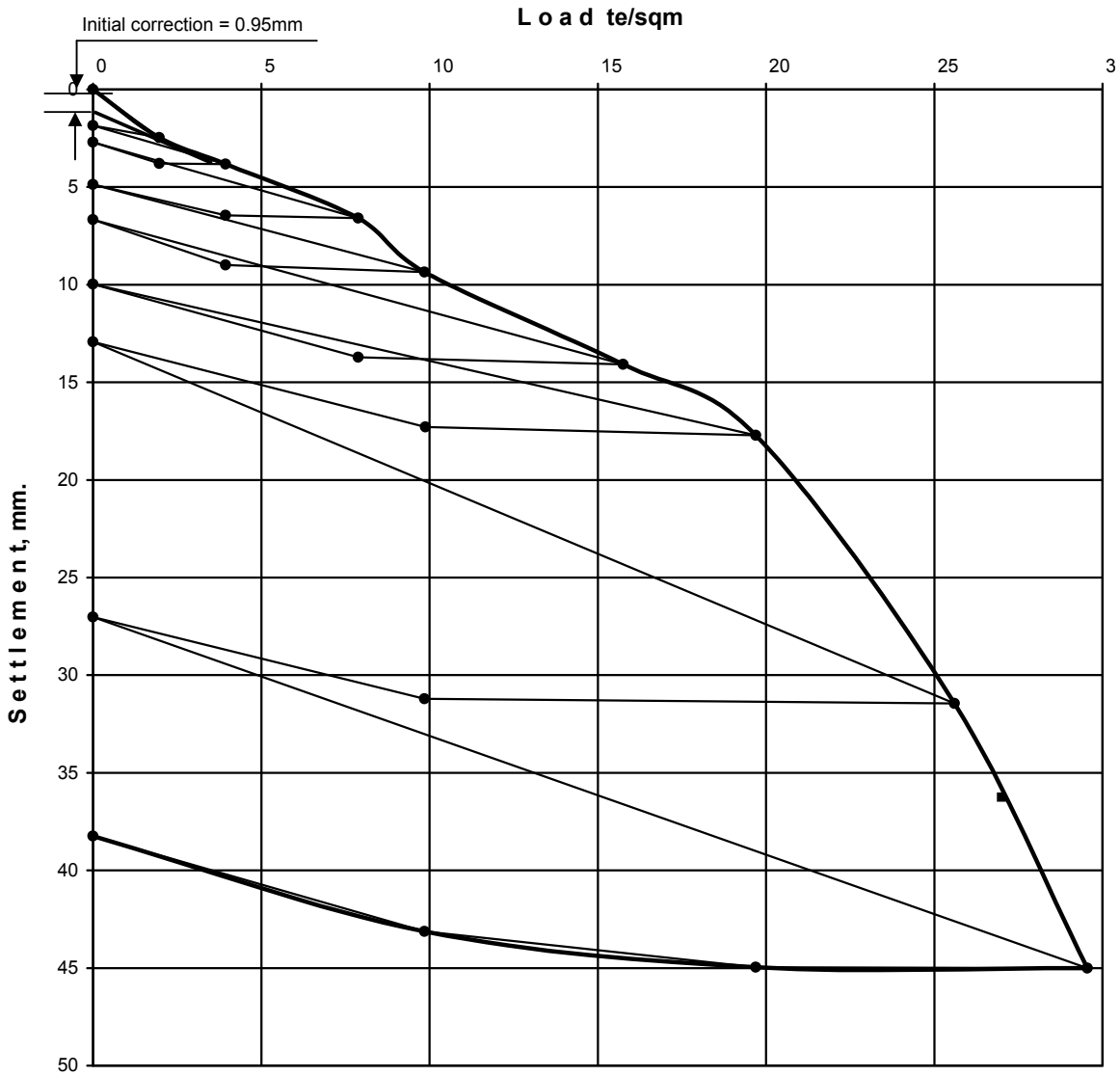


FIG. 3.7 LOAD VS SETTLEMENT GRAPH FOR CPLT-2

Test No.	Depth (M)	Subgrade Modulus for Plate as per IS 9214, Kg/cm^3	Subgrade Modulus for Plate, correcting as per IS 9214 Kg/cm^3
PLT-01	3.00	3.14	2.45
PLT-02	3.00	2.30	1.79
PLT-03	3.00	1.29	1.01
PLT-04	3.00	1.01	0.79
PLT-05	3.00	4.48	3.87
CPLT-01	3.00	1.35	1.06
CPLT-02	3.00	1.38	1.08

The Subgrade modulus value is inversely proportional to the square root of the foundation area up to a base area of 10 sqm and then remains constant. The calculated subgrade modulus values for different foundation areas are presented below.

Test No.	Depth (M)	Subgrade Modulus, (kg/cucm)			
		Foundation Area = 1 sqm	Foundation Area = 4 sqm	Foundation Area = 5 sqm	Foundation Area = 10 sqm or above
PLT-01	3.00	1.47	0.74	0.66	0.46
PLT-02	3.00	1.07	0.54	0.48	0.34
PLT-03	3.00	0.61	0.30	0.27	0.19
PLT-04	3.00	0.47	0.24	0.21	0.15
PLT-05	3.00	2.32	1.16	1.04	0.73
CPLT-01	3.00	0.64	0.32	0.28	0.20
CPLT-02	3.00	0.65	0.32	0.29	0.20

Sample Calculation of Subgrade Modulus for foundation area 5 Sq.m of PLT-05

For Plate

Safe Load, corresponding to 1.25mm settlement = 5.60 t/sqm
Subgrade Modulus for Plate, K = P/S = 5.60/1.25 = 4.48 Kg/cm^3
Since the test was conducted on 600mm square plate (i.e. smaller than 75cm dia,), corrected Subgrade Modulus as per Clause 5.1.1 & Fig.3 of IS:9214 = 4.48 / 1.28 = 3.50 Kg/cm^3
Again applying correction for plate bending, as per Clause 5.1.3 & Fig.5 of IS:9214, corrected Subgrade Modulus = 3.87 Kg/cm^3

For Foundation

Corrected Subgrade Modulus of plate = 3.87 Kg/cm^3
Area of plate = 60 x 60 sq.cm = 0.60 x 0.60 sq.m
Area of footing = 5 sq.m
Subgrade Modulus of foundation = 3.87 x $\sqrt{(0.60x0.60)/5}$ Kg/cm^3 = 1.04 Kg/cm^3

ELASTIC COMPRESSION:

This load test was of cyclic type. Here, after application of each load increment and full stabilisation of plate settlement, the applied load was reduced to zero and the settlement records were noted till full stabilisation. Thereafter, the next load increment was applied.

The elastic rebounds at these load intensities are calculated (As per IS 5249-1992, Pg-6) from the field data and are graphically presented in graph. The coefficient of elastic uniform compression, C_u is obtained as $C_u = P / S_e$ kg/cucm

CPLT- 01:

From the load vs elastic rebound plot, the slope of the trend line = C_u = (20-10)/(2.67-1.34) = 7.51 kg/cucm

Now, for a foundation size of 10 sqm (3m x 3.33m, say), the corresponding value will be,

$C_{u10sqm} = 7.51 \times \sqrt{[(0.60 \times 0.60) / 10]} = 1.42$ kg/cucm

CPLT- 02:

From the load vs elastic rebound plot, the slope of the trend line = C_u = (20-10)/(4.78 -2.41) = 4.23 kg/cucm

Now, for a foundation size of 10 sqm (3m x 3.33m, say), the corresponding value will be,

$C_{u10sqm} = 4.23 \times \sqrt{[(0.60 \times 0.60) / 10]} = 0.803$ kg/cucm

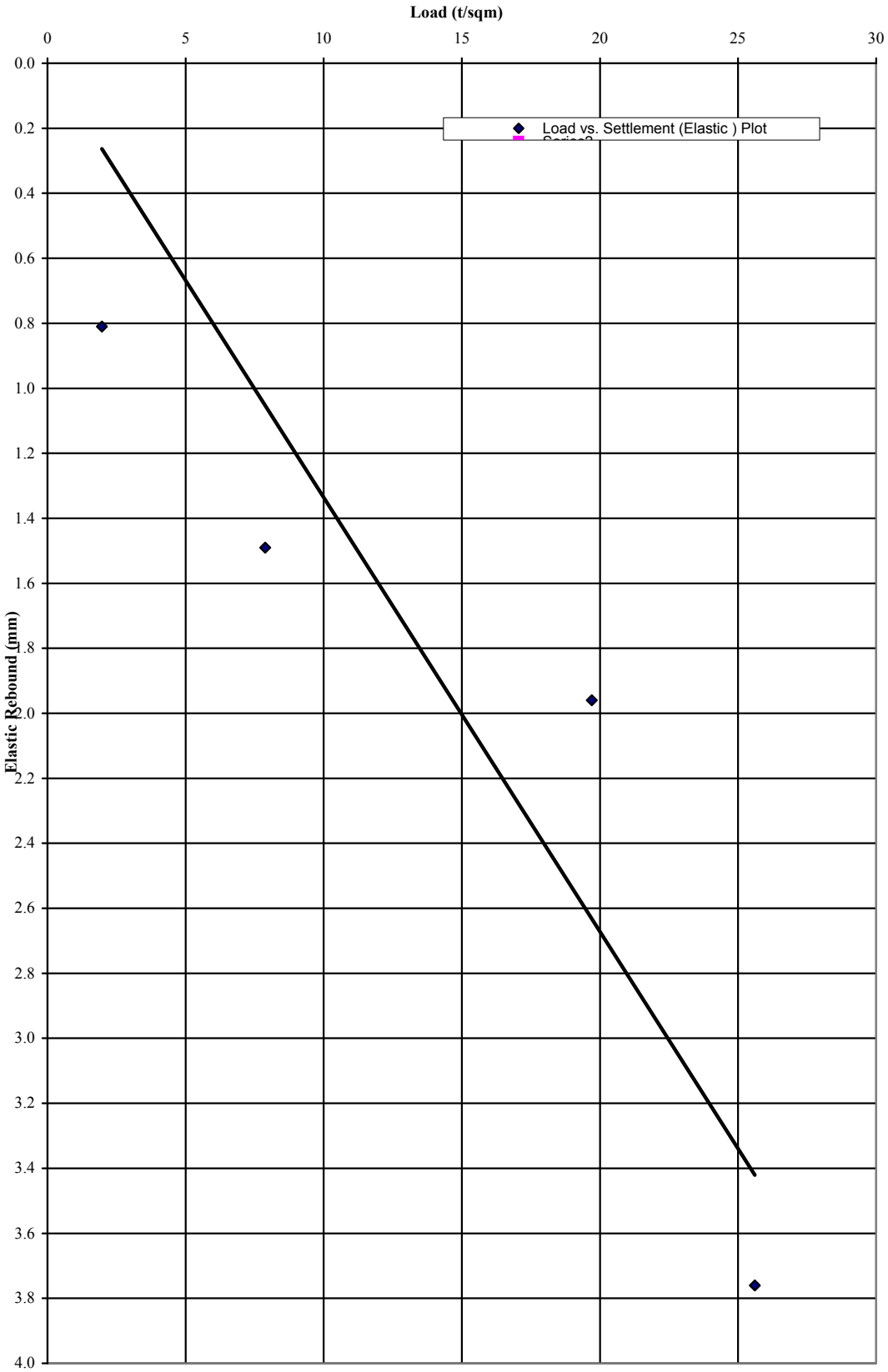


Fig. 3.8 Load Vs. Elastic Rebound Plot (CPLT-01)

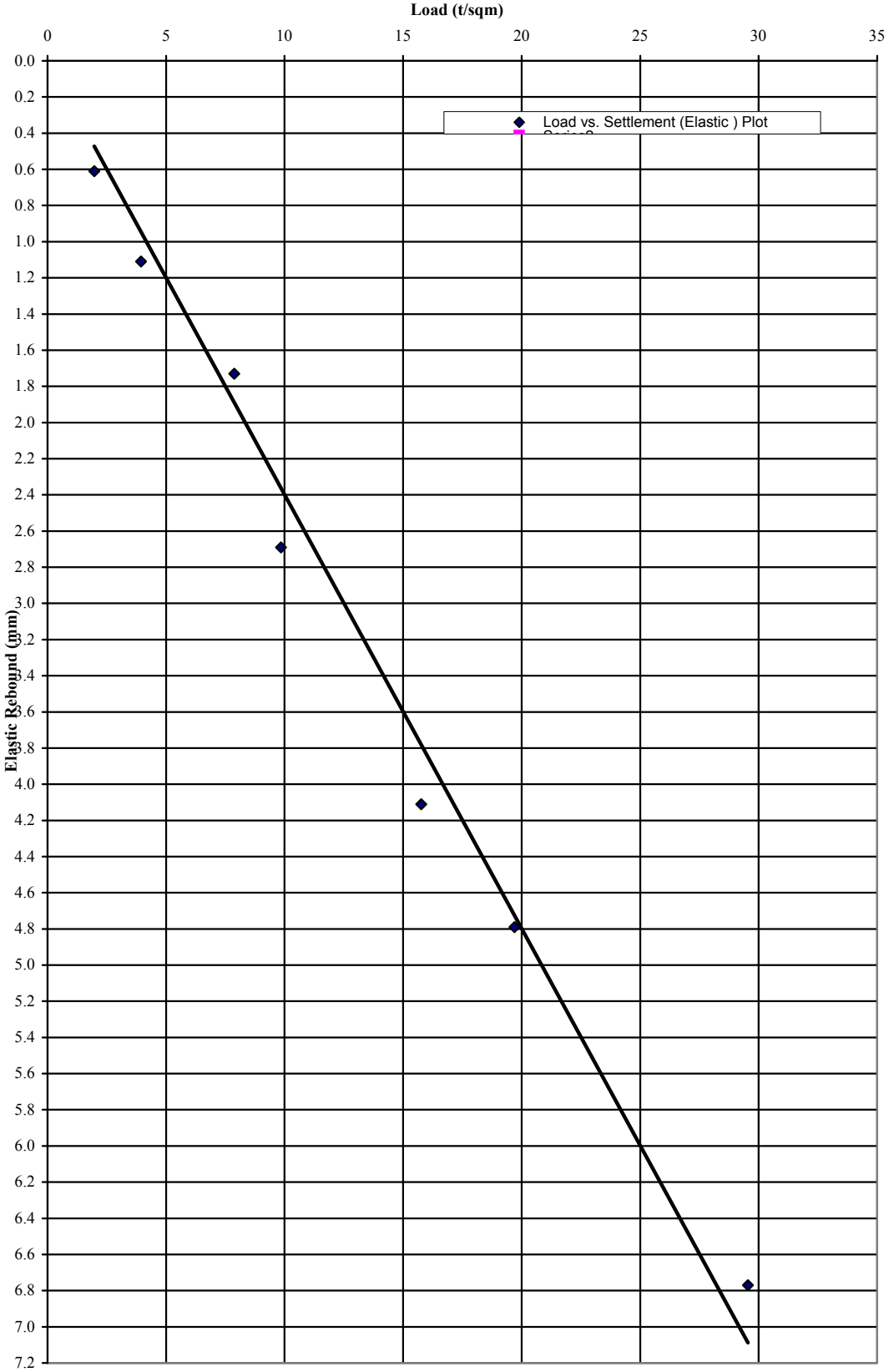


Fig. 3.9 Load Vs. Elastic Rebound Plot (CPLT-02)

5.2. DISCUSSION ON FOUNDATION SYSTEM:

The subsoil is characterised by a filled up soil followed by loose to medium dense silty sand. Then stiff / very stiff to hard clayey silt layer was found. A dense to very dense silty sand layer was observed below that. Again a hard clayey silt layer was observed there after. Underlying that, a very dense silty sand layer was struck and that continued upto the terminating depth of the boreholes.

Considering the nature of the subsoil, for major and heavily loaded structures deep foundation in form of pile is suggested.

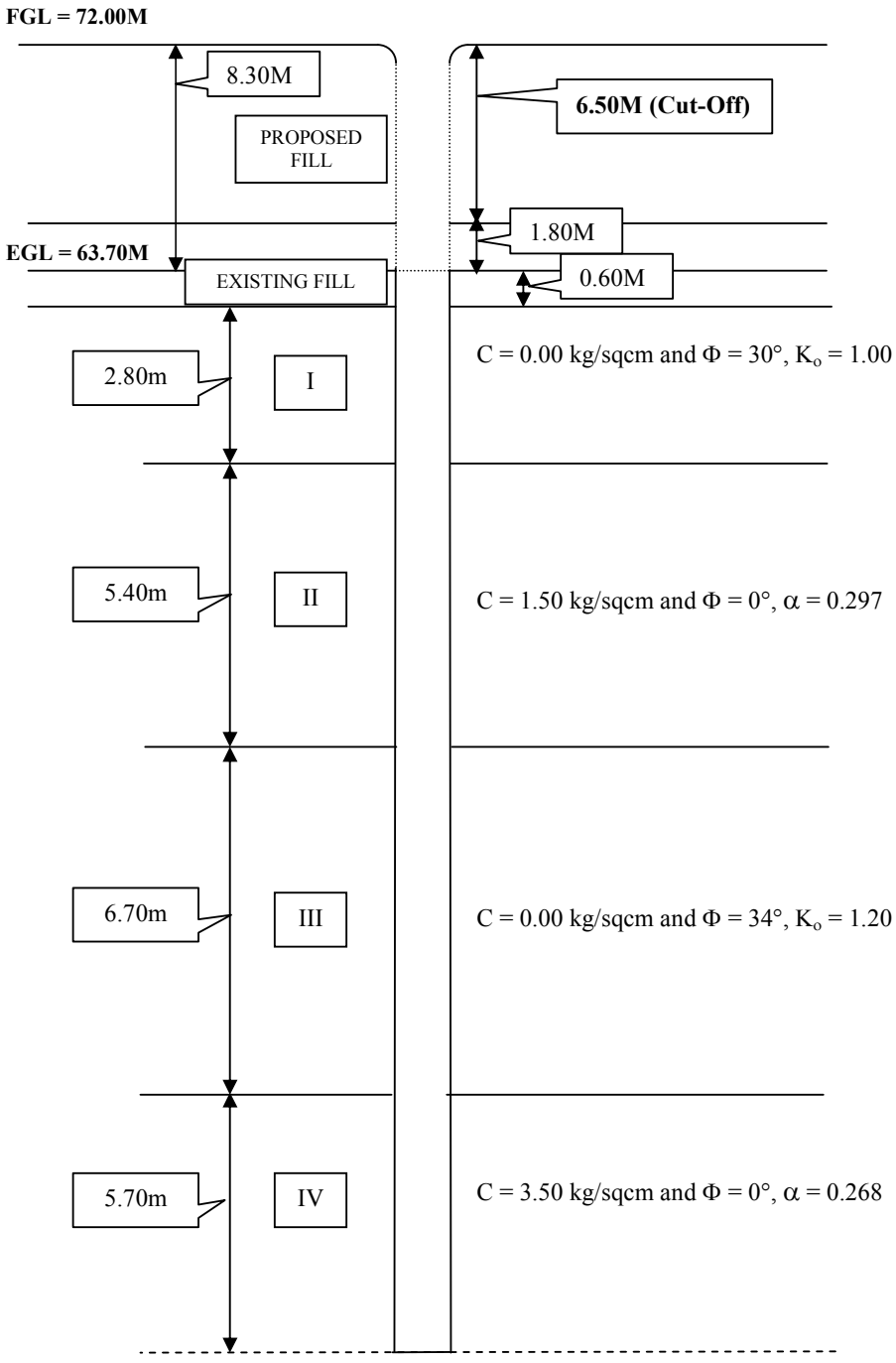
For minor & lightly loaded structures, open foundation may be used. However, this is discussed afterwards.

5.3. USE OF DEEP FOUNDATION:

Bored cast in-situ piles are suggested.

Based on the subsoil condition / desired pile capacity, several pile foundation design model are prepared and enclosed herewith.

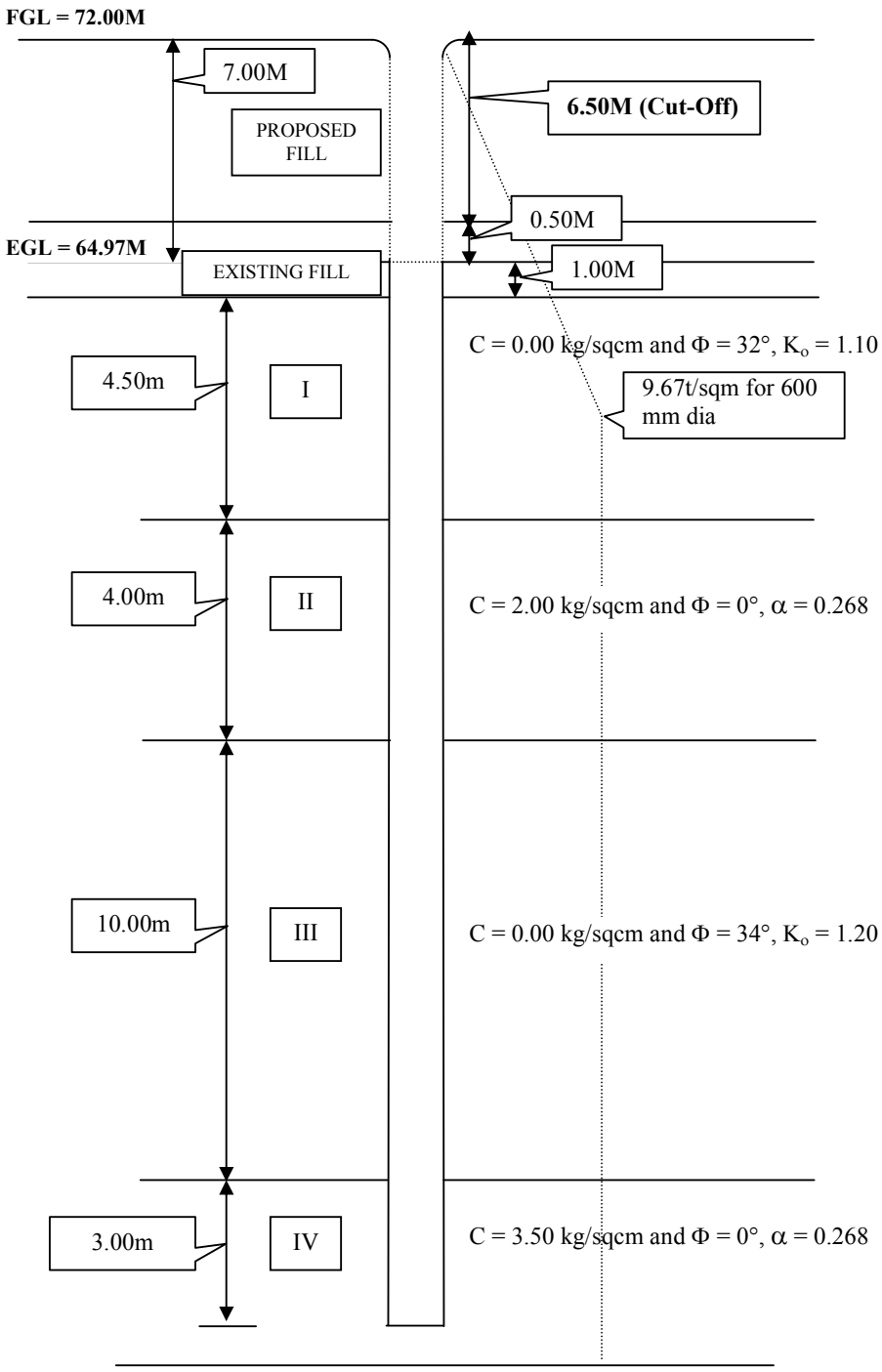
The pile capacity values (vertical, uplift & lateral) are calculated and the recommended values are presented afterwards (FGL = + 72.00M)



BORED PILE FOUNDATION DESIGN MODEL

Based on Design layer stratification around BTG Area (eg. Power House, Mill Bunker, Boiler, ESP, ID Fan Area etc.)

Not to scale



BORED PILE FOUNDATION DESIGN MODEL

(Based on Design layer stratification around Chimney area)

Not to scale

SAMPLE PILE CAPACITY CALCULATION FOR BTG AREA (600 DIA.)

Bottom depth of Pile =	29.50	m below FGL, i.e. 23m below cut off		
Cut-off Length =	6.50	m		
Diameter of Pile =	600	mm	Critical depth	17.00 D
FOS of Shaft Resistance =	2.50		Maximum OVP =	9.89 t/sqm
FOS for End Bearing =	2.50			

So, maximum Depth upto which pressure will increase = 10.20 m

Layer No.	Top Depth (M)	Bottom Depth (M)	Eff. Depth (M)	Cohesion (kg/sqcm)	Φ (Degree)	Adhesion Factor (α)	K_0	Eff. Density (gm/cc)	Mean Pressure (t/sqm)
FILL	6.50	8.30	1.80	--	--	--	--	1.00	7.40
FILL	8.30	8.90	0.60	--	--	--	--	0.80	8.54
1	8.90	11.70	2.80	0.00	30	1.000	1.00	0.85	9.63
2	11.70	17.10	5.40	1.50	0	0.297	1.00	0.90	9.89
3	17.10	23.80	6.70	0.00	34	1.000	1.20	0.90	9.89
4	23.80	29.50	5.70	3.50	0	0.268	1.00	0.90	9.89

Layer No.	Eff. Depth (M)	Effective σ_z (t/sqm)	$f_{s1} = \alpha C$	$f_{s2} = K_0\sigma_z \tan\Phi$	$fs = f_{s1} + f_{s2}$ (t/sqm)	Ultimate Shaft Resistance (T)	Safe Shaft Resistance (T)
Fill	1.80	7.40	--	--	--	--	--
Fill	0.60	8.54	--	--	--	--	--
1	2.80	9.63	0.00	5.56	5.56	29.34	11.74
2	5.40	9.89	4.45	0.00	4.45	45.29	18.12
3	6.70	9.89	0.00	8.00	8.00	101.05	40.42
4	5.70	9.89	9.37	0.00	9.37	100.63	40.25
						276.31	110.52

For End Bearing

Cohesion C=	3.5	kg/sqcm
Friction Angle =	0	°
So, Nc =	9	
Nq =	1.00	
Eff. Ovp. Pressure=p(tip)	9.89	t/sqm
q(tip) =C.Nc+p(tip).Nq=	324.89	t/sqm
Ultimate End Bearing =	91.86	T
Safe End Bearing =	36.74	T
Safe Shaft Resistance=	110.52	T
So, Total Pile Capacity =	147.27	T

Uplift Pile Capacity:

Uplift capacity = (Ultimate shaft Resistance in Vertical Capacity + self weight of pile(buoyant))/3

Uplift capacity = [276.31 + (3.1415/4) x (600/1000)2 x (29.50-6.50) x (2.5-1)]/3

= 92.103

So, Recommended Uplift Capacity = 90 ton

Calculation of "-"ve Drag

Case-1

Use C = 0.00 kg/sqcm & Φ = 30°

Hence "-" Drag = π x D x L x 0.40 x [$k_0.\sigma_z$. tanΦ]

= 3.141 x 0.600 x (8.30-6.50) x 0.40 x [[1.00] x [(8.30+6.50) x 1] x tan30°]

= 5.80 T

Case-2

Use C = 0.50 kg/sqcm & Φ = 0°

Hence "-" Drag = π x D x L x 0.40 x (α x c)

= [3.141 x 0.600 x (8.30-6.50)x 0.40 x (0.871 x 5.0)]

= 5.91 T

Considering the above 2 cases, maximum possible "-"ve drag = 5.9T

So, Recommended Pile Capacity = 140T

SAMPLE PILE CAPACITY CALCULATION FOR BTG AREA(760 DIA.)

Bottom depth of Pile =	29.50	m below FGL, i.e. 23m below cut off		
Cut-off Length =	6.50	m		
Diameter of Pile =	760	mm	Critical depth	17.00 D
FOS of Shaft Resistance =	2.50		Maximum OVP =	12.26 t/sqm
FOS for End Bearing =	2.50			

So, maximum Depth upto which pressure will increase = 12.92 m

Layer No.	Top Depth (M)	Bottom Depth (M)	Eff. Depth (M)	Cohesion (kg/sqcm)	Φ (Degree)	Adhesion Factor (α)	K_0	Eff. Density (gm/cc)	Mean Pressure (t/sqm)
FILL	6.50	8.30	1.80	--	--	--	--	1.00	7.40
FILL	8.30	8.90	0.60	--	--	--	--	0.80	8.54
1	8.90	11.70	2.80	0.00	30	1.000	1.00	0.85	9.97
2	11.70	17.10	5.40	1.50	0	0.297	1.00	0.90	12.13
3	17.10	23.80	6.70	0.00	34	1.000	1.20	0.90	12.26
4	23.80	29.50	5.70	3.50	0	0.268	1.00	0.90	12.26

Layer No.	Eff. Depth (M)	Effective σ_z (t/sqm)	$f_{s1} = \alpha C$	$f_{s2} = K_0\sigma_z\tan\Phi$	$fs = f_{s1} + f_{s2}$ (t/sqm)	Ultimate Shaft Resistance (T)	Safe Shaft Resistance (T)
Fill	1.80	7.40	--	--	--	--	--
Fill	0.60	8.54	--	--	--	--	--
1	2.80	9.97	0.00	5.76	5.76	38.48	15.39
2	5.40	12.13	4.45	0.00	4.45	57.37	22.95
3	6.70	12.26	0.00	9.92	9.92	158.72	63.49
4	5.70	12.26	9.37	0.00	9.37	127.47	50.99
						382.03	152.81

For End Bearing

Cohesion C=	3.5	kg/sqcm
Friction Angle =	0	°
So, Nc =	9	
Nq =	1.00	
Eff. Ovp. Pressure=p(tip)	12.26	t/sqm
q(tip) =C.Nc+p(tip).Nq=	327.26	t/sqm
Ultimate End Bearing =	148.46	T
Safe End Bearing =	59.38	T
Safe Shaft Resistance=	152.81	T
So, Total Pile Capacity =	212.20	T

Uplift Pile Capacity:

Uplift capacity = (Ultimate shaft Resistance in Vertical Capacity + self weight of pile(buoyant))/3

Uplift capacity = [382.03 + (3.1415/4) x (760/1000)2 x (29.50-6.50) x (2.5-1)]/3

= 127.345

So, Recommended Uplift Capacity = 125 ton

Calculation of "-"ve Drag

Case-1

Use C = 0.00 kg/sqcm & Φ = 30°

Hence "-" Drag = π x D x L x 0.40 x [$k_0.\sigma_z$. tanΦ]

= 3.141 x 0.760 x (8.30-6.50) x 0.40 x [[1.00] x [(8.30+6.50) x 1] x tan30°]

= 7.34 T

Case-2

Use C = 0.50 kg/sqcm & Φ = 0°

Hence "-" Drag = π x D x L x 0.40 x (α x c)

= [3.141 x 0.760 x (8.30-6.50) x 0.40 x (0.871 x 5.0)]

= 7.49 T

Considering the above 2 cases, maximum possible "-"ve drag = 7.49T

So, Recommended Pile Capacity = 200T

SAMPLE PILE CAPACITY CALCULATION FOR CHIMNEY AREA (600 DIA.)

Bottom depth of Pile =	29.50	m below FGL, i.e. 23m below cut off		
Cut-off Length =	6.50	m		
Diameter of Pile =	600	mm	Critical depth	17.00 D
FOS of Shaft Resistance =	2.50		Maximum OVP =	9.67 t/sqm
FOS for End Bearing =	2.50			

So, maximum Depth upto which pressure will increase = 10.20 m

Layer No.	Top Depth (M)	Bottom Depth (M)	Eff. Depth (M)	Cohesion (kg/sqcm)	Φ (Degree)	Adhesion Factor (α)	K_0	Eff. Density (gm/cc)	Mean Pressure (t/sqm)
FILL	6.50	7.00	0.50	--	--	--	--	1.00	6.75
FILL	7.00	8.00	1.00	--	--	--	--	0.80	7.40
1	8.00	12.50	4.50	0.00	32	1.000	1.10	0.85	9.21
2	12.50	16.50	4.00	2.00	0	0.268	1.00	0.90	9.67
3	16.50	26.50	10.00	0.00	34	1.000	1.20	0.90	9.67
4	26.50	29.50	3.00	3.50	0	0.268	1.00	0.90	9.67

Layer No.	Eff. Depth (M)	Effective σ_z (t/sqm)	$f_{s1} = \alpha C$	$f_{s2} = K_0\sigma_z\tan\Phi$	$fs = f_{s1} + f_{s2}$ (t/sqm)	Ultimate Shaft Resistance (T)	Safe Shaft Resistance (T)
Fill	0.50	6.75	--	--	--	--	--
Fill	1.00	7.40	--	--	--	--	--
1	4.50	9.21	0.00	6.33	6.33	53.71	21.49
2	4.00	9.67	5.35	0.00	5.35	40.35	16.14
3	10.00	9.67	0.00	7.83	7.83	147.54	59.01
4	3.00	9.67	9.37	0.00	9.37	52.96	21.19
						294.57	117.83

For End Bearing

Cohesion C=	3.5	kg/sqcm
Friction Angle =	0	°
So, Nc =	9	
Nq =	1.00	
Eff. Ovp. Pressure=p(tip)	9.67	t/sqm
q(tip) =C.Nc+p(tip).Nq=	324.67	t/sqm
Ultimate End Bearing =	91.80	T
Safe End Bearing =	36.72	T
Safe Shaft Resistance=	117.83	T
So, Total Pile Capacity =	154.55	T

Uplift Pile Capacity:

Uplift capacity = (Ultimate shaft Resistance in Vertical Capacity + self weight of pile(buoyant))/3

Uplift capacity = [185.57 + (3.1415/4) x (600/1000)2 x (29.50-6.50) x (2.5-1)]/3

= 98.190

So, Recommended Uplift Capacity = 95 ton

Calculation of "-"ve Drag

Case-1

Use C = 0.00 kg/sqcm & Φ = 30°

Hence "-" Drag = π x D x L x 0.40 x [$k_0.\sigma_z$. tanΦ]

= 3.141 x 0.600 x (7.00-6.50) x [[0.40 x [1.00] x [(7.00+6.50) x 1] x tan30°]

= 1.47 T

Case-2

Use C = 0.50 kg/sqcm & Φ = 0°

Hence "-" Drag = π x D x L x 0.40 x (α x c)

= [3.141 x 0.600 x (7.00-6.50) x 0.871 x 5.0] x 0.40

= 1.64 T

Considering the above 2 cases, maximum possible "-"ve drag = 1.60T

So, Recommended Pile Capacity = 150T

SAMPLE PILE CAPACITY CALCULATION FOR EFFLUENT TREATMENT PLANT AREA (600 DIA.)

Bottom depth of Pile =	26.50	m below FGL, i.e. 23m below cut off		
Cut-off Length =	3.50	m		
Diameter of Pile =	600	mm	Critical depth	17.00 D
FOS of Shaft Resistance =	2.50		Maximum OVP =	9.87 t/sqm
FOS for End Bearing =	2.50			

So, maximum Depth upto which pressure will increase = 10.20 m

Layer No.	Top Depth (M)	Bottom Depth (M)	Eff. Depth (M)	Cohesion (kg/sqcm)	Φ (Degree)	Adhesion Factor (α)	K_0	Eff. Density (gm/cc)	Mean Pressure (t/sqm)
FILL	3.50	8.10	4.60	--	--	--	--	1.00	5.80
FILL	8.10	8.60	0.50	--	--	--	--	0.80	8.30
2A	8.60	10.10	1.50	0.40	0	1.000	1.00	0.85	9.14
2	10.10	15.60	5.50	1.50	0	0.297	1.00	0.90	9.86
3	15.60	17.10	1.50	0.00	34	1.000	1.20	0.90	9.87
4	17.10	26.50	9.40	3.50	0	0.268	1.00	0.90	9.87

Layer No.	Eff. Depth (M)	Effective σ_z (t/sqm)	$f_{s1} = \alpha C$	$f_{s2} = K_0\sigma_z\tan\Phi$	$fs = f_{s1} + f_{s2}$ (t/sqm)	Ultimate Shaft Resistance (T)	Safe Shaft Resistance (T)
Fill	4.60	5.80	--	--	--	--	--
Fill	0.50	8.30	--	--	--	--	--
2A	1.50	9.14	4.00	0.00	4.00	11.31	4.52
2	5.50	9.86	4.45	0.00	4.45	46.13	18.45
3	1.50	9.87	0.00	7.98	7.98	22.58	9.03
4	9.40	9.87	9.37	0.00	9.37	165.95	66.38
						245.97	98.39

For End Bearing

Cohesion C=	3.5	kg/sqcm
Friction Angle =	0	°
So, Nc =	9	
Nq =	1.00	
Eff. Ovp. Pressure=p(tip)	9.87	t/sqm
q(tip) =C.Nc+p(tip).Nq=	324.87	t/sqm
Ultimate End Bearing =	91.85	T
Safe End Bearing =	36.74	T
Safe Shaft Resistance=	98.39	T
So, Total Pile Capacity =	135.13	T

Uplift Pile Capacity:

Uplift capacity = (Ultimate shaft Resistance in Vertical Capacity + self weight of pile(buoyant))/3

Uplift capacity = [185.57 + (3.1415/4) x (600/1000)2 x (29.50-6.50) x (2.5-1)]/3

= 81.990

So, Recommended Uplift Capacity = 75 ton

Calculation of "-"ve Drag

Case-1

Use C = 0.00 kg/sqcm & Φ = 30°

Hence "-" Drag = π x D x L x 0.40 x [$k_0.\sigma_z$. tanΦ]

= 3.141 x 0.760 x (8.1-3.50) x [[0.40 x [1.00] x [(8.10+3.50) x 1] x tan30°]

= 11.61 T

Case-2

Use C = 0.50 kg/sqcm & Φ = 0°

Hence "-" Drag = π x D x L x 0.40 x (α x c)

= [3.141 x 0.760 x (8.1-3.50) x 0.871 x 5.0] x 0.40

= 15.10 T

Considering the above 2 cases, maximum possible "-"ve drag = 15.10T

So, Recommended Pile Capacity = 115T

SAMPLE PILE CAPACITY CALCULATION FOR CW PIPE CORRIDOR AREA(450 DIA.)

Bottom depth of Pile =	16.50	m below FGL, i.e. 13m below cut off		
Cut-off Length =	3.50	m		
Diameter of Pile =	450	mm	Critical depth	17.00 D
FOS of Shaft Resistance =	2.50		Max unit friction on shaft f_s	13 t/sqm
FOS for End Bearing =	2.50		Maximum q(tip) =	500 t/sqm
So, maximum Depth upto which pressure will increase =	7.65	m	Maximum OVP =	7.18 t/sqm

Layer No.	Top Depth (M)	Bottom Depth (M)	Eff. Depth (M)	Cohesion (kg/sqcm)	Φ (Degree)	Adhesion Factor (α)	K_0	Eff. Density (gm/cc)	Mean Pressure (t/sqm)
FILL	3.50	4.50	1.00	--	--	--	--	1.00	4.00
1	4.50	10.50	6.00	0.00	30	1.000	1.00	0.85	6.47
4	10.50	13.50	3.00	2.50	0	0.268	1.00	0.90	7.18
5	13.50	32.00	3.00	0.00	35	1.000	1.25	0.90	7.18

Layer No.	Eff. Depth (M)	Effective σ_z (t/sqm)	$f_{s1} = \alpha C$	$f_{s2} = K_0\sigma_z\tan\Phi$	$fs = f_{s1} + f_{s2}$ (t/sqm)	Ultimate Shaft Resistance (T)	Safe Shaft Resistance (T)
Fill	1.00	4.00	--	--	--	--	--
1	6.00	6.47	0.00	3.74	3.74	31.71	12.68
4	3.00	7.18	6.69	0.00	6.69	28.37	11.35
5	3.00	7.18	0.00	6.28	6.28	26.64	10.66
						86.73	34.69

For End Bearing

Cohesion C=	0	kg/sqcm
Friction Angle =	35	°
So, Nc =	81	
Nq =	51.42	
Eff. Ovp. Pressure=p(tip)	7.18	t/sqm
q(tip) =C.Nc+p(tip).Nq=	369.04	t/sqm
Ultimate End Bearing =	58.69	T
Safe End Bearing =	23.48	T
Safe Shaft Resistance=	34.69	T
So, Total Pile Capacity =	58.17	T

Uplift Pile Capacity:

Uplift capacity = (Ultimate shaft Resistance in Vertical Capacity + self weight of pile(buoyant))/3

Uplift capacity = [185.57 + (3.1415/4) x (600/1000)2 x (29.50-6.50) x (2.5-1)]/3

= 28.908

So, Recommended Uplift Capacity = 25 ton

Calculation of "-"ve Drag

Case-1

Use C = 0.00 kg/sqcm & Φ = 30°

Hence "-" Drag = π x D x L x 0.40 x [$k_0.\sigma_z$. tanΦ]

= 3.141 x 0.450 x (4.50-3.50) x [[0.40 x [1.00] x [(4.50+3.50) x 1] x tan30°]

= 1.31 T

Case-2

Use C = 0.50 kg/sqcm & Φ = 0°

Hence "-" Drag = π x D x L x 0.40 x (α x c)

= [3.141 x 0.450 x (4.50-3.50) x 0.871 x 5.0] x 0.40

= 2.46 T

Considering the above 2 cases, maximum possible "-"ve drag = 2.46T

So, Recommended Pile Capacity = 55T

5.3.2. DETERMINATION OF VERTICAL PILE CAPACITY (BORED CAST IN-SITU PILE):

With reference to the above, the pile capacity values for various pile diameter are calculated and presented below. A sample pile capacity calculations is presented in a separate sheet.

Foundation Location	Length of pile below cut off level (M)	Pile Diameter (mm)	Recommended Vertical Pile Capacity, (T)
Chimney Area	23m (cut off =6.50)	600	150
BTG Area	23m (cut off =6.50)	600	140
		760	200
Switch Yard cont. room & Switch Yard Area and Transformer Yard Area	23m (cut off =3.50)	600	140
Effluent Treatment Plant Area	23m (cut off =3.50)	600	115
Guard Pond, Air Washers, Space For Dm Plant, DMW Stg.Tanks, Chem. House etc., Side stream Filtration Plant, Clarified Water PH & FWPH , LFO & HFO Tank, IA/SA/MRS Compressor House Area	23m (cut off =3.50)	600	150
CW Gas Chlorination Plant, DG Set, Service & Technical Bldg., FO Pressuring Pump House Area	23m (cut off =3.50)	600	130
CW Pipe Corridor Area	13m (cut off =3.50)	450	55
Pipe Rack Area	13m (cut off =3.50)	450	30

Note: Pile capacity shall be confirmed by conducting Pile Load Test as per IS: 2911, Part-IV.

5.3.3. DETERMINATION OF UPLIFT PILE CAPACITY (BORED CAST IN-SITU PILE):

With reference to the above, the uplift pile capacity values for various pile diameter are calculated and presented below.

Foundation Location	Length of pile below cut off level (M)	Pile Diameter (mm)	Recommended Uplift Pile Capacity, (T)
Chimney Area	23m (cut off =6.50)	600	95
BTG Area	23m (cut off =6.50)	600	90
		760	125
Switch Yard cont. room & Switch Yard Area and Transformer Yard Area	23m (cut off =3.50)	600	90
Effluent Treatment Plant Area	23m (cut off =3.50)	600	75
Guard Pond, Air Washers, Space For Dm Plant, DMW Stg.Tanks, Chem. House etc., Side stream Filtration Plant, Clarified Water PH & FWPH , LFO & HFO Tank, IA/SA/MRS Compressor House Area	23m (cut off =3.50)	600	85
CW Gas Chlorination Plant, DG Set, Service & Technical Bldg., FO Pressuring Pump House Area	23m (cut off =3.50)	600	80
CW Pipe Corridor Area	13m (cut off =3.50)	450	25
Pipe Rack Area	13m (cut off =3.50)	450	20

5.3.4. LATERAL PILE CAPACITY (AROUND BTG AREA):

Refer to IS : 2911 (Part I/Sec 2) - 2010, Appendix - C

Constant Factor, η_h = 0.20 kg/cucm corresponding to "N" value = 13 [Assuming Submerged Sand]

$T = [EI/\eta_h]^{1/5}$

Now, $I = 0.64 \times 10^6$ cm^4 [for 600mm dia pile]

$E = 5000 \times (f_{ck})^{0.5} = 5000 \times (25)^{0.5} = 25000$ N/sqmm $= 2.50 \times 10^5$ kg/sqcm

Hence, T = 238.81 cm

From Graph (Fig.4), L_f = 2.18 x T = 520.60 cm [Assuming Fixed Head Piles in Sands]

Pile Head deflection, Y = H x L_f^3 / 12EI = 0.7393mm for 1T load

So, for 5mm horizontal deflection, H = 6.76T, say 6.70T

Similarly, for 760 dia pile, H = 9.80T.

Foundation Location	Length of pile below cut off level (M)	Pile Diameter (mm)	Recommended Lateral Pile Capacity, (T)
Chimney Area	23m (cut off =6.50)	600	7.00
BTG Area	23m (cut off =6.50)	600	6.70
		760	9.80
Switch Yard cont. room & Switch Yard Area and Transformer Yard Area	23m (cut off =3.50)	600	6.70
Effluent Treatment Plant Area	23m (cut off =3.50)	600	5.40
Guard Pond, Air Washers, Space For Dm Plant, DMW Stg.Tanks, Chem. House etc., Side stream Filtration Plant, Clarified Water PH & FWPH , LFO & HFO Tank, IA/SA/MRS Compressor House Area	23m (cut off =3.50)	600	7.00
CW Gas Chlorination Plant, DG Set, Service & Technical Bldg., FO Pressuring Pump House Area	23m (cut off =3.50)	600	5.40
CW Pipe Corridor Area	13m (cut off =3.50)	450	3.40
Pipe Rack Area	13m (cut off =3.50)	450	3.40

5.4. USE OF OPEN FOUNDATION:

For minor and lightly loaded structures, open foundation can be used. The determination of bearing capacity is presented below.

Determination of Bearing Capacity (around Chimney area):

Place the foundation 1.00m below existing ground level.

Use average "N" = 17

Correcting for Overburden Pressure & Dilatancy, Corrected "N" = 16

Hence, use C = 0 kg/sqcm & Φ = 32°

Stratum-I:

Average corrected 'N' = 16

Treating the sand to be silty sand, E_s = 3 x (N+6) = 66 kg/sqcm

Treating the sand to be normally consolidated sand, E_s = 5 x (N+15) = 155 kg/sqcm

Considering the above, let us use E_s = 110 kg/sqcm

Use Geological Factor, G = 1.00 & μ = 0.25

[Refer to "Foundation Analysis and Design", 5th Edition, by J.E.Bowles, pp. No. 316, Table:5-6]

Stratum-II:

"N" value in this layer = 39, use C = 2.00 kg/sqcm

We know, E_s = 4.4 x N = 4.4 x 39 = 171.60 kg/sqcm

[Ref. to "History of Soil penetration testing" by B. B. Broms & N. Flodin in "Penetration Testing 1988", ISPOT-1: vol.1, p – 185]

Undrained Young's modulus, E_u = 500C = 1000 kg/sqcm

Again, $1/E_s = 1/E_u + 1/E_d$ giving drained young's modulus, E_d = 207.15 kg/sqcm

Now, we have, $E_d = E_u/3$ = 333.33 kg/sqcm

[Refer to "Cone Penetration Testing" by A.C.Meigh, pp. No. – 53]

Considering the above, let us use E_d = 270 kg/sqcm

From E_d, $m_{vc} = 1/G.E_d$ = 0.0074 sqcm/kg [Geological Factor, G = 0.50 & μ = 0.35]

Again from SPT "N", m_{vc} = 1/5N = 0.0051 sqcm/kg

[Refer to "Standard Penetration Test, State-of-the-art-Report" by Ivan K. Nixon in "Penetration testing 1" Edited by A.Verrujt, F.L.beringen & E.H.De Leeuw, pp. No. 11]

So, use design m_{vc} = [0.0074 + 0.0051]/2 = 0.0063 sqcm/kg

Stratum-III:

Average corrected 'N' = 29

Treating the sand to be silty sand, E_s = 3 x (N+6) = 105 kg/sqcm

Treating the sand to be normally consolidated sand, E_s = 5 x (N+15) = 220 kg/sqcm

Considering the above, let us use E_s = 160 kg/sqcm

Use Geological Factor, G = 1.00 & μ = 0.25

Bearing Capacity Calculation:

Use depth of foundation = 1.00m below EGL & size of footing = 3m x 4.5m (assumed)

The foundation falls inside sand layer.

The Net Ultimate Bearing Capacity is given as:

$$q_{nu} = C.N_c.S_c.D_c + q.N_q.S_q.D_q + 0.5\gamma.B.N_\gamma.S_\gamma.D_\gamma - q$$

Where,

N_c, N_q and N_γ are bearing capacity factors,
S_c, S_q and S_γ are shape factors,
D_c, D_q and D_γ are depth factors,

And

C = Cohesion
q = Overburden pressure,
B = Width of foundation,
γ = Effective density below foundation.

Considering general shear failure

Cohesion, C = 0.00 t/sqm

Using ϕ = 32 degree, the bearing capacity factors are:

N_c = 35.49
N_q = 23.18
N_γ = 30.21

Use,

Depth of Foundation = D_f = 1 M below EGL
Width of Foundation = B = 3 M
Length of Foundation = L = 4.5 M

Overburden Pressure = q =1.000 (Depth) x 0.90 (Submerged density) = 0.90 t/sqm (assuming water table is flushing with the ground)

The Shape factors are [IS:6403 - 1981]

S_c = 1.13 S_q = 1.13 S_γ = 0.73

The Depth factors are [IS:6403 - 1981]

D_c = 1.12 D_q = 1.06 D_γ = 1.06

Computed Net Ultimate Bearing Capacity = 55.87 t/sqm

Using a factor of safety of 2.5, Net Safe Bearing Capacity = 22.35 t/sqm

Considering local shear failure

$\phi = 32°$, $\Phi' = \tan^{-1}(2/3 \tan\Phi) \approx 22°$

Computed Net Ultimate Bearing Capacity = 14.88 t/sqm

Using a factor of safety of 2.5, Net Safe Bearing Capacity = 5.95 t/sqm

Therefore, interpolated SBC = [5.95 + {(32-28) / (36-28)} x (22.35-5.95)] = 14.15 t/sqm.

The above bearing capacity should be checked against settlement criteria and this is shown below.

For 3m x 4.5m Isolated footing

Settlement Analysis

A) General Data:

Width of foundation =	3.0	m
Length of foundation =	4.5	m
Depth of foundation =	1.0	m
Net Base Pressure =	1.4	kg/sqcm

B) Subsoil Properties:

Layer - I			**Layer - II**		
Young's Modulus =	110	kg/sqcm	Young's Modulus =	1000	kg/sqcm
Poisson Ratio, μ =	0.25		Poisson Ratio, μ =	0.35	
Top of Stratum =	0.00	m	Top of Stratum =	5.50	m
End of Stratum =	5.50	m	End of Stratum =	7.00	m
Geological factor, G =	1.00		Geological factor, G =	0.50	
m_{vc} =	0.0000	sqcm/kg	m_{vc} =	0.0063	sqcm/kg

C) Calculation of Immediate Settlement:

Settlement at center

M = L' / B' =	1.500		
N = H / B' =	3.000		
I_1 =	0.393		
I_2 =	0.068		
$I_s = I_1 + \{(1-2\mu) / (1-\mu)\} I_2$ =		0.438	
Immediate settlement S_i =		3.134	cm
$[q_o \times B' \times (1-\mu^2) \times m \times I_s] / E_s$			

Settlement at center

M = L' / B' =	1.200		
N = H / B' =	0.400		
I_1 =	0.031		
I_2 =	0.069		
$I_s = I_1 + \{(1-2\mu) / (1-\mu)\} I_2$ =		0.062	
Immediate settlement S_i =		0.023	cm
$[q_o \times B' \times (1-\mu^2) \times m \times I_s] / E_s$			

Settlement at corner

M = L' / B' =	1.50		
N = H / B' =	1.500		
I_1 =	0.220189		
I_2 =	0.096223		
$I_s = I_1 + \{(1-2\mu) / (1-\mu)\} I_2$ =		0.284	
Immediate settlement S_i =		1.018	cm

Settlement at corner

M = L' / B' =	1.20		
N = H / B' =	0.200		
I_1 =	0.008		
I_2 =	0.042		
$I_s = I_1 + \{(1-2\mu) / (1-\mu)\} I_2$ =		0.027	
Immediate settlement S_i =		0.005	cm

Average S_i for Stratum I= 20.76 mm

Total immediate settlement = 20.90 mm

Average S_i for Stratum II= 0.14 mm

(for both the layer)

D) Calculation of Consolidation Settlement:

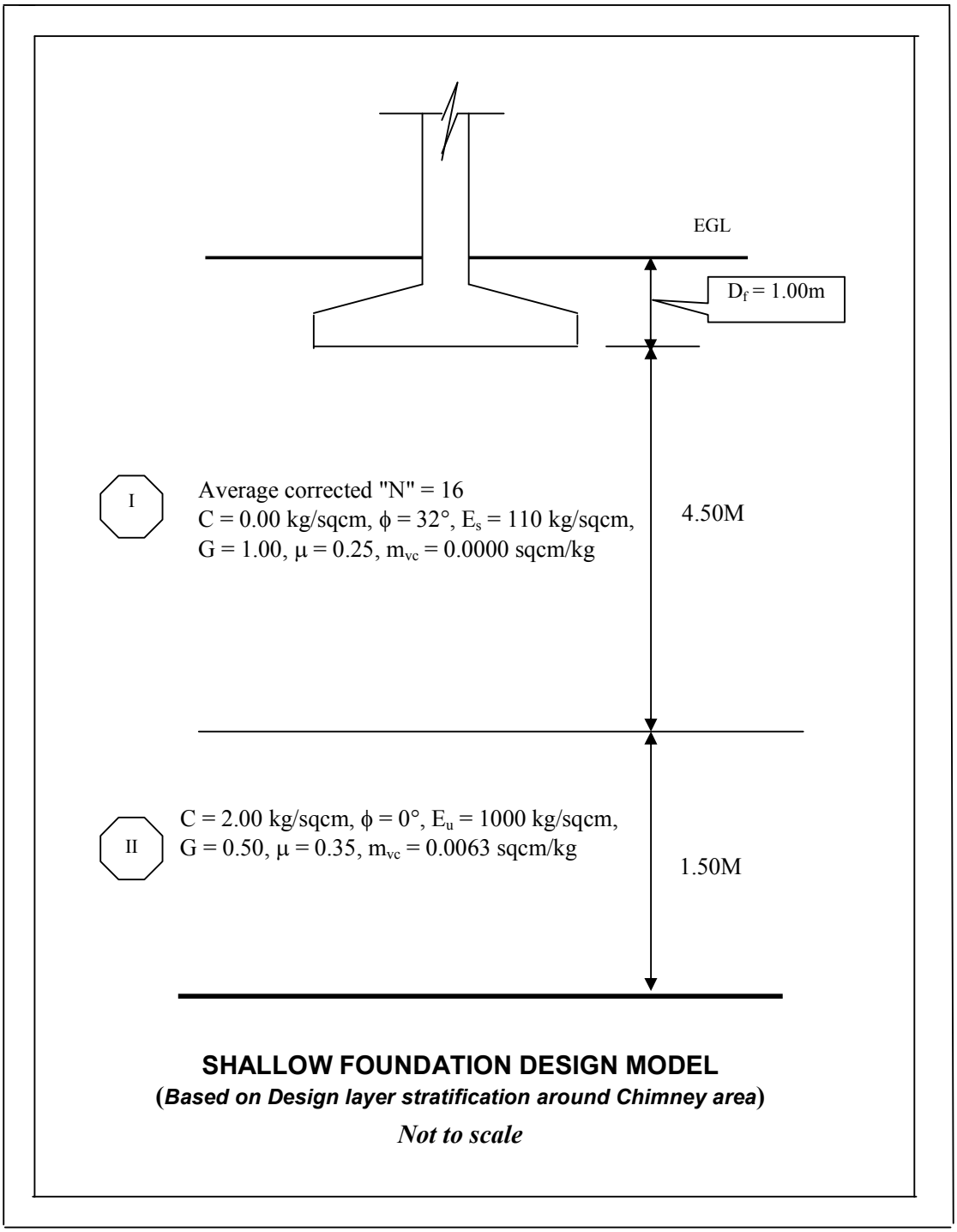
Strata	From (M)	To (M)	Thickness (M)	Mid depth (M)	Δ P (kg/sqcm)	m_{vc}, sqcm/kg	G	S_c (cm)
Layer - II	5.50	6.25	0.75	4.88	0.26	0.0063	0.50	0.06
	6.25	7.00	0.75	5.63	0.22	0.0063	0.50	0.05

Hence, Total Consolidation Settlement = 1.12 mm

So, Total Settlement = 22.02 mm

Foxe's Depth correction Factor = 0.93

Corrected total settlement = 20.46 mm



SHALLOW FOUNDATION DESIGN MODEL

(***Based on Design layer stratification around Chimney area***)

Not to scale

Based on the above, following bearing capacity values are recommended.

A) Recommendation on bearing Capacity for foundations where EGL is below FGL (Area required Filling)

Foundation Location	D_f below EGL (M)	Width of Foundation (m)	NSBC (t/sqm)	NABC (t/sqm)		
				S=25mm	S=40mm	S=75mm
BTG / Chimney Area	Upto 1.50	Upto 6	--	5		
	2	Up to 2	11.78	10	10	--
		3-4	13.85	12	12	--
		5	15.07	11	15	--
		>6	16.34	--	16	16
	3	Up to 2	17.28	16	16	--
		3-4	18.54	18	18	--
		5	19.61	14	18	--
		>6	20.77	--	20	20
Switch Yard Control Room & Switch Yard, Transformer Yard	1	Up to 2	6.92	6	6	--
		3-4	9.47	9	9	--
		5	10.79	8	10	--
		>6	12.12	--	12	12
	2	Up to 2	11.78	10	10	--
		3-4	13.85	12	12	--
		5	15.07	11	15	--
		>6	16.34	--	16	16
	3	Up to 2	17.28	16	16	--
		3-4	18.54	18	18	--
		5	19.61	14	18	--
		>6	20.77	--	20	20
Effluent Treatment Plant	1	Upto 2	10.31	10	10	--
		3-4	9.84	7	11	--
		5	9.75	6	10	--
		>6	9.69	--	9	9
	2	Up to 2	43.85	12	12	--
		3-4	39.47	8	12	--
		5	38.60	7	10	--
		>6	38.02	--	10	10
	3	Up to 2	45.62	20	20	--
		3-4	40.37	16	18	--
		5	39.32	15	18	--
		>6	38.62	--	18	18
Guard Pond, Air Washers, Space For Dm Plant, DMW Stg.Tanks, Chem. House etc., Side stream Filtration Plant, Clarified Water PH & FWPH , LFO & HFO Tank, IA/SA/MRS Compressor House Area	1	Up to 2	6.92	6	6	--
		3-4	9.47	5	8	--
		5	10.79	5	8	--
		>6	12.12	--	9	12
	2	Up to 2	11.78	10	10	--
		3-4	13.85	7	11	--
		5	15.07	6	10	--
		>6	16.34	--	12	16
	3	Up to 2	17.28	14	16	--
		3-4	18.54	9	14	--
		5	19.61	8	13	--
		>6	20.77	--	15	20

Foundation Location	D_f below EGL (M)	Width of Foundation (m)	NSBC (t/sqm)	NABC (t/sqm)		
				S=25mm	S=40mm	S=75mm
CW Gas Chlorination Plant, DG Set, Service & Technical Bldg., FO Pressuring Pump House, CW Pipe Corridor Area	1	Upto 2	6.92	6	6	--
		3-4	9.47	5	8	--
		5	10.79	5	8	--
		>6	12.12	--	6	9
	2	Up to 2	11.78	10	10	--
		3-4	13.85	6	10	--
		5	15.07	5	9	--
		>6	16.34	--	10	16
	3	Up to 2	17.28	14	22	--
		3-4	18.54	8	13	--
		5	19.61	7	11	--
		>6	20.77	--	12	20
400 KV Extn. Switch Yard	1	Upto 2	6.92	6	6	--
		3-4	8.17	6	8	--
		5	10.79	6	10	--
		>6	12.12	--	10	12
	2	Up to 2	11.78	10	11	--
		3-4	12.71	7	11	--
		5	15.07	6	10	--
		>6	16.34	--	12	16
	3	Up to 2	17.28	15	17	--
		3-4	17.67	9	14	--
		5	19.61	8	13	--
		>6	20.77	--	15	20

B) Recommendation on bearing Capacity for foundations where EGL is above FGL (Area required Cutting)

Foundation Location	D_f below FGL (M)	Width of Foundation (m)	NSBC (t/sqm)	NABC (t/sqm)		
				S=25mm	S=40mm	S=75mm
Natural Draft Cooling Tower (NDCT)	1m	Upto 2	10.00	10	10	--
		3-4	14.15	14	14	--
		5	18.93	16	18	--
		>6	21.36	20	20	20
	2m	Up to 2	19.89	18	18	--
		3-4	21.63	20	20	--
		5	25.98	22	25	--
		>6	28.30	28	28	28
	3m	Up to 2	29.01	28	28	--
		3-4	29.84	28	28	--
		5	32.79	30	30	--
		>6	32.21	30	30	30
	4 -5m	Up to 2	114.46	45	45	--
		3-4	98.14	45	45	--
		5	94.87	42	45	--
		>6	92.69	42	45	45

Foundation Location	D_f below FGL (M)	Width of Foundation (m)	NSBC (t/sqm)	NABC (t/sqm)		
				S=25mm	S=40mm	S=75mm
Store, Retaining Wall & Equipment Laydown Space	1m	Up to 2	89.83	35	40	--
		3-4	85.75	32	38	--
		5	84.93	30	35	--
		>6	84.39	--	35	40
	2m	Up to 2	98.04	40	40	--
		3-4	89.88	38	38	--
		5	88.24	35	35	--
		>6	87.16	--	35	40
	3m	Up to 2	106.25	45	45	--
		3-4	94.01	40	40	--
		5	91.56	38	38	--
		>6	89.92	--	40	45
FO Transfer Pump House	1-2m	Upto 2	25.80	25	25	--
		3-4	36.66	35	35	--
		5	37.87	35	35	--
		>6	37.41	--	35	35
	3m	Upto 2	45.62	45	45	--
		3-4	40.37	40	40	--
		5	39.32	38	38	--
		>6	38.62	--	38	38
Space for service water pumps, New clarifier pumps, CW chlorination Plant Area	1m	Upto 2	10.00	10	10	--
		3-4	14.15	10	14	--
		5	18.93	9	14	--
		>6	21.36	--	16	20
	2m	Up to 2	19.89	18	18	--
		3-4	21.63	12	18	--
		5	25.98	10	16	--
		>6	28.30	--	18	28
	3m	Up to 2	29.01	26	28	--
		3-4	29.84	14	22	--
		5	33.46	12	18	--
		>6	35.60	--	20	35

Note:

1. NSBC = Net Safe Bearing Capacity
2. NABC = Net Allowable Bearing Capacity
3. S = Limiting Settlement.

5.5. STATIC CONE PENETRATION TESTS:

Total seventeen (17) nos. SCP Tests were conducted at the proposed site up to a maximum depth of about 13m below existing ground level. Using the SCPT results, the average properties of the soil is calculated and presented in separate sheet in volume-2. The average strength properties as obtained from SCPT are summarised below.

SCPT No.	Layer No.	Average Properties	
		C (kg/sqcm)	Φ (°)
SCPT – 1 to 17	I	0.00	38
	II	1.50	0
	III	0.00	38
	IV	4.06	0

5.6. SWELLING CHARACTERISTICS:

The swelling pressure and Free Swell Index tests were performed on a few samples and the test results are presented at the end of this report. The average swelling pressure and Free Swelling Index as found from the tests are 0.38kg/sqcm & 14.63% respectively. Thus, the subsoil has low swelling characteristics. So, no problem with respect to the swelling of the subsoil is anticipated.

5.7. PERCOLATION TESTS:

Percolation tests were conducted in different trial pits. The test results are presented below.

Test Locations	Type of Test	Depth of Test (M)	Permeability (cm/sec)
TP-01	Falling Head	3.00	3.909×10^{-6}
TP-03	Falling Head	3.00	4.241×10^{-6}
TP-04	Falling Head	3.00	1.875×10^{-6}
TP-08	Falling Head	3.00	1.330×10^{-6}

5.8. FIELD PERMEABILITY TESTS:

Field permeability tests were conducted in four bore holes. The test results are presented below.

Test Locations	Type of Test	Depth of Test (M)	Permeability (cm/sec)
BH-02	Falling Head	1.40 – 2.00	7.737×10^{-6}
	Falling Head	2.80 – 3.50	1.172×10^{-6}
BH-10	Falling Head	1.45 – 2.00	5.401×10^{-6}
	Falling Head	2.90 – 3.50	5.132×10^{-6}
BH-31	Falling Head	1.30 – 2.00	2.588×10^{-5}
	Falling Head	2.80 – 3.50	7.311×10^{-6}
BH-53	Falling Head	1.40 – 2.00	4.079×10^{-4}
	Falling Head	2.90 – 3.50	3.414×10^{-4}

5.9. CHEMICAL TESTS:

Chemical tests were performed on a few soil & water samples for determining the pH value, Sulphate, Chloride etc. The results are given in a tabular form below:

CHEMICAL TEST RESULTS ON SOIL SAMPLES: -

BH / UDS No.	Depth (M)	pH value	Sulphate (%) as SO_3	Chloride as Cl %	Carbonate as %	Nitrate as %	Organic Matters %
06/02	4.00	6.27	0.050	0.01849	0.12	0.004	0.3442
11/01	2.00	7.80	BDL*	0.01851	0.30	0.008	0.6732

BH / UDS No.	Depth (M)	pH value	Sulphate (%) as SO_3	Chloride as Cl %	Carbonate as %	Nitrate as %	Organic Matters %
11/02	4.00	8.22	BDL*	0.01994	0.40	0.002	0.1292
16/01	2.00	6.65	0.050	0.01991	0.16	0.010	0.2884
23/03	6.50	7.81	0.050	0.01709	0.32	0.012	0.1110
26/03	6.50	7.77	0.050	0.02564	0.20	0.004	0.6310
34/03	6.50	5.93	0.350	0.02134	0.40	0.004	0.3016
39/01	2.00	4.73	0.050	0.05127	0.44	0.013	0.2235
45/02	4.00	7.64	0.050	0.01994	0.25	0.011	0.7658
50/01	2.00	8.03	0.050	0.01851	0.52	0.007	0.0401

CHEMICAL TEST RESULTS ON WATER SAMPLE: -

BH No.	Depth (M)	pH value	Sulphate as mg/litr	Chloride as mg/litr	Carbonate as mg/litr	Nitrate as mg/litr	Turbidity As MTU	Organic Matters mg/litr
41	13.80	7.47	240	115.36	12.0	0.12	2.50	15.55
43	13.50	7.49	240	116.78	14.0	0.16	2.00	17.78
01	19.65	7.34	480	109.53	10.0	0.12	4.30	8.32
09	13.40	7.24	420	108.11	10.0	0.24	5.00	6.24
17	15.90	7.10	420	110.95	22.0	0.12	2.25	8.32
22	13.85	7.12	420	109.53	18.0	0.14	2.40	8.32
30	25.10	7.06	420	106.68	10.0	0.26	2.40	8.32
48	14.00	7.67	420	109.53	18.0	0.08	2.22	6.24
53	22.30	7.21	480	116.64	14.0	0.18	3.40	8.32
58	26.50	7.18	480	118.07	14.0	0.18	3.25	6.24

***BDL = Below Detection Limit**

It is seen that the values are on safe side with slightly higher sulphate content. **So, either Ordinary Portland cement or Portland slag cement or Portland Pozzolana cement (minimum cement content will be 330kg/m^3) can be used as per IS : 456. Alternatively, Supersulphated cement or Sulphate Resisting Portlant cement (minimum cement content will be 310 kg/m^3) can be used (as per IS : 456).**

5.10. POSSIBILITY OF SUBSOIL LIQUEFACTION DUE TO EARTHQUAKE:

Based on the subsoil condition and level of ground water table, it can be concluded that the site is not prone to liquefaction.

5.11. SUITABILITY OF EXISTING SOIL FOR FILLING AND BACK-FILLING:

The subsoil at the site is inorganic in nature & consists of silty clay with fine sand mixtures / clayey silty sand having low swelling properties. Thus the soil can be used for filling and back filling purposes with necessary compaction as required.

5.12. SUITABILITY OF SOIL FOR CONSTRUCTION OF ROADS & PAVEMENT:

The subsoil at the site is inorganic in nature & consists of silty clay with fine sand mixtures / clayey silty sand having low swelling properties. Thus the soil can be used for the construction of roads and pavement as a fill material.

In the laboratory, Standard & Modified proctor compaction tests were performed, using samples collected at a depth varying from 1-3m below ground level. The MDD ranges between 1.77 gm/cc to 1.86 gm/cc (standard proctor compaction tests) & 1.82 gm/cc to 1.96 gm/cc (modified proctor compaction tests).

Laboratory CBR tests were performed on remoulded soil samples (compacted at MDD) collected from site at soaked condition. The CBR values are in the range of 6% to 10% (for standard proctor compaction tests) & 14% to 21% (for modified proctor compaction tests).

Modified proctor test on fly ash shows OMC, MDD & CBR (4 days soaked) as 26.50%, 1.205 gm/cc & 15% respectively.

Considering the above, CBR value of 6% (for standard proctor compaction tests) and 14% (for modified proctor compaction tests) may be used for pavement subgrade design.

5.13. EXCAVATION:

For excavation in soil, a slope of 1(V):2(H) is to be adopted for the site with suitable berms, if required.

5.14. EARTH PRESSURE CO-EFFICIENT:

The Co-efficient of earth pressure at Active and Passive State are given below in a tabular form.

Layer	K_a	K_p
Layer – I	0.33	3.00
Layer – IIA	0.38	2.66
Layer – II	0.36	2.77
Layer – III	0.28	3.54
Layer – IV	0.35	2.88
Layer – V	0.27	3.69

6. SUMMARY & RECOMMENDATIONS

Based on the field tests and observation and the foregoing discussion the following are summarized.

1. The subsoil is characterised by a filled up soil followed by loose to medium dense silty sand. Then stiff / very stiff to hard clayey silt layer was found. A dense to very dense silty sand layer was observed below that. Again a hard clayey silt layer was observed there after. Underlying that, a very dense silty sand layer was struck and that continued upto the terminating depth of the boreholes.

2. The standing water level was struck at an average depth of about 16.42m below ground. So, construction of open foundation placed at 1.00m – 3.00m below existing level may not create any problem. However, if required, ordinary surface operated pumps will be able to tackle the situation.

3. Seven nos. (7). Plate Load Tests were conducted in the site (five nos. are of routine type & the rest two nos. are of cyclic type) and discussed in the previous section. Based on the above test results, the subgrade modulus for different foundation areas is presented below.

Test No.	Depth (M)	Subgrade Modulus, (kg/cucm)			
		Foundation Area = 1 sqm	Foundation Area = 4 sqm	Foundation Area = 5 sqm	Foundation Area = 10 sqm or above
PLT-01	3.00	1.47	0.74	0.66	0.46
PLT-02	3.00	1.07	0.54	0.48	0.34
PLT-03	3.00	0.61	0.30	0.27	0.19
PLT-04	3.00	0.47	0.24	0.21	0.15
PLT-05	3.00	2.32	1.16	1.04	0.73
CPLT-01	3.00	0.64	0.32	0.28	0.20
CPLT-02	3.00	0.65	0.32	0.29	0.20

4. Using the elastic rebound as we obtain from CPLT-01 to 02, the dynamic properties are calculated and presented below.

Test No.	Depth (M)	$C_{u\ (10sqm\ fdn.size)}$ (kg/cucm)
CPLT-01	3.00	1.420
CPLT-02	3.00	0.803

5. For major and heavily loaded structures, deep foundation in form of pile is suggested. Bored cast in-situ piles are preferred as discussed in the previous section.

6. The determination of pile capacity (vertical, uplift & lateral) is presented in the previous section. The recommended pile capacity values for different depths & pile diameters are presented below with a cut-off level (COL) of 3.50/6.50m below finished ground level (FGL).

Foundation Location	Length of pile below cut off level (M)	Pile Diameter (mm)	Recommended Pile Capacity, (T)		
			Vertical (T)	Uplift (T)	Lateral (T)
Chimney Area	23m (COL= 6.50)	600	150	95	7.00
BTG Area	23m (COL =6.50)	600	140	90	6.70
		760	200	125	9.80
Switch Yard cont. room & Switch Yard Area and Transformer Yard Area	23m (COL =3.50)	600	140	90	6.70
Effluent Treatment Plant Area	23m (COL =3.50)	600	115	75	5.40
Guard Pond, Air Washers, Space For Dm Plant, DMW Stg.Tanks, Chem. House etc., Side stream Filtration Plant, Clarified Water PH & FWPH , LFO & HFO Tank, IA/SA/MRS Compressor House Area	23m (COL =3.50)	600	150	85	7.00
CW Gas Chlorination Plant, DG Set, Service & Technical Bldg., FO Pressuring Pump House Area	23m (COL =3.50)	600	130	80	5.40
CW Pipe Corridor Area	13m (COL =3.50)	450	55	25	3.40
Pipe Rack Area	13m (COL =3.50)	450	30	20	3.40

Note: Pile capacity shall be confirmed by conducting Pile Load Test as per IS: 2911, Part-IV.

7. For minor & lightly loaded structures, open foundation may be used. The determination of bearing capacity is presented in the previous section. However this is further presented below.

A) Recommendation on bearing Capacity for foundations where EGL is below FGL (Area required Filling)

Foundation Location	D_f below EGL (M)	Width of Foundation (m)	NSBC (t/sqm)	NABC (t/sqm)		
				S=25mm	S=40mm	S=75mm
BTG / Chimney Area	Upto 1.50	Upto 6	--	5		
	2	Up to 2	11.78	10	10	--
		3-4	13.85	12	12	--
		5	15.07	11	15	--
		>6	16.34	--	16	16

Foundation Location	D_f below EGL (M)	Width of Foundation (m)	NSBC (t/sqm)	NABC (t/sqm)		
				S=25mm	S=40mm	S=75mm
BTG / Chimney Area	3	Up to 2	17.28	16	16	--
		3-4	18.54	18	18	--
		5	19.61	14	18	--
		>6	20.77	--	20	20
Switch Yard Control Room & Switch Yard, Transformer Yard	1	Up to 2	6.92	6	6	--
		3-4	9.47	9	9	--
		5	10.79	8	10	--
		>6	12.12	--	12	12
	2	Up to 2	11.78	10	10	--
		3-4	13.85	12	12	--
		5	15.07	11	15	--
		>6	16.34	--	16	16
	3	Up to 2	17.28	16	16	--
		3-4	18.54	18	18	--
		5	19.61	14	18	--
		>6	20.77	--	20	20
Effluent Treatment Plant	1	Upto 2	10.31	10	10	--
		3-4	9.84	7	11	--
		5	9.75	6	10	--
		>6	9.69	--	9	9
	2	Up to 2	43.85	12	12	--
		3-4	39.47	8	12	--
		5	38.60	7	10	--
		>6	38.02	--	10	10
	3	Up to 2	45.62	20	20	--
		3-4	40.37	16	18	--
		5	39.32	15	18	--
		>6	38.62	--	18	18
Guard Pond, Air Washers, Space For Dm Plant, DMW Stg.Tanks, Chem. House etc., Side stream Filtration Plant, Clarified Water PH & FWPH , LFO & HFO Tank, IA/SA/MRS Compressor House Area	1	Up to 2	6.92	6	6	--
		3-4	9.47	5	8	--
		5	10.79	5	8	--
		>6	12.12	--	9	12
	2	Up to 2	11.78	10	10	--
		3-4	13.85	7	11	--
		5	15.07	6	10	--
		>6	16.34	--	12	16
	3	Up to 2	17.28	14	16	--
		3-4	18.54	9	14	--
		5	19.61	8	13	--
		>6	20.77	--	15	20
CW Gas Chlorination Plant, DG Set, Service & Technical Bldg., FO Pressuring Pump House, CW Pipe Corridor Area	1	Upto 2	6.92	6	6	--
		3-4	9.47	5	8	--
		5	10.79	5	8	--
		>6	12.12	--	6	9
	2	Up to 2	11.78	10	10	--
		3-4	13.85	6	10	--
		5	15.07	5	9	--
		>6	16.34	--	10	16
	3	Up to 2	17.28	14	22	--
		3-4	18.54	8	13	--

Foundation Location	D_f below EGL (M)	Width of Foundation (m)	NSBC (t/sqm)	NABC (t/sqm)		
				S=25mm	S=40mm	S=75mm
	3	5	19.61	7	11	--
		>6	20.77	--	12	20
400 KV Extn. Switch Yard	1	Upto 2	6.92	6	6	--
		3-4	8.17	6	8	--
		5	10.79	6	10	--
		>6	12.12	--	10	12
	2	Up to 2	11.78	10	11	--
		3-4	12.71	7	11	--
		5	15.07	6	10	--
		>6	16.34	--	12	16
	3	Up to 2	17.28	15	17	--
		3-4	17.67	9	14	--
		5	19.61	8	13	--
		>6	20.77	--	15	20

B) Recommendation on bearing Capacity for foundations where EGL is above FGL (Area required Cutting)

Foundation Location	D_f below FGL (M)	Width of Foundation (m)	NSBC (t/sqm)	NABC (t/sqm)		
				S=25mm	S=40mm	S=75mm
Natural Draft Cooling Tower (NDCT)	1m	Upto 2	10.00	10	10	--
		3-4	14.15	14	14	--
		5	18.93	16	18	--
		>6	21.36	20	20	20
	2m	Up to 2	19.89	18	18	--
		3-4	21.63	20	20	--
		5	25.98	22	25	--
		>6	28.30	28	28	28
	3m	Up to 2	29.01	28	28	--
		3-4	29.84	28	28	--
		5	32.79	30	30	--
		>6	32.21	30	30	30
	4-5m	Up to 2	114.46	45	45	--
		3-4	98.14	45	45	--
		5	94.87	42	45	--
		>6	92.69	42	45	45
Store, Retaining Wall & Equipment Laydown Space	1m	Up to 2	89.83	35	40	--
		3-4	85.75	32	38	--
		5	84.93	30	35	--
		>6	84.39	--	35	40
	2m	Up to 2	98.04	40	40	--
		3-4	89.88	38	38	--
		5	88.24	35	35	--
		>6	87.16	--	35	40
	3m	Up to 2	106.25	45	45	--
		3-4	94.01	40	40	--
		5	91.56	38	38	--
		>6	89.92	--	40	45

Foundation Location	D_f below FGL (M)	Width of Foundation (m)	NSBC (t/sqm)	NABC (t/sqm)		
				S=25mm	S=40mm	S=75mm
FO Transfer Pump House	1-2m	Upto 2	25.80	25	25	--
		3-4	36.66	35	35	--
		5	37.87	35	35	--
		>6	37.41	--	35	35
	3m	Upto 2	45.62	45	45	--
		3-4	40.37	40	40	--
		5	39.32	38	38	--
		>6	38.62	--	38	38
Space for service water pumps, New clarifier pumps, CW chlorination Plant Area	1m	Upto 2	10.00	10	10	--
		3-4	14.15	10	14	--
		5	18.93	9	14	--
		>6	21.36	--	16	20
	2m	Up to 2	19.89	18	18	--
		3-4	21.63	12	18	--
		5	25.98	10	16	--
		>6	28.30	--	18	28
	3m	Up to 2	29.01	26	28	--
		3-4	29.84	14	22	--
		5	33.46	12	18	--
		>6	35.60	--	20	35

Note:

a) NSBC = Net Safe Bearing Capacity
b) NABC = Net Allowable Bearing Capacity
c) S = Limiting Settlement.

8. Swelling pressure and Free Swelling Index tests have been performed on sufficient samples over the entire zone of investigation. The average swelling pressure and Free Swelling Index as found from the tests are 0.38 kg/sqcm & 14.63% respectively. Thus, the subsoil has low swelling characteristics. So, no problem with respect to heaving of the subsoil is anticipated.

9. Chemical tests were carried out on a few soil and water samples to detect the **pH value, Sulphate, Chloride, Organic matter etc.** It is seen that the values are on safe side with slightly higher sulphate content. **So, either Ordinary Portland cement or Portland slag cement or Portland Pozzolana cement (minimum cement content will be 330kg/m^3) can be used as per IS:456. Alternatively, Supersulphated cement or Sulphate Resisting Portlant cement (minimum cement content will be 310 kg/m^3) can be used (as per IS:456).**

10. 8 (eight) nos. field permeability tests were carried out in 4nos. BH and the test results are presented in the previous section.

11. The suitability of existing soil for filling and back-filling is given in Section 5.11

12. The suitability of soil for construction of roads & pavement is discussed in Section 5.12

13. The discussion on Excavation scheme to be adopted is given in Section 5.13
14. The calculation of earth pressure for deep excavation is given in Section 5.14.
15. The Electrical Resistivity Test Results are presented in Section - 7.
16. The Seismic Refraction Test Results are discussed in Section – 8.
17. The Pressure Meter Test Results are discussed in Section – 9.
18. The Block Vibration Test Results are discussed in Section – 10.
19. The geology of the area is discussed in Section – 11.

For C. E. Testing Company Private Limited,

Prepared By	**Checked By**	**Approved By**
(B. BANERJEE)	**(S. NATH)**	**(DR. M. NAYAK)**

7. ELECTRICAL RESISTIVITY TEST

REPORT ON
ELECTRICAL RESISTIVITY TEST (ERT) FOR THE PROPOSED 1 x 800MW WANAKBORI TPS, GUJARAT.

INTRODUCTION:

Electrical Resistivity Test was carried out for proposed 1X800 MW TPS at Wanakbori, in the state of Gujarat on 06/11/2014 to 10/11/2014 using resistivity meter (model DDR3, IGIS) and following Indian standard at thirty one (37) locations.

METHODOLOGY:

The Soil Resistivity Survey is a method to find out the Electrical Resistivity (Specific Resistance) of a medium. It is the resistance offered by a unit cube of a particular medium (so called strata below the ground level) when a unit current passes perpendicular to the surface of a cross-sectional area A. The relation is given by Ohm's Law is –

$$\rho = R \text{ ohm} \frac{A}{l} = \text{ohm} \frac{m^2}{m} = \text{ohm} - m \text{ where}$$

ρ= Resistivity, R = resistance offered by the medium of length L and Cross-sectional area A.

In electrical resistivity survey a known current I (direct current or low frequency alternating current) is sent into the ground through a pair of current electrodes A & B and the potential difference (∆V) created in the medium is measured between another pair of electrodes M & N. The resistivity of the formation is then given

by $\rho = K \frac{\Delta V}{I}$ where ρ is the apparent resistivity, K is the geometric factor.

In the Earth Resistivity Test, the Wenner configuration was followed. In this configuration two potential electrodes M & N are placed in a line with the current electrodes A & B, all four being situated equidistance from one to another and disposed symmetrically with respect to a central point such that AM=MN=NB=a . The outer two electrodes A & B were used for

sending current (I) and inner two M & N were used for measuring the potential differences (ΔV). The distance between each consecutive electrode (a) was kept constant and was progressively increased to reach the depth at which resistivity information are wanted. Suitable electrode spacing determines the conductivity of the top soil as well as the various subsurface layers occurring in the area under study. At each location, 4 sets of observations were taken for each of the electrode spacing (a) in four directions (N-S,E-W,NE-SW and NW-SE) and in six different electrode spacing viz,: a = 1.0m, 2.0m, 3.0m, 4.0m, 5.0m, 7.0m and 10.0m were used to know the nature of change of resistivity.

The apparent resistivity was determined by the formula –

$\rho = 6.28\ a \frac{\Delta V}{I}$ where 'a' is the distance between the two consecutive Electrodes and $\frac{\Delta V}{I}$ is R which is the observed resistance for measuring resistivity. A The mean value of the resistivity estimated was taken as the representative one.

The depth of investigation in an isotropic and homogeneous formation can be approximated to the distance between the consecutive two electrodes (a).

GEOLOGY:

The area where the investigation was conducted was full of ash and transported material on the top up to considerable depth. Area is covered with soil and at places thick overburden of loose ash right at the ground surface. This top soil extends up to almost 40 cm bgl and below that it is only red coloured soil - a sticky clay variety. Such sandy ground surface continues further below the ground level. This depicts that, this subsurface layer below that top soil is partly water saturated sandy clay. It continues further below. Summarized result of the resistivity measurements at different locations in the area are given in the following tables.

Here it may be indicated that in case of highly resistive formations, current penetrates much deeper into the earth than when the subsurface formations are conducting. Further, in the present investigation only apparent resistivity is measured which may be taken (as a first approximation) as the weighted average of the true resistivity of the subsurface formations in which current lines flow.

INTERPRETATION:

ERT observations were taken on 31 (Thirty one) locations distributed over the different locations as given in the work schedule of the Client and for direction of observations also followed the same work schedule.

The summarized result of the resistivity measurements along with the co-ordinates and the RL at different locations are given in the table annexed hereto.

All the ERT curves are plotted as "a" (m) vs. ρ (ohm-m) and are exhibited in the form plates annexed hereto. It may also please be noted that in the present investigation we have measured only the apparent resistivity which may be taken as a first approximation to the weighted average of the true resistivity of the subsurface stratums in which the current lines flow. There were much of hindrance and constraint in laying of line due to dumps.

In general, all the ERT curves exhibit the nature of Q-type curves which is indicative of the fact that the resistivity gradually decreases with depth up to a certain depth, then again decreases or remains the same with very little fluctuation and becomes asymptotic to the abscissa.

CONCLUSION:-

The first criteria for earthing purpose is that, the zones of high resistivity are to be avoided and discarded and should hunt for the zone of steady resistivity of so called UNIFORM LAYER. The average apparent resistivity of uniform soil should be considered as correct computation of resistivity to be used in design calculation. It is not the average of all the apparent resistivity values revealed from top to bottom layers. It is only the average of apparent resistivities of so called uniform soil occurring at a particular depth below the ground level at a particular depth when for few consecutive electrodes spacing (with the gradual increase of electrode spacing) the resistivity variations are within 20 to 30 percent, the soil, at that depth, in the vicinity of the test location is to be considered as uniform one. When the electrode spacing is increased gradually from low values, at a stage, it may be found that the resistivity readings are more or less constant (variations are within 20 to 30 %) irrespective of the increase in the electrode spacing. Such type of uniform soil, the corresponding average apparent resistivity and the corresponding average depth are of prime importance for design purpose. Keeping in view of the necessity of detection of

Uniform Soil, one should give a keen and close look in the tables to discern where the apparent resistivity readings for different electrode spacing in a direction is within 20 to 30 percent and the soil at that level will have to be considered as uniform. Such type of Uniform Soil was envisaged and corresponding average resistivities of that particular layer were deciphered and tabulated below.

It can be concluded that the mean apparent resistivity of the uniform soil for different ERT locations are as hereunder:–

Sl. No.	ERT Location	Overall Mean Resistivity (Ohm – m)	Sl. No.	ERT Location	Overall Mean Resistivity (Ohm – m)
1.	ERT- 01	101.94	20.	ERT- 20	122.66
2.	ERT- 02	56.66	21.	ERT- 21	40.54
3.	ERT- 03	60.10	22.	ERT- 22	34.99
4.	ERT- 04	67.00	23.	ERT- 23	62.72
5.	ERT- 05	70.28	24.	ERT- 24	58.54
6.	ERT- 06	34.28	25.	ERT- 25	50.01
7.	ERT- 07	65.79	26.	ERT- 26	41.19
8.	ERT- 08	45.46	27.	ERT- 27	85.43
9.	ERT- 09	40.21	28.	ERT- 28	54.77
10.	ERT- 10	54.56	29.	ERT- 29	53.91
11.	ERT- 11	87.30	30.	ERT- 30	21.80
12.	ERT- 12	141.95	31.	ERT- 31	61.29
13.	ERT- 13	114.68	32.	ERT- 32	78.08
14.	ERT- 14	134.56	33.	ERT- 33	72.55
15.	ERT- 15	44.20	34.	ERT- 34	56.10
16.	ERT- 16	43.70	35.	ERT- 35	74.53
17.	ERT- 17	34.31	36.	ERT- 36	73.18
18.	ERT- 18	578.23	37.	ERT- 37	59.88
19.	ERT- 19	77.41			

APPARENT RESISTIVITY VALUES

ERT No. 01

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	523.33	496.28	322.68	352.87	423.79
2	2.0	271.51	238.83	89.25	115.64	178.81
3	3.0	75.44	58.47	26.40	37.72	49.51
4	4.0	15.08	12.57	17.60	22.63	16.97
5	5.0	15.72	15.72	12.57	15.72	14.93
6	7.0	17.60	17.60	13.20	13.20	15.40
7	10.0	18.86	12.57	12.57	12.57	14.14

Mean Resistivity at ERT-01 is 101.94 Ohm - m.

ERT No. 02

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	70.32	75.98	65.67	73.66	71.41
2	2.0	69.39	74.04	64.11	65.24	68.20
3	3.0	62.05	64.31	59.22	62.24	61.96
4	4.0	60.84	65.36	57.57	61.09	61.22
5	5.0	56.57	61.60	56.26	59.40	58.46
6	7.0	39.60	44.00	43.12	45.76	43.12
7	10.0	30.80	32.06	32.69	33.32	32.22

Mean Resistivity at ERT-02 is 56.65 Ohm - m.

ERT No. 03

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	100.64	93.09	81.77	80.51	89.00
2	2.0	74.16	64.11	71.65	76.68	71.65
3	3.0	71.67	56.58	75.44	79.21	70.73
4	4.0	67.88	62.85	62.85	67.88	65.37
5	5.0	62.86	56.57	53.43	59.72	58.15
6	7.0	48.40	44.00	30.80	39.60	40.70
7	10.0	31.43	25.14	18.86	25.14	25.14

Mean Resistivity at ERT-03 is 60.10 Ohm - m.

ERT No. 04

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	167.94	181.78	163.54	151.59	166.21
2	2.0	93.02	100.56	89.25	82.96	91.45
3	3.0	56.58	66.01	60.35	54.69	59.41
4	4.0	45.25	52.79	50.28	45.25	48.39
5	5.0	37.72	47.15	37.72	31.43	38.51
6	7.0	35.20	39.60	35.20	30.80	35.20
7	10.0	31.43	37.72	25.14	25.14	29.86

Mean Resistivity at ERT-04 is 67.00 Ohm - m.

ERT No. 05

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	125.17	138.38	93.72	106.30	115.89
2	2.0	78.94	83.09	81.71	84.09	81.96
3	3.0	73.37	75.06	77.51	81.48	76.86
4	4.0	73.41	75.42	74.41	74.16	74.35
5	5.0	63.17	69.15	60.97	63.17	64.12
6	7.0	44.00	47.52	45.76	48.40	46.42
7	10.0	32.06	33.32	31.43	32.69	32.38

Mean Resistivity at ERT-05 is 70.28 Ohm - m.

ERT No. 06

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	59.00	56.11	60.57	57.93	58.40
2	2.0	55.31	53.80	57.70	51.91	54.68
3	3.0	42.25	40.17	45.45	43.38	42.81
4	4.0	30.17	25.89	36.70	32.93	31.42
5	5.0	18.86	17.29	22.63	18.86	19.41
6	7.0	15.84	13.64	17.60	15.40	15.62
7	10.0	17.60	15.72	20.12	16.97	17.60

Mean Resistivity at ERT-6 is 34.28 Ohm - m.

ERT No. 07

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	150.96	164.17	149.07	147.82	153.01
2	2.0	86.73	90.50	81.71	82.96	85.48
3	3.0	56.58	62.24	66.01	67.90	63.18
4	4.0	55.31	62.85	55.31	50.28	55.94
5	5.0	47.15	53.43	44.00	40.86	46.36
6	7.0	35.20	39.60	30.80	26.40	33.00
7	10.0	25.14	31.43	18.86	18.86	23.57

Mean Resistivity at ERT-7 is 65.79 Ohm - m.

ERT No. 08

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	91.27	68.12	76.61	70.45	76.61
2	2.0	50.15	51.79	51.16	52.54	51.41
3	3.0	43.38	73.93	43.94	51.11	53.09
4	4.0	39.72	38.46	43.24	41.73	40.79
5	5.0	35.20	33.00	37.09	32.06	34.34
6	7.0	30.80	28.60	31.68	30.36	30.36
7	10.0	32.69	29.54	33.32	30.80	31.59

Mean Resistivity at ERT-8 is 45.46 Ohm - m.

ERT No. 09

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	91.83	85.54	88.04	83.03	87.11
2	2.0	42.74	49.02	46.51	40.22	44.62
3	3.0	45.26	33.95	45.26	39.61	41.02
4	4.0	40.22	27.65	30.17	27.65	31.42
5	5.0	34.57	22.00	31.43	25.14	28.29
6	7.0	35.20	26.40	30.80	22.00	28.60
7	10.0	18.86	25.14	18.86	18.86	20.43

Mean Resistivity at ERT-9 is 40.21 Ohm - m.

ERT No. 10

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	103.91	120.64	112.59	120.14	114.32
2	2.0	116.78	90.50	90.50	85.48	95.82
3	3.0	75.25	62.24	62.24	71.67	67.85
4	4.0	30.17	30.17	25.14	35.20	30.17
5	5.0	28.92	25.14	22.00	25.14	25.30
6	7.0	24.64	22.88	17.60	22.00	21.78
7	10.0	31.43	25.14	25.14	25.14	26.71

Mean Resistivity at ERT-10 is 54.56 Ohm - m.

ERT No. 11

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	293.11	208.83	261.04	244.05	251.76
2	2.0	183.52	163.41	153.35	139.53	159.95
3	3.0	79.21	92.41	98.07	86.76	89.11
4	4.0	45.25	47.77	50.28	45.25	47.14
5	5.0	37.72	25.14	25.14	18.86	26.72
6	7.0	13.20	17.60	22.00	17.60	17.60
7	10.0	12.57	18.86	25.14	18.86	18.86

Mean Resistivity at ERT-11 is 87.30 Ohm - m.

ERT No. 12

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	255.37	248.46	261.66	252.23	254.43
2	2.0	240.09	225.00	247.63	214.95	231.92
3	3.0	118.82	111.27	122.59	111.27	115.99
4	4.0	100.56	93.02	110.62	103.07	101.82
5	5.0	106.86	94.29	119.43	106.86	106.86
6	7.0	96.80	88.00	105.60	88.00	94.60
7	10.0	94.29	75.43	94.29	88.00	88.00

Mean Resistivity at ERT-12 is 141.95 Ohm - m.

ERT No. 13

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	192.47	183.04	197.51	188.07	190.27
2	2.0	201.12	194.84	188.55	182.27	191.70
3	3.0	150.88	139.56	152.65	148.99	148.02
4	4.0	98.05	85.48	103.07	100.56	96.79
5	5.0	84.86	78.58	91.15	84.86	84.86
6	7.0	57.20	48.40	61.60	52.80	55.00
7	10.0	37.72	31.43	44.00	31.43	36.15

Mean Resistivity at ERT-13 is 114.68 Ohm - m.

ERT No. 14

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	462.94	441.56	468.61	452.25	456.34
2	2.0	196.09	175.98	196.09	178.49	186.66
3	3.0	96.19	90.53	86.76	81.10	88.65
4	4.0	82.96	80.45	70.39	62.85	74.16
5	5.0	62.86	56.57	59.72	53.43	58.15
6	7.0	48.40	39.60	44.00	35.20	41.80
7	10.0	44.00	31.43	37.72	31.43	36.15

Mean Resistivity at ERT-14 is 134.56 Ohm - m.

ERT No. 15

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	78.44	75.29	76.74	73.84	76.08
2	2.0	61.09	56.06	59.20	55.56	57.98
3	3.0	41.49	39.98	41.87	39.61	40.74
4	4.0	35.20	32.93	34.44	33.69	34.07
5	5.0	37.40	36.14	37.09	36.14	36.69
6	7.0	32.56	30.80	31.68	30.80	31.46
7	10.0	33.32	31.43	32.69	32.06	32.38

Mean Resistivity at ERT-15 is 44.20 Ohm - m.

ERT No. 16

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	74.60	77.74	76.17	73.66	75.54
2	2.0	55.31	60.46	59.33	53.93	57.26
3	3.0	38.66	43.57	41.68	39.98	40.97
4	4.0	34.44	35.70	34.69	32.93	34.44
5	5.0	33.00	36.46	34.89	33.63	34.50
6	7.0	31.24	33.00	31.68	30.36	31.57
7	10.0	31.43	32.69	32.06	30.17	31.59

Mean Resistivity at ERT-16 is 43.70 Ohm - m.

ERT No. 17

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	32.90	35.29	35.73	34.66	34.65
2	2.0	31.43	32.56	34.94	34.06	33.25
3	3.0	33.01	33.95	31.12	30.55	32.16
4	4.0	35.20	36.20	33.69	32.68	34.44
5	5.0	34.89	35.52	36.46	34.57	35.36
6	7.0	35.20	36.08	37.84	35.64	36.19
7	10.0	33.32	33.94	35.20	33.94	34.10

Mean Resistivity at ERT-17 is 34.31 Ohm - m.

ERT No. 18

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	483.70	516.41	544.71	578.68	530.88
2	2.0	483.95	507.83	476.40	494.00	490.55
3	3.0	646.90	671.42	622.38	699.71	660.10
4	4.0	623.47	676.27	590.79	678.78	642.33
5	5.0	628.60	694.60	691.46	726.03	685.17
6	7.0	448.80	567.60	440.00	422.40	469.70
7	10.0	540.60	616.03	509.17	609.74	568.89

Mean Resistivity at ERT-18 is 578.23 Ohm - m.

ERT No. 19

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	231.47	205.68	344.06	311.98	273.30
2	2.0	93.02	86.73	110.62	99.30	97.42
3	3.0	71.67	62.24	50.92	47.15	58.00
4	4.0	50.28	42.74	32.68	27.65	38.34
5	5.0	31.43	25.14	18.86	15.72	22.79
6	7.0	26.40	30.80	22.00	22.00	25.30
7	10.0	25.14	31.43	25.14	25.14	26.71

Mean Resistivity at ERT-19 is 77.41 Ohm - m.

ERT No. 20

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	457.91	553.52	451.62	484.96	487.00
2	2.0	351.96	113.13	147.07	128.21	185.09
3	3.0	150.88	60.35	84.87	77.33	93.36
4	4.0	50.28	27.65	40.22	32.68	37.71
5	5.0	25.14	18.86	22.00	18.86	21.22
6	7.0	17.60	17.60	22.00	17.00	18.55
7	10.0	18.86	12.57	18.86	12.57	15.72

Mean Resistivity at ERT-20 is 122.66 Ohm - m.

ERT No. 21

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	80.20	62.65	67.62	68.06	69.63
2	2.0	57.07	58.95	60.96	64.74	60.43
3	3.0	42.44	43.76	45.64	49.98	45.46
4	4.0	31.68	34.19	34.44	36.45	34.19
5	5.0	31.43	27.97	24.52	28.92	28.21
6	7.0	30.36	22.88	21.56	23.76	24.64
7	10.0	22.63	22.00	18.86	21.37	21.22

Mean Resistivity at ERT-21 is 40.54 Ohm - m.

ERT No. 22

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	118.00	90.95	95.10	103.53	101.90
2	2.0	59.58	43.12	54.81	41.98	49.87
3	3.0	43.00	28.86	31.12	28.48	32.87
4	4.0	26.40	20.11	20.61	19.36	21.62
5	5.0	15.40	15.72	15.09	11.31	14.38
6	7.0	10.56	12.32	11.44	10.12	11.11
7	10.0	14.46	12.57	12.57	13.20	13.20

Mean Resistivity at ERT-22 is 34.99 Ohm - m.

ERT No. 23

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	160.40	276.76	176.12	236.50	212.45
2	2.0	45.25	90.50	50.28	101.82	71.96
3	3.0	33.95	94.30	30.18	86.76	61.30
4	4.0	31.93	50.28	25.14	40.22	36.89
5	5.0	25.14	44.00	18.86	22.00	27.50
6	7.0	17.60	13.20	13.20	8.80	13.20
7	10.0	18.86	18.86	12.57	12.57	15.72

Mean Resistivity at ERT-23 is 62.72 Ohm - m.

ERT No. 24

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	174.23	193.10	305.69	271.73	236.19
2	2.0	50.28	71.65	74.41	85.48	70.46
3	3.0	34.14	26.40	20.75	22.63	25.98
4	4.0	35.20	17.60	23.13	27.65	25.90
5	5.0	37.72	18.86	11.94	12.57	20.27
6	7.0	13.20	13.20	12.76	13.20	13.09
7	10.0	17.60	16.34	18.86	18.86	17.92

Mean Resistivity at ERT-24 is 58.54 Ohm - m.

ERT No. 25

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	58.25	84.54	47.24	63.59	63.41
2	2.0	74.41	54.81	77.93	73.28	70.11
3	3.0	54.32	53.75	66.01	69.22	60.83
4	4.0	45.75	53.80	48.52	55.81	50.97
5	5.0	36.77	49.35	38.97	44.63	42.43
6	7.0	30.80	30.80	35.20	36.96	33.44
7	10.0	28.29	30.17	27.66	29.54	28.92

Mean Resistivity at ERT-25 is 50.01 Ohm - m.

ERT No. 26

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	76.42	74.60	77.43	74.98	75.86
2	2.0	47.77	45.13	49.53	44.25	46.67
3	3.0	37.91	36.02	39.98	37.72	37.91
4	4.0	34.69	33.44	35.70	32.43	34.07
5	5.0	33.94	30.80	35.52	34.26	33.63
6	7.0	29.48	28.16	30.80	30.36	29.70
7	10.0	30.80	29.54	31.43	30.17	30.49

Mean Resistivity at ERT-26 is 41.19 Ohm - m.

ERT No. 27

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	478.67	375.51	259.15	580.57	423.48
2	2.0	57.82	101.82	125.70	111.87	99.30
3	3.0	24.89	21.88	15.09	33.95	23.95
4	4.0	15.59	11.56	7.04	12.57	11.69
5	5.0	12.57	11.94	11.31	9.43	11.31
6	7.0	14.08	14.08	13.20	8.80	12.54
7	10.0	17.60	17.60	15.09	12.57	15.72

Mean Resistivity at ERT-27 is 85.43 Ohm - m.

ERT No. 28

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	75.29	80.51	79.38	81.20	79.10
2	2.0	62.72	66.37	64.36	66.75	65.05
3	3.0	53.00	54.69	54.32	55.83	54.46
4	4.0	45.25	47.77	46.76	48.02	46.95
5	5.0	42.43	44.63	43.69	44.32	43.77
6	7.0	44.00	45.32	43.56	44.88	44.44
7	10.0	48.40	50.92	49.03	50.29	49.66

Mean Resistivity at ERT-28 is 54.77 Ohm - m.

ERT No. 29

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	131.46	123.28	135.24	125.17	128.79
2	2.0	64.11	59.08	69.14	62.86	63.80
3	3.0	49.04	43.38	54.69	45.26	48.09
4	4.0	47.77	40.22	57.82	52.79	49.65
5	5.0	31.43	31.43	37.72	34.57	33.79
6	7.0	30.80	26.40	35.20	26.40	29.70
7	10.0	25.14	25.14	25.14	18.86	23.57

Mean Resistivity at ERT-29 is 53.91 Ohm - m.

ERT No. 30

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	74.85	27.68	65.42	55.35	55.83
2	2.0	22.63	18.86	22.63	20.11	21.06
3	3.0	22.63	16.97	11.32	11.32	15.56
4	4.0	12.57	15.08	12.57	10.06	12.57
5	5.0	12.57	15.72	12.57	12.57	13.36
6	7.0	8.80	17.60	22.00	13.20	15.40
7	10.0	12.57	18.86	25.14	18.86	18.86

Mean Resistivity at ERT-30 is 21.80 Ohm - m.

ERT No. 31

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	82.08	79.57	137.50	143.03	110.55
2	2.0	66.87	63.10	70.39	73.16	68.38
3	3.0	64.12	61.11	67.52	69.40	65.54
4	4.0	51.29	49.78	50.28	52.29	50.91
5	5.0	48.40	46.52	47.15	49.03	47.78
6	7.0	45.76	44.00	44.88	46.64	45.32
7	10.0	41.49	40.23	38.97	41.49	40.55

Mean Resistivity at ERT-31 is 61.29 Ohm - m.

ERT No. 32

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	132.47	130.58	130.96	131.71	131.43
2	2.0	112.38	119.42	113.13	113.88	114.70
3	3.0	84.12	88.26	89.40	86.38	87.04
4	4.0	59.33	79.95	78.94	71.40	72.41
5	5.0	52.80	69.15	63.49	62.86	62.08
6	7.0	40.48	44.88	47.52	45.76	44.66
7	10.0	31.43	36.46	35.20	33.94	34.26

Mean Resistivity at ERT-32 is 78.08 Ohm - m.

ERT No. 33

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	114.10	126.05	113.85	104.04	114.51
2	2.0	97.79	98.29	95.28	95.78	96.79
3	3.0	89.02	84.49	87.51	89.77	87.70
4	4.0	79.95	76.93	49.78	81.45	72.03
5	5.0	60.35	67.89	36.46	64.12	57.21
6	7.0	49.28	51.92	35.20	50.16	46.64
7	10.0	35.20	37.72	25.14	33.94	33.00

Mean Resistivity at ERT-33 is 72.55 Ohm - m.

ERT No. 34

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	69.57	73.84	61.77	66.55	67.93
2	2.0	62.85	36.08	66.87	70.39	59.05
3	3.0	69.40	65.26	64.50	45.64	61.20
4	4.0	63.86	57.82	63.35	55.81	60.21
5	5.0	59.09	56.57	57.83	56.57	57.52
6	7.0	47.52	48.40	48.40	43.12	46.86
7	10.0	45.26	37.72	40.23	36.46	39.92

Mean Resistivity at ERT-34 is 56.10 Ohm - m.

ERT No. 35

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	100.26	96.11	152.09	151.34	124.95
2	2.0	97.29	84.22	111.62	105.84	99.74
3	3.0	82.98	84.49	96.56	94.30	89.58
4	4.0	75.92	62.85	68.10	70.39	69.32
5	5.0	66.00	61.60	44.00	50.29	55.47
6	7.0	49.28	50.16	44.00	41.36	46.20
7	10.0	37.72	36.46	42.74	28.92	36.46

Mean Resistivity at ERT-35 is 74.53 Ohm - m.

ERT No. 36

Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	152.22	155.36	93.72	94.35	123.91
2	2.0	106.34	105.59	85.48	85.48	95.72
3	3.0	86.38	81.85	82.61	83.36	83.55
4	4.0	71.90	69.89	77.93	62.85	70.64
5	5.0	57.83	56.57	64.75	62.86	60.50
6	7.0	41.36	39.60	47.52	48.40	44.22
7	10.0	36.69	31.43	33.94	32.69	33.69

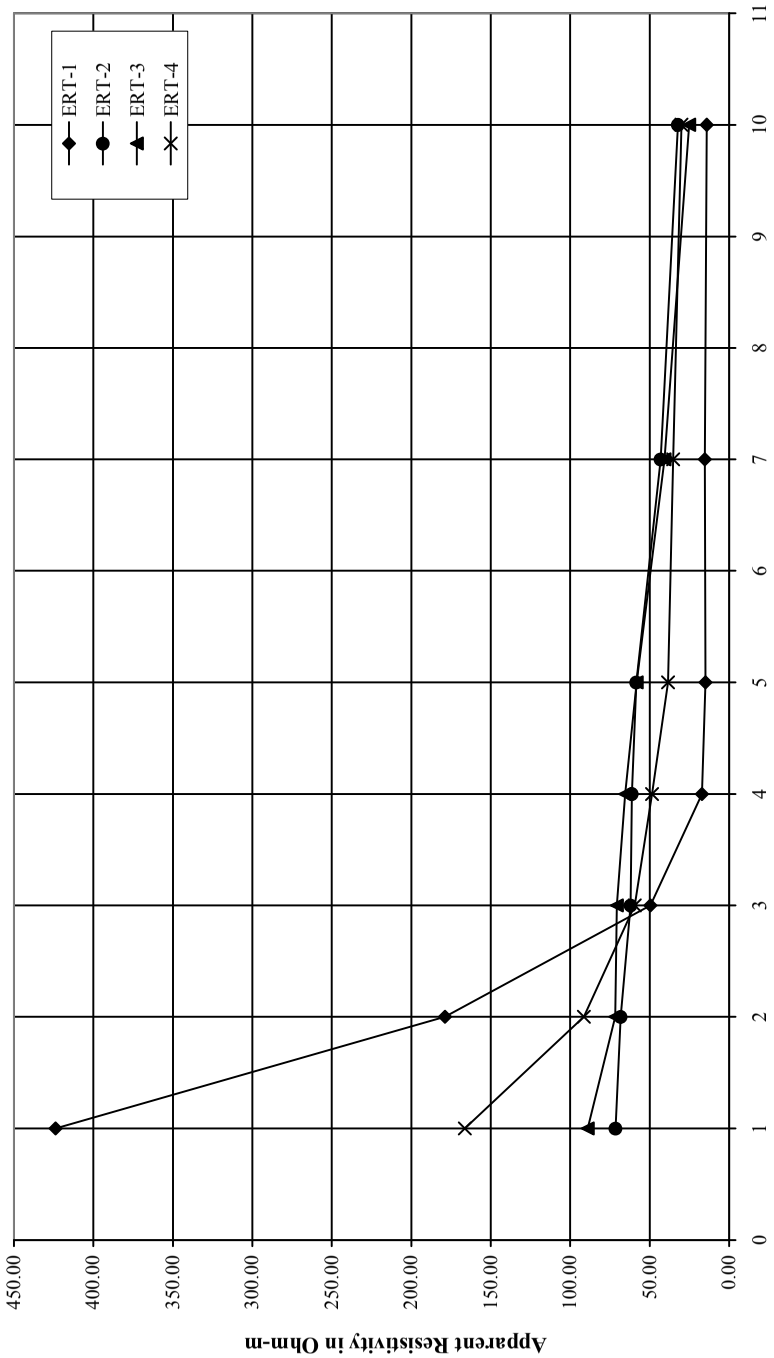
Mean Resistivity at ERT-36 is 73.18 Ohm - m.

ERT No. 37

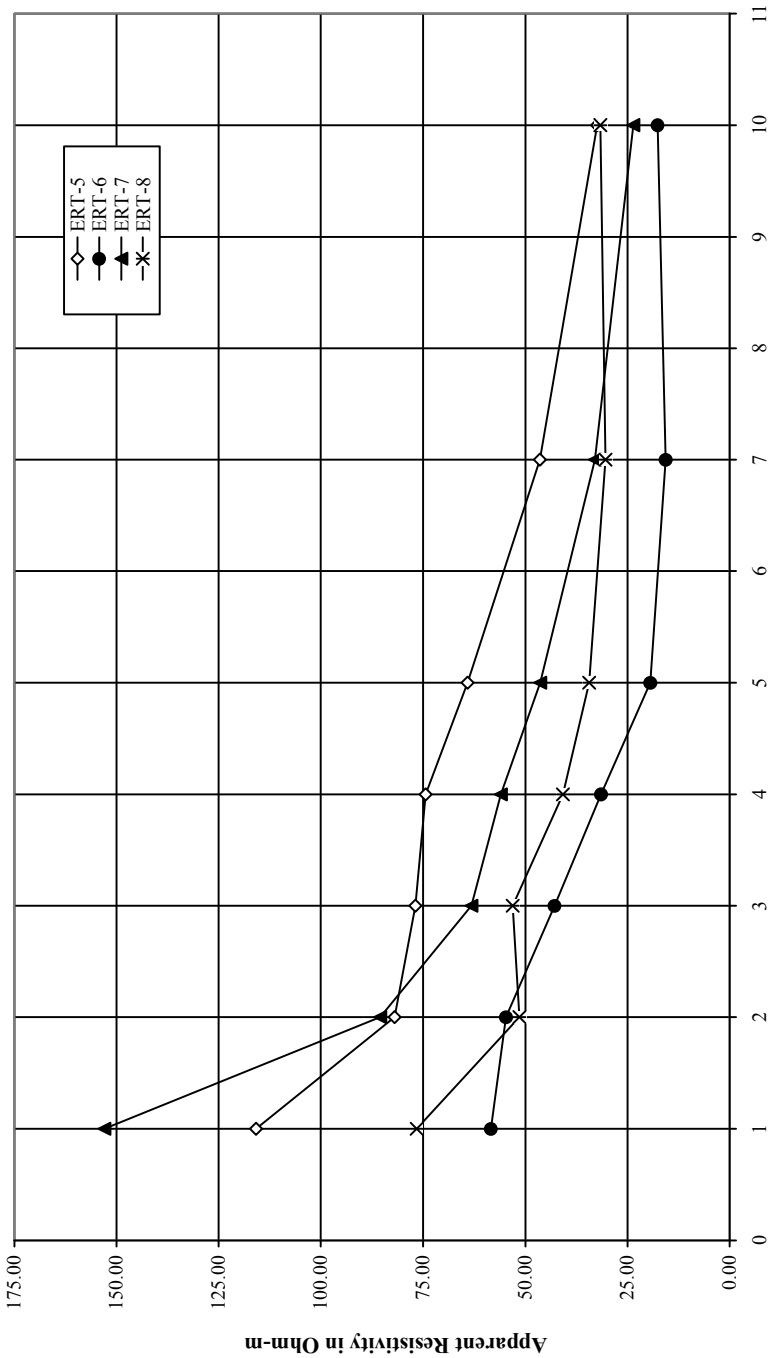
Sl No.	S (M)	Apparent Electrical Resistivity (Ohm-m)				
		(N - S)	(E - W)	(NE - SW)	(NW - SE)	Mean
1	1.0	82.90	108.82	99.00	83.78	93.63
2	2.0	85.48	67.12	75.42	70.89	74.73
3	3.0	75.06	66.01	51.68	67.90	65.16
4	4.0	68.88	58.83	43.74	55.81	56.82
5	5.0	59.72	56.57	31.43	50.29	49.50
6	7.0	46.64	44.00	27.28	44.88	40.70
7	10.0	42.74	37.72	33.94	40.23	38.66

Mean Resistivity at ERT-37 is 59.88 Ohm - m.

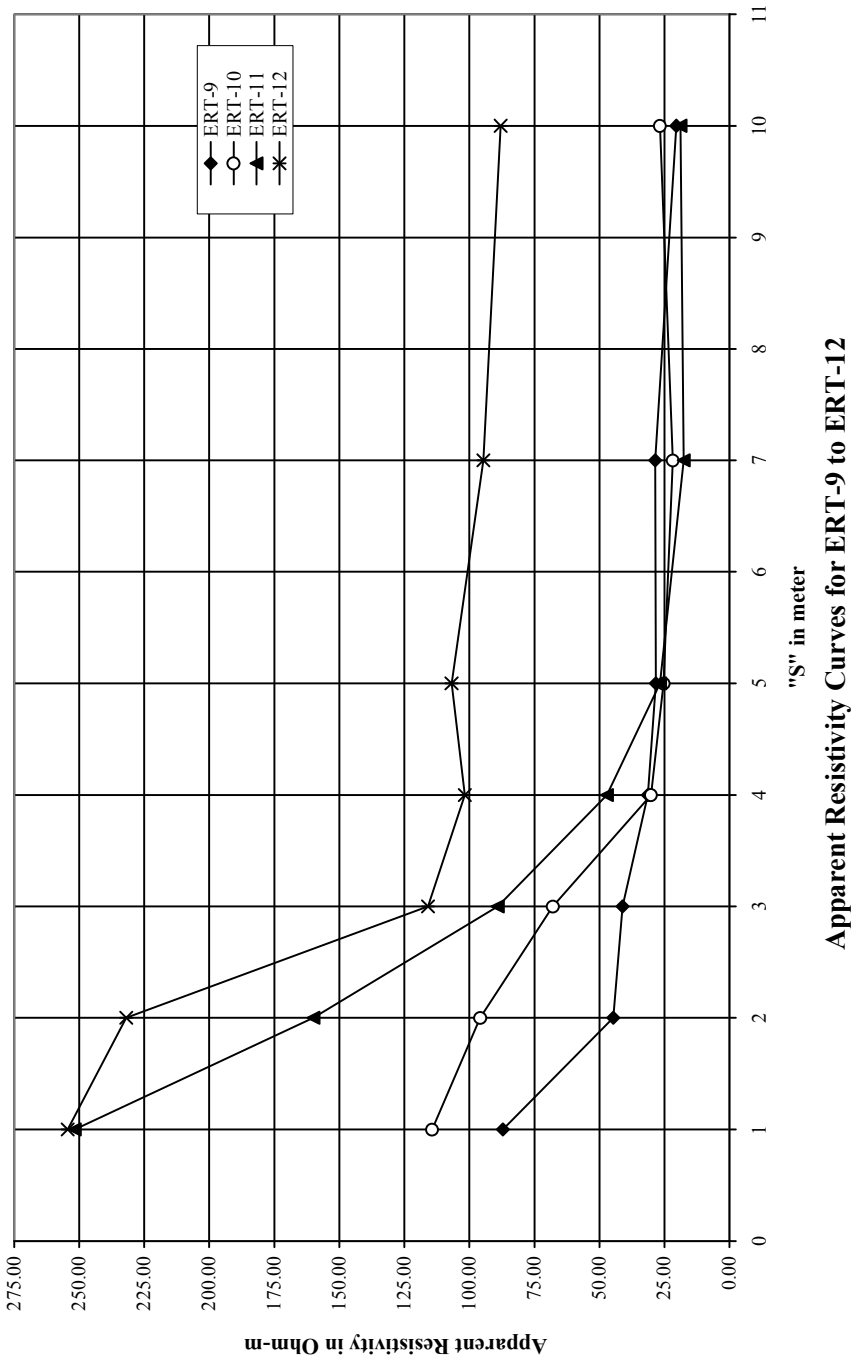
APPARENT RESISTIVITY CURVES



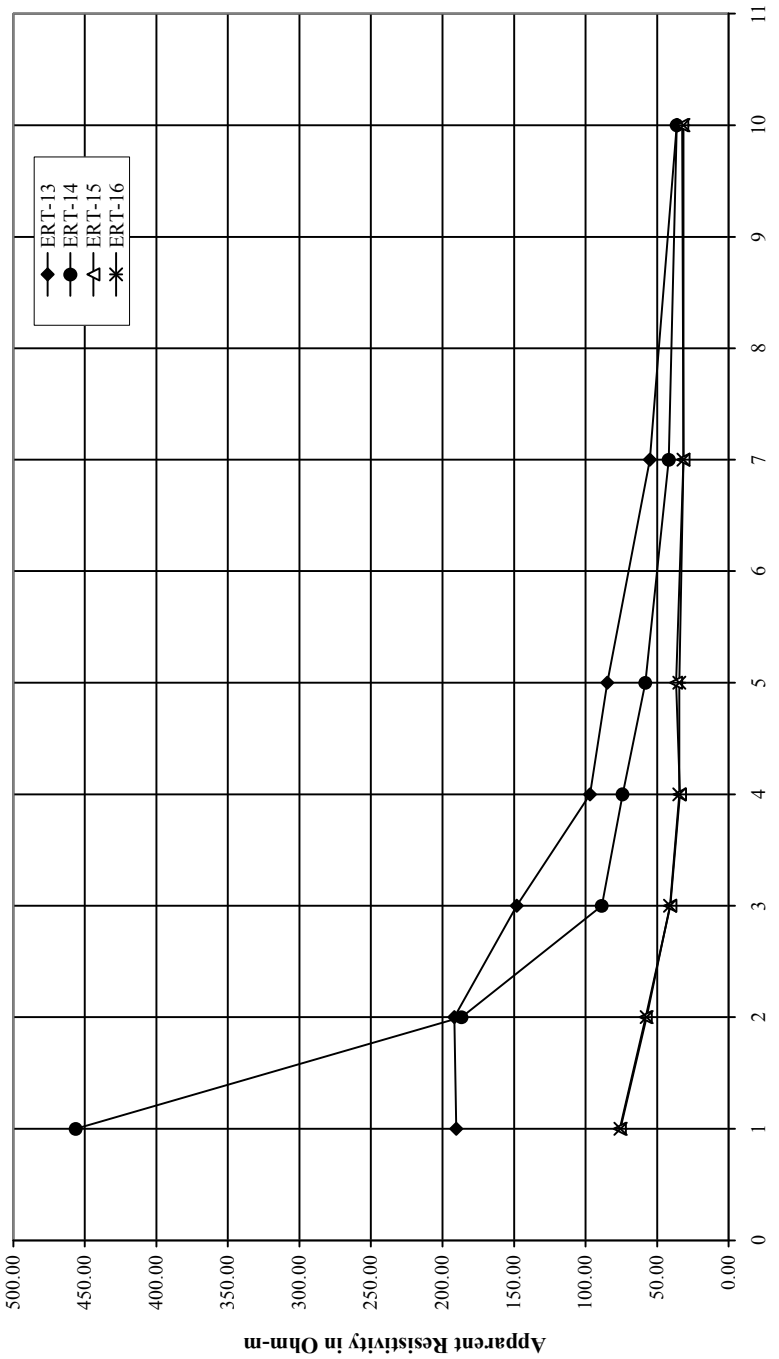
Apparent Resistivity Curves for ERT-1 to ERT-4



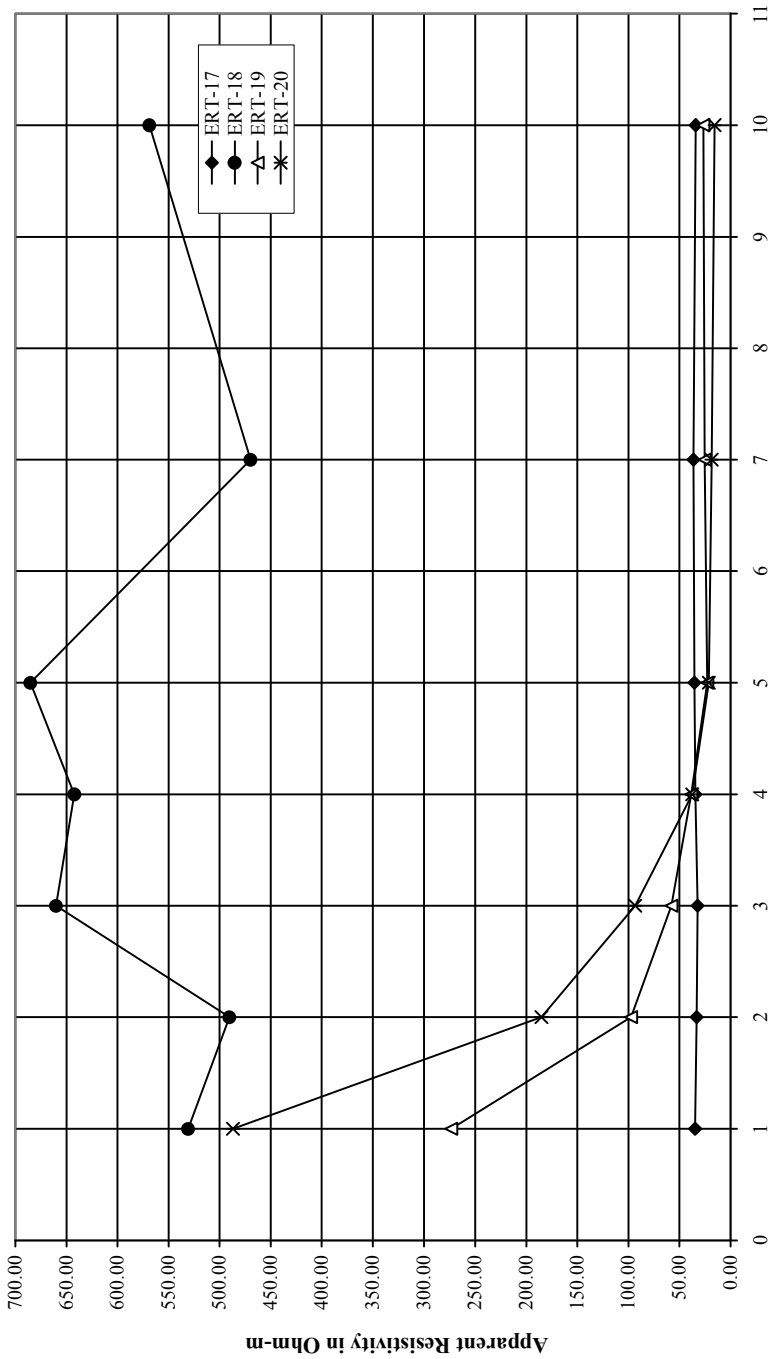
Apparent Resistivity Curves for ERT-5 to ERT-8



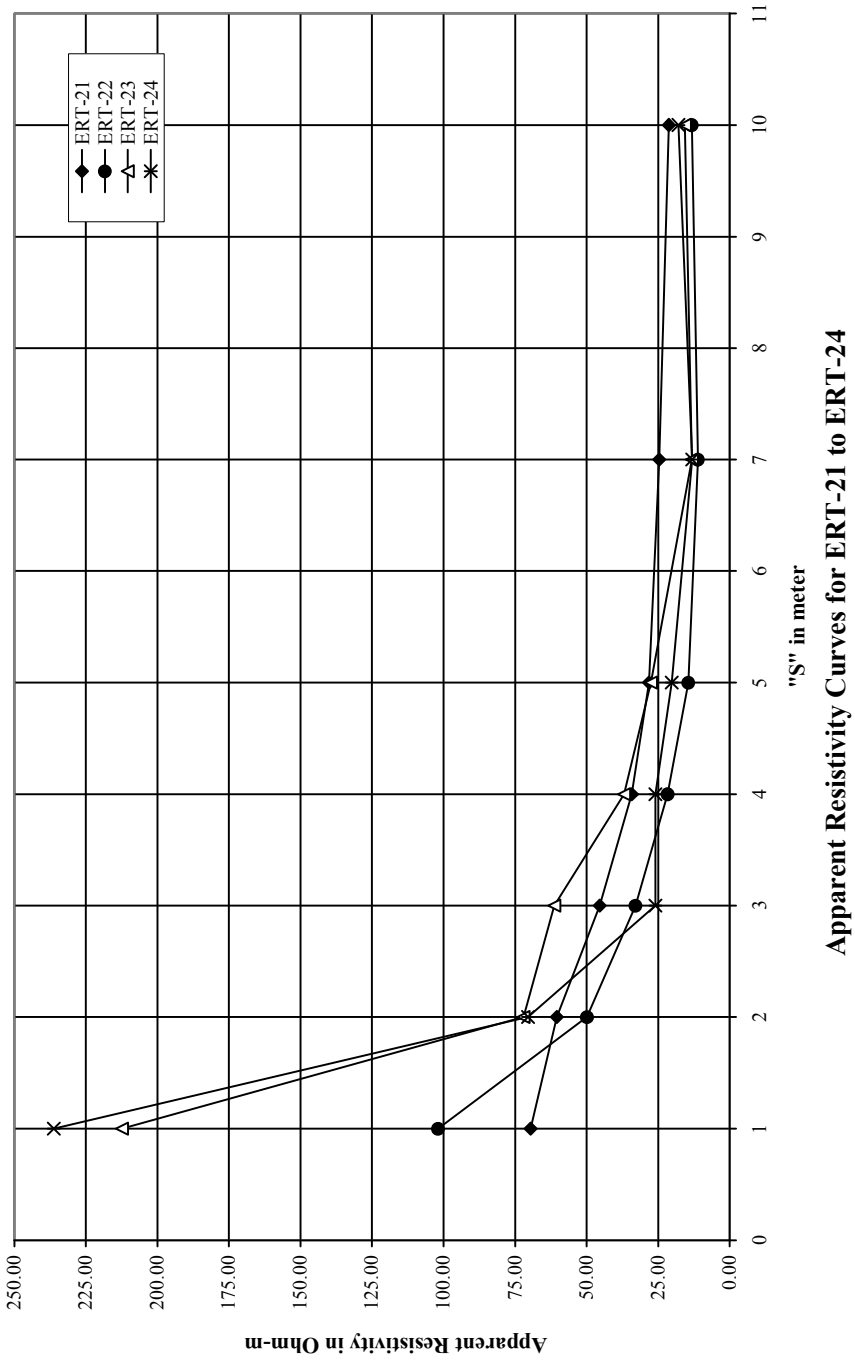
Apparent Resistivity Curves for ERT-9 to ERT-12



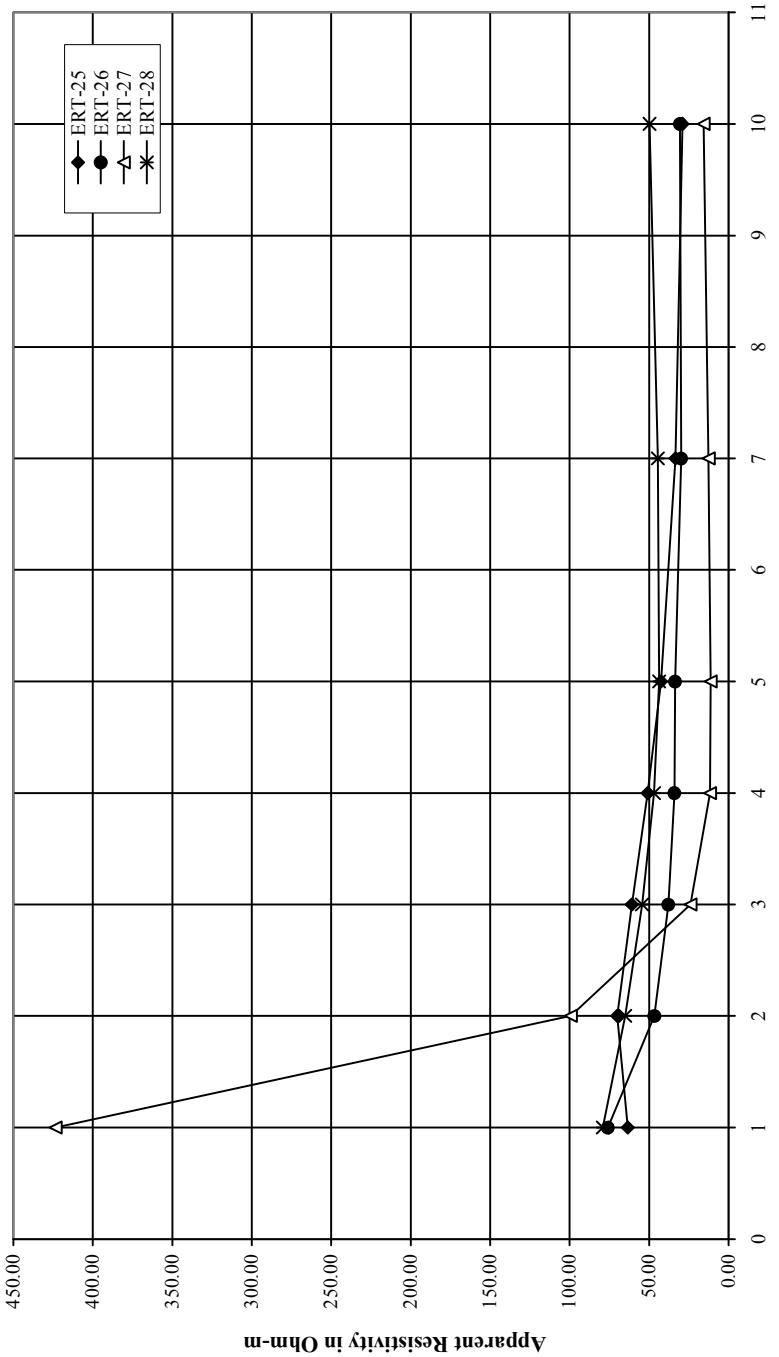
Apparent Resistivity Curves for ERT-13 to ERT-16



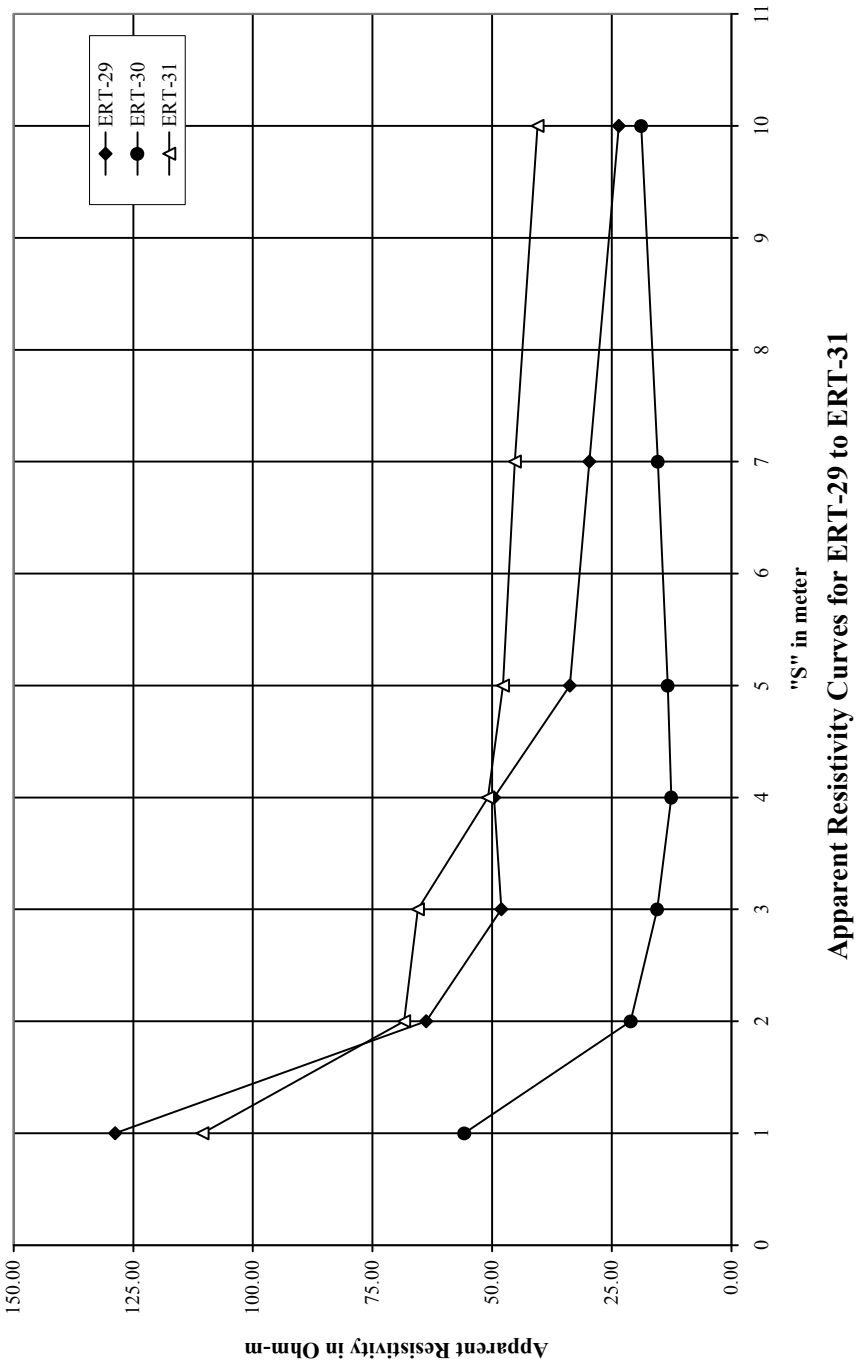
Apparent Resistivity Curves for ERT-17 to ERT-20



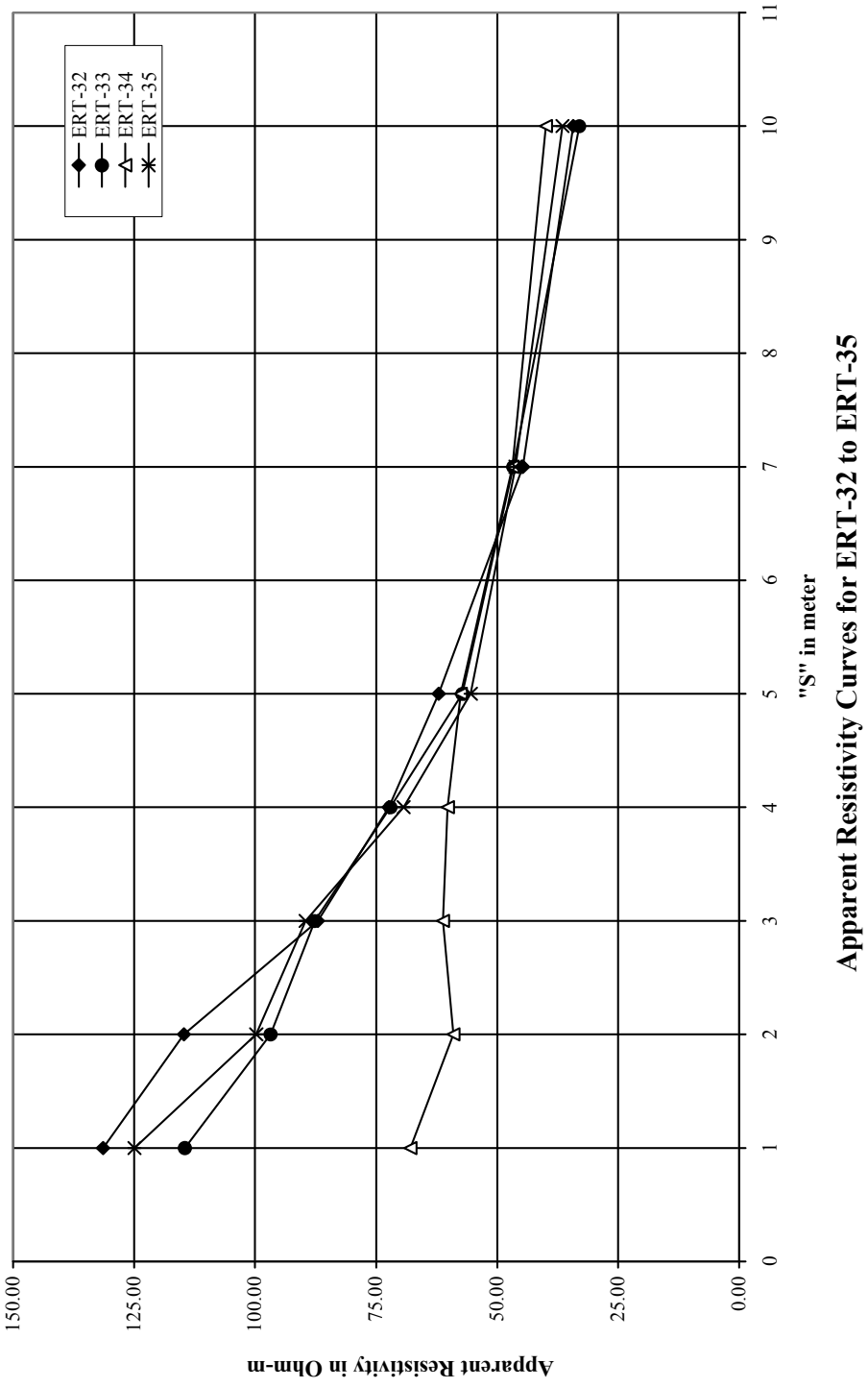
Apparent Resistivity Curves for ERT-21 to ERT-24



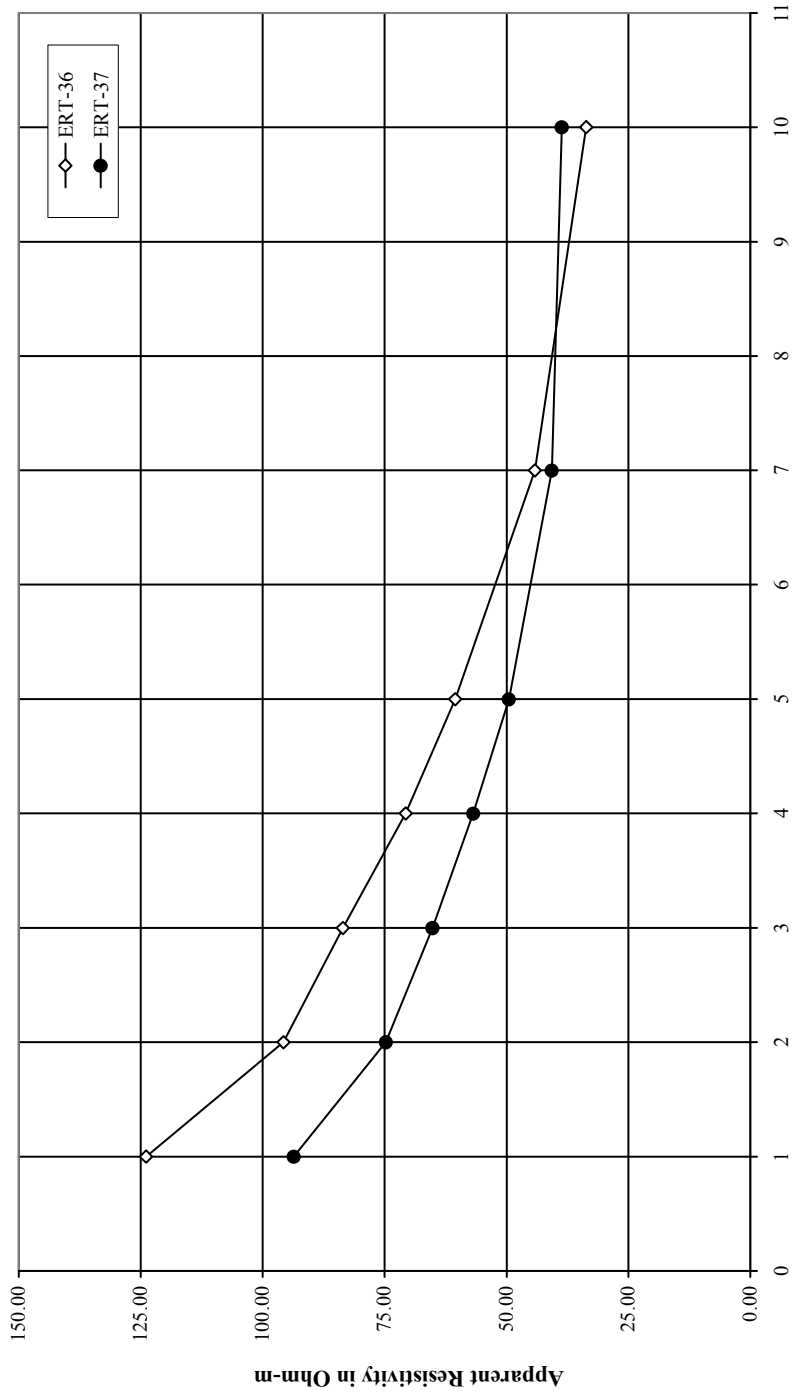
Apparent Resistivity Curves for ERT-25 to ERT-28



Apparent Resistivity Curves for ERT-29 to ERT-31



Apparent Resistivity Curves for ERT-32 to ERT-35



Apparent Resistivity Curves for ERT-36 to ERT-37

8. SEISMIC REFRACTION TESTS

REPORT ON
SEISMIC REFRACTION TEST FOR
1 x 800MW WANAKBORI TPS, GUJARAT

1. INTRODUCTION

M/s. C E Testing Company (P) Limited carried out the work of Geotechnical Investigation for the proposed 1 X 800MW TPS AT Wanakbori, Gujarat.

As a part of geotechnical investigations, seismic refraction survey was carried out to determine the stratigraphy of the proposed area. Present report presents the findings of Seismic Refraction Test.

2. SCOPE OF WORK

The Seismic refraction survey was conducted along five (5) seismic lines with total length of about 1140m. The seismic refraction survey was performed in the month of December' 2014.

3. PURPOSE OF INVESTIGATIONS

The aim of the seismic investigation was to provide information regarding the shallow lithology along the surveyed seismic lines and soil profiles.

4. GENERAL SITE DESCRIPTION

4.1. LOCATION AND TOPOGRAPHY

The Seismic line was located on an undulating ground. The area is having insignificant topographic undulations.

4.2. SITE GEOLOGY

The subsoil is characterised by loose / medium dense silty sand to soft / medium cohesive soil followed by dense silty sand / very stiff to hard cohesive soil. The sand and clay layer were found sandwiched between each other.

5. SEISMIC REFRACTION SURVEY

5.1. LOCATION

Total five seismic line were surveyed and for which separate seismic profile were obtained and presented later in this report.

SRT No.	Spread	Length (M)	Co-ordinate	
			Start	End
SRT1	L1S1	120	N = (-) 102, E = 579	N = (-) 102, E = 759
	L1S2	60		
SRT2	L1S1	120	N = (-) 102, E = 746	N = 198, E = 746
	L1S2	120		
	L1S3	60		
SRT3	L1S1	60	N = 149, E = 746	N = 149, E = 566
	L1S2	120		
SRT4	L1S1	120	N = 149, E = 579	N = (-) 151, E = 579
	L1S2	120		
	L1S3	60		
SRT5	L1S1	60	N = 58, E = 579	N = 58, E = 759
	L1S2	120		

5.2. EQUIPMENT AND ACCESSORIES

Following equipment and accessories were used:

1. Seismograph : PASI model 16S24-U
   Signal enhancement type fully digital 24 channel seismograph,
2. Geophones : Moving-coil type digital grade vertical &
   Horizontal geophones, natural frequency 10 Hertz.
3. Cable : Geophone spread cables, 10m spacing, water
   proof joints, made in Italy
4. Software : WinSism 14

5.2.1. Energy Source:

For the seismic refraction survey work sledge-hammer is struck vertically on an iron plate to generate P-wave.

5.2.2. Geophone and Geophone Spread:

Low frequency (10Hz) spike geophones were used to record seismic signals. The general layout of the seismic survey lines was supplied in accordance with the co-ordinate system provided by the client. Shooting progressed along the lines. Depending on the length available for seismic lines 5 meter geophone spacing was used in a spread. Depending on the length available along seismic lines 24 channels were used. The seismic spread consisted of number of shots with a minimum of two offset shots, two end shots and one center shot.

Care was taken to ensure that the pointed ends (spikes) of the geophones are fully embedded in the topsoil.

5.2.3. Seismograph:

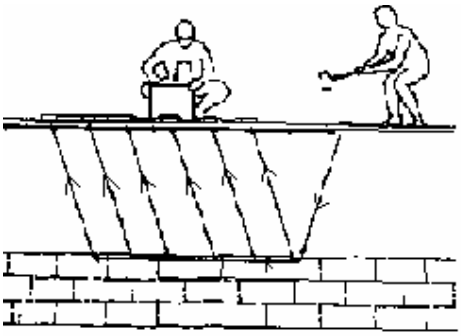
PASI 16S 24-U Seismograph is to be used to record field data. The seismograph has the signal enhancement or stacking capability. The seismograph records the arrival of seismic waves through 24 channels. The seismic waves detected by each geophone are displayed simultaneously on the screen.

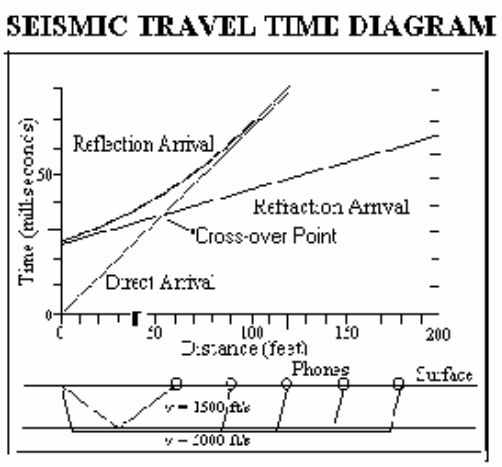
5.3. SEISMIC REFRACTION

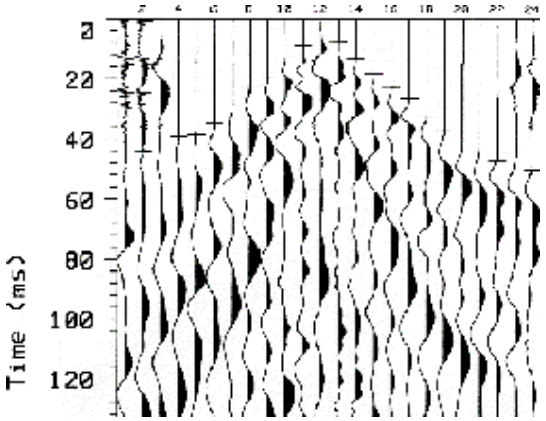
With seismic techniques, in general, a stress applied at the surface of an elastic media creates the conditions for the associated strains to propagate as elastic waves (P & S) in the subsurface material as pattern of particle deformation traveling with velocities that are dependent on the elastic properties and densities of the media through which they travel.

The basic principle behind seismic refraction surveys is to initiate elastic waves at a point at or near the ground surface and to determine at a number of other positions the arrival times of the seismic energy that has traveled along discontinuities or interfaces between surface layers and totally refracted back to the surface.

The seismic energy source creates the seismic elastic waves. The travel times of these elastic waves are detected by series of geophones, placed in line into the ground and connected to the seismograph, via the geophone cable. The seismograph will register these times and display them as traces of time for individual geophones.







By processing these arrival times the characteristic velocity and the thickness of the underlying layer can be calculated.

5.4. SEISMIC REFRACTION SURVEY DATA INTERPRETATION

5.4.1. Data Processing

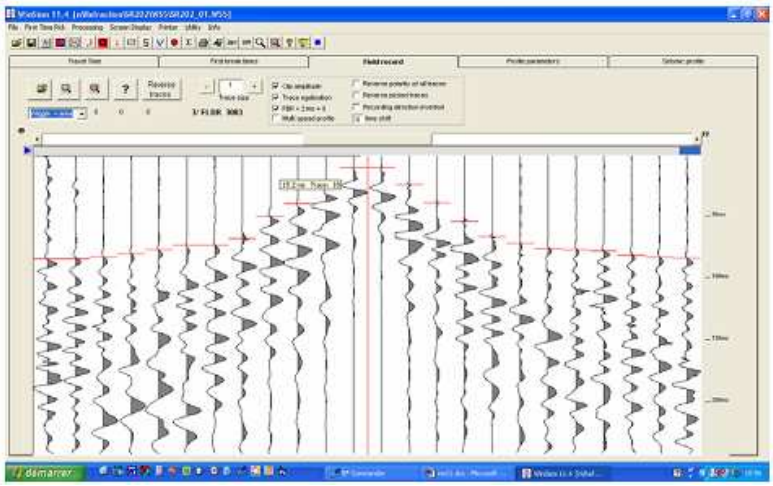
The data is stored in the hard disk of the seismograph at the time of data acquisition. The data is transferred to the computer for further processing.

The processing involves picking the first arrivals, input of data with geophone elevations and first arrivals, and final interpretation for velocity model. In case of noisy data there are intermediate steps of data processing using filtering, amplitude corrections etc.

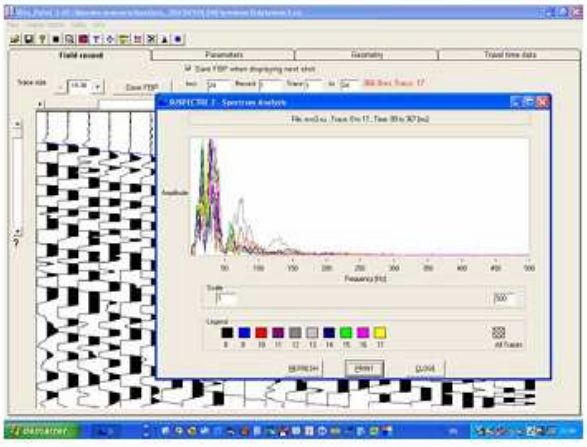
5.4.2. Picking of First Arrivals:

All geometrical data will are displayed under field record panel on the grid. Now one can start first break picking by clicking on the first break, the travel time is drawn automatically and the First break value is written on the grid as the picking progress. One need very precise time determinations to ensure good travel time and a good seismic interpretation.

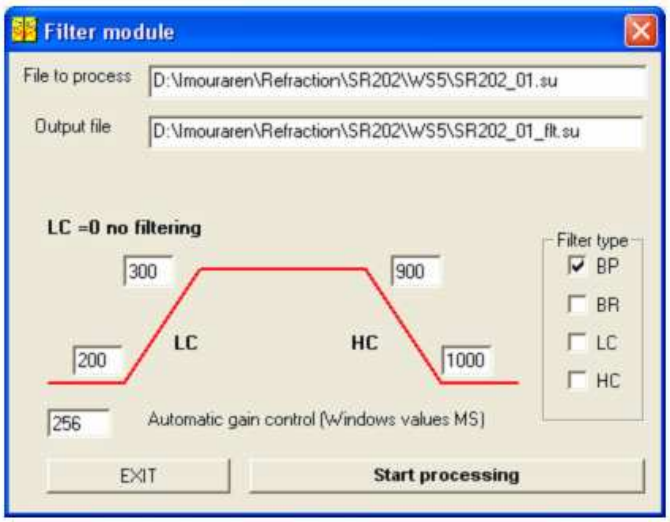
Time scale can be modified by pressing and release mouse button on the time scale (At the right of the record display) to select a time range to display. Click close to time zero to remove a picking time



First Break Point



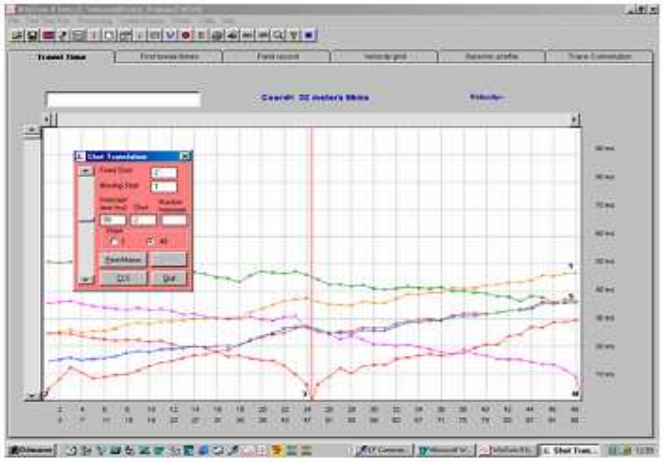
Frequency Spectrum



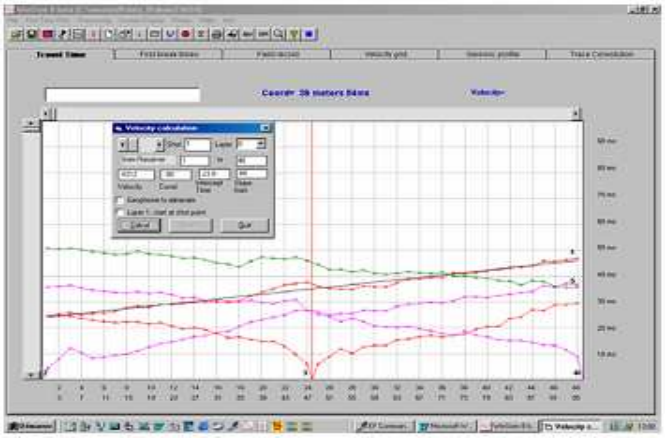
Automatic grain & Filtering

5.4.3. Velocity Model Development

a) Phantom Trace: With WinSism one can move up and down very easily any shot to compare the travel time with others travel time. Intercept times can be measured and recorded. Phantoming is used to check if parts of two travel times correspond to the same layer. Using the Input of Fixed shot number, moving shot number, Intercept number, Intercept time is obtained.

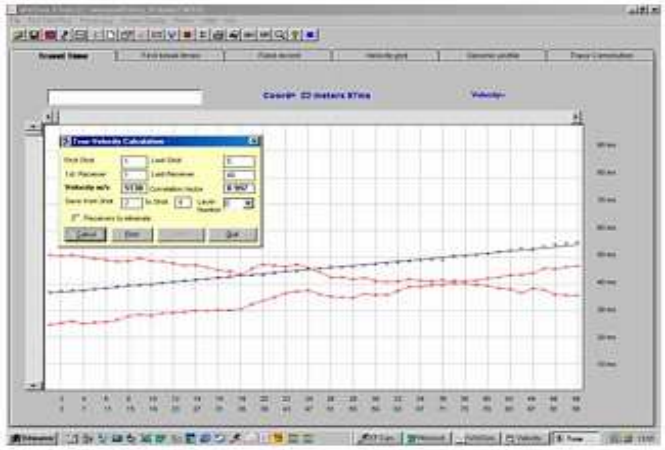


b) Linear Regression:



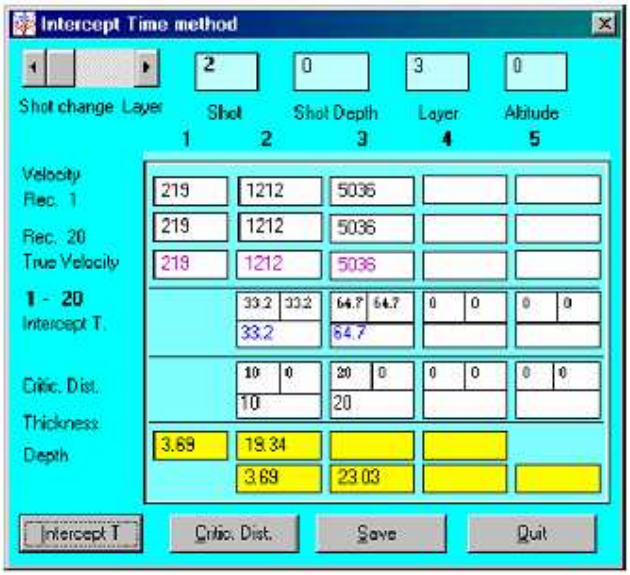
Velocity is computed using linear regression between selected receivers.

c) True Velocity



One can compute the true velocity, even if the bedrock is not horizontal. In this case, two shots (first and last) and the 1st and last receivers are selected. You will get the real velocity and the correlation factor.

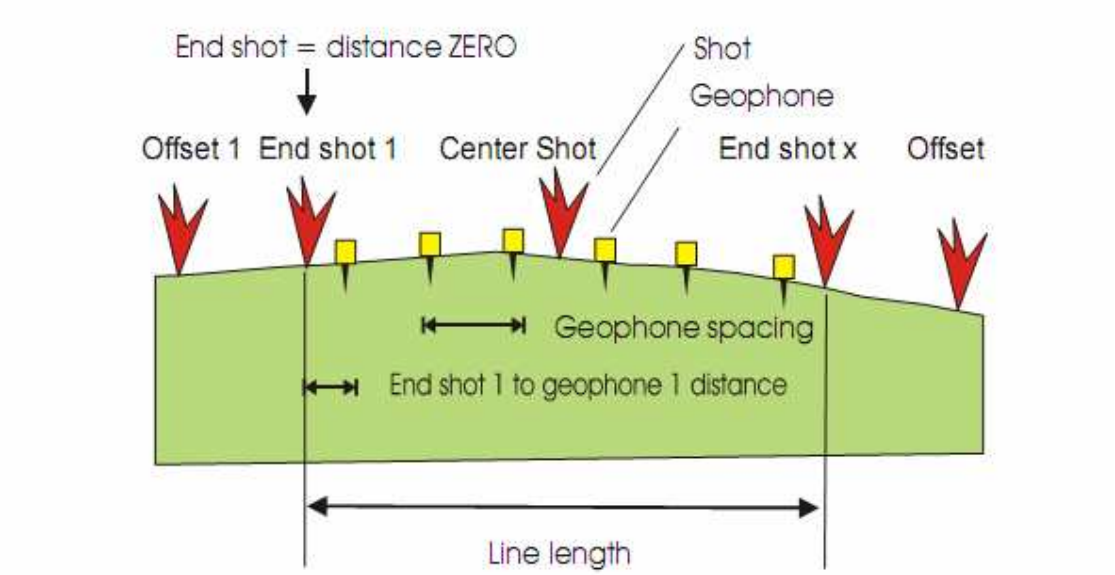
d) Depth Computation

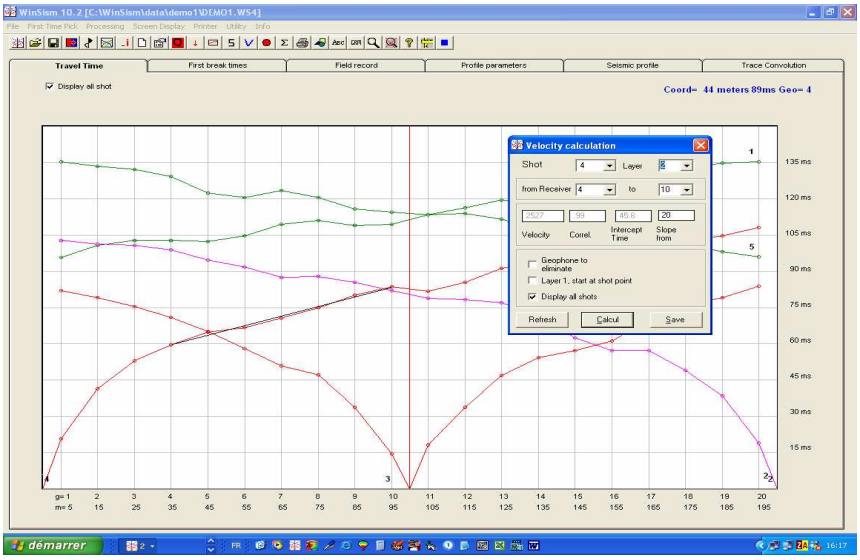


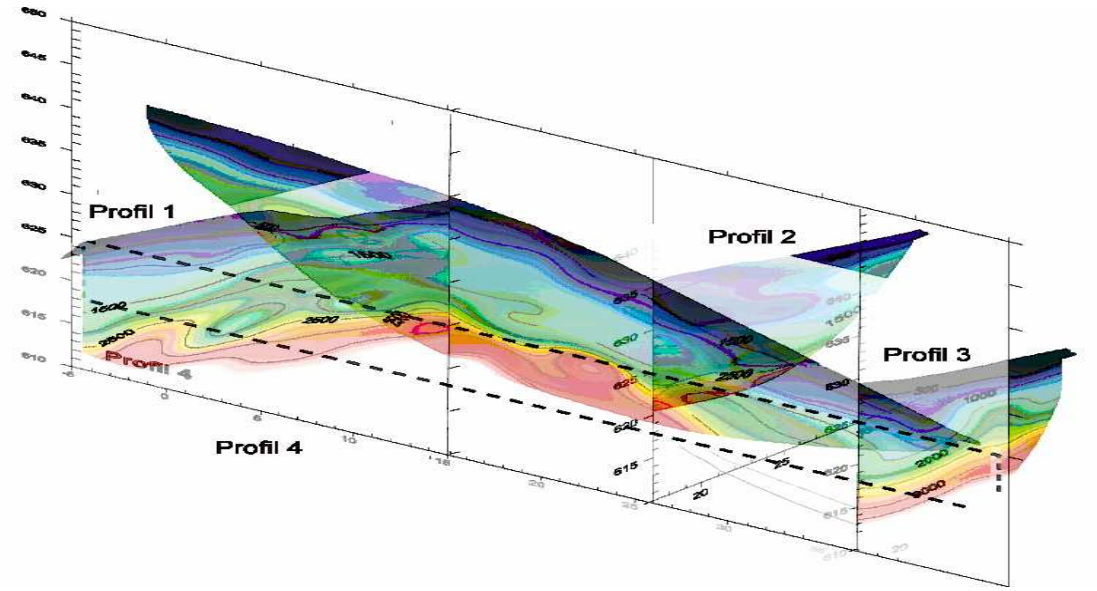
When all velocities and intercept times are recorded, user can compute thickness at shot point using the intercept time method.

5.4.4. Why WinSism 14?

WinSism can accept any field geometry, receiver spacing, shot spacing, shot distance to receiver. All distances are computed from first End-of-line shot. This shot must be always distance 0 and must exist. First Out-of-line shot must have a negative distance. Line length is computed from first End-of-line shot to the last End-of-Shot. Usually, the first End-of-line shot distance to the first receiver is half receiver spacing. Remember that two offset shots are necessary to use Delay or GRM method.


End shot = distance ZERO
Shot
Geophone
Offset 1
End shot 1
Center Shot
End shot x
Offset
Geophone spacing
End shot 1 to geophone 1 distance
Line length


WinSism 10.2 [C:\WinSism\data\demo1\DEMO1.WS4]
Travel Time
First break times
Field record
Profile parameters
Seismic profile
Trace Convolution
Display all shot
Coord= 44 meters 89ms Geo= 4
Velocity calculation
Shot
Layer
from Receiver
to
Velocity
Correl.
Intercept Time
Slope from
Geophone to eliminate
Layer 1, start at shot point
Display all shots
Refresh
Calcul
Save
démarrer



WinSism Travel time can be composed of more than one spread. In this case, first pick all original records using picking module, without to take care of exact geometry then see below.

It is strongly recommended recording at least 5 shots; offset shots allow to use ABC method and to compute depth below all geophones.

1. two offsets shots (distance half spread length),
2. two end shot (half receiver spacing from receiver one)
3. One centre shot

If subsurface geometry is complex, more shot are required.

5.4.5. Seismic Survey Results

1. Seismic wave velocity in soil is dependent on the soil type and its condition. The velocity models obtained from the seismic refraction survey are enclosed.

2. The results show variations in velocities upto the investigated depth. The highest velocities are in the range of 1600-1800m/s. There are various lateral variations in velocity in the models generally associated with intrusions and typical of such sites.

   a) **SRT-1 Profile:** At the top we have a layer of about 5-8m thick having velocity ranges between 200m/sec to 300m/sec. Then a layer of about 11-16m thick having a velocity range of 1000-1200m/sec is found. A velocity range of 1600-1800m/sec is found thereafter.

   b) **SRT-2 Profile:** At the top we have a layer of about 5-11m thick having velocity ranges between 200m/sec to 300m/sec. Then a layer of about 15-18m thick having a velocity range of 1000-1200m/sec is found. A velocity range of 1600-1800m/sec is found thereafter.

   c) **SRT-3 Profile:** At the top we have a layer of about 4-9m thick having velocity ranges between 200m/sec to 300m/sec. Then a layer of about 12-17m thick having a velocity range of 1000-1200m/sec is found. A velocity range of 1600-1800m/sec is found thereafter.

   d) **SRT-4 Profile:** At the top we have a layer of about 4-13m thick having velocity ranges between 200m/sec to 300m/sec. Then a layer of about 10-18m thick having a velocity range of 1000-1200m/sec is found. A velocity range of 1600-1800m/sec is found thereafter.

   e) **SRT-5 Profile:** At the top we have a layer of about 4-11m thick having velocity ranges between 200m/sec to 300m/sec. Then a layer of about 14-20m thick having a velocity range of 1000-1200m/sec is found. A velocity range of 1600-1800m/sec is found thereafter.

3. Based on the Seismic Profile it is seen that we are having following dynamic parameters.

Avg. Thickness of layer below EGL (M)		Avg. V_p (m/sec)	Calculated V_s (m/sec)	Dynamic Young's Modulus (MPa)	Shear Modulus (Mpa)	Soil Type
From	To					
0.00	8.00	250	133	88	33	Granular soil with loose to medium density / cohesive soil with soft to medium consistency
8.00	23.00	1100	588	1797	691	Dense to very dense granular soil / very stiff to hard cohesive soil
Below 23.00		1700	981	4816	1926	Very dense granular soil / hard cohesive soil

Sample Calculation:

$E = V_p^2 \times \rho \times (1+\mu) \times (1-2\mu) / (1-\mu)$

Where, E = Dynamic Young's Modulus in kN/m^2

$V_p = 250$ m/sec

$\rho = 1.90$ gm/cc ≈ 1.90 $kN.s^2/m^4$ (mass density)

$\mu = 0.30$

So, calculated E = 88214 kN/sqm ≈ 88 MPa

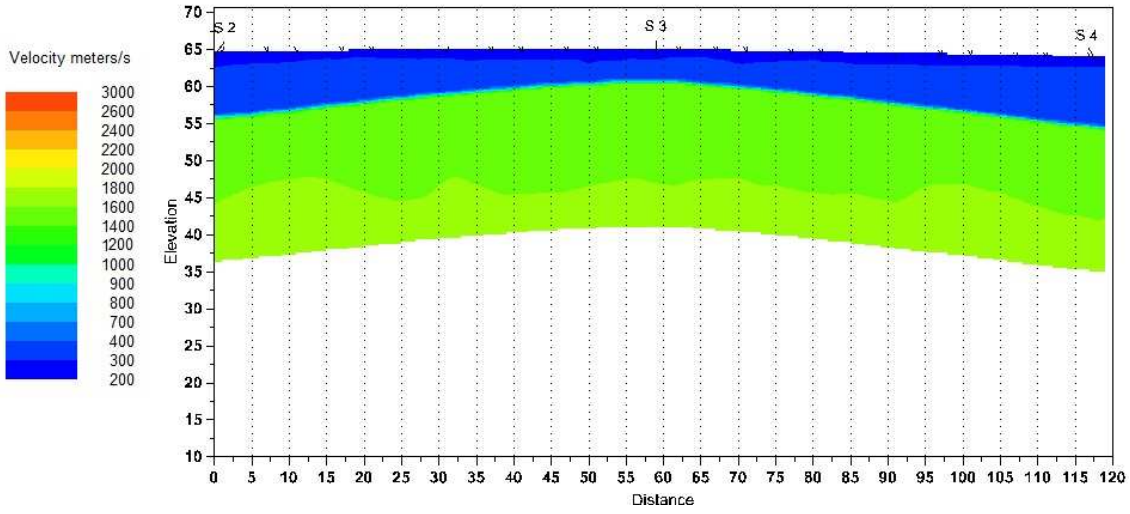
And Shear Modulus comes out to be 33 MPa

Again, $G = \rho V_s^2$ giving $V_s = \sqrt{G/\rho}$

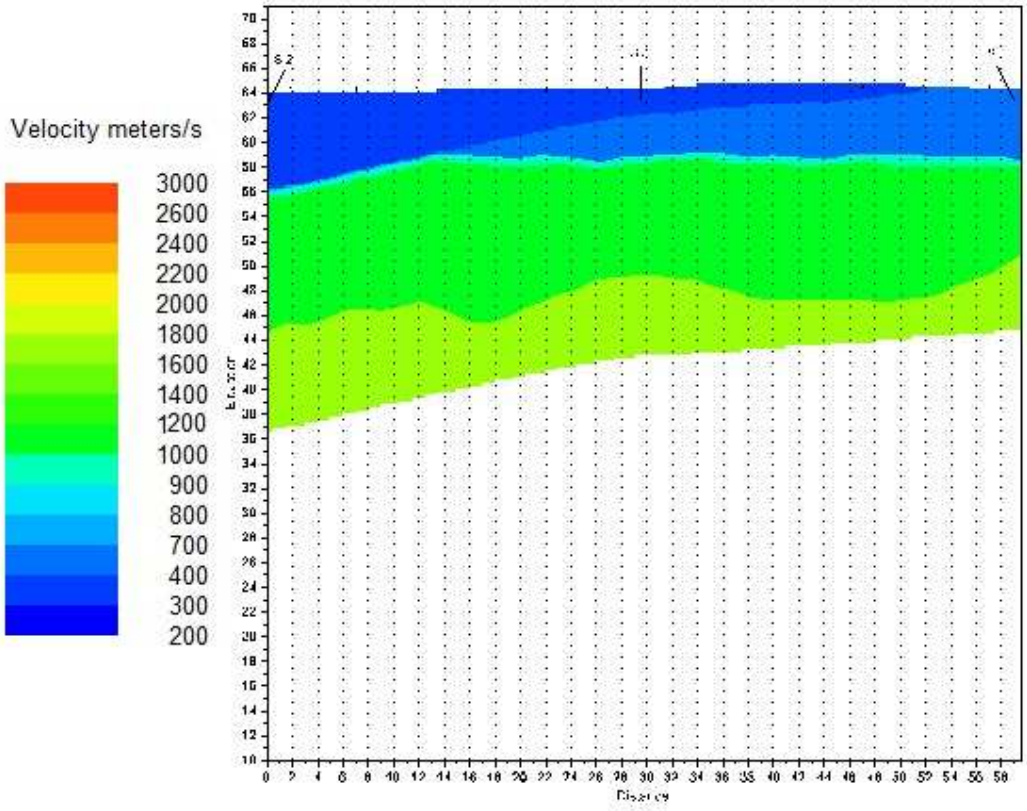
So, calculated V_s = 133 m/sec

SEISMIC PROFILE

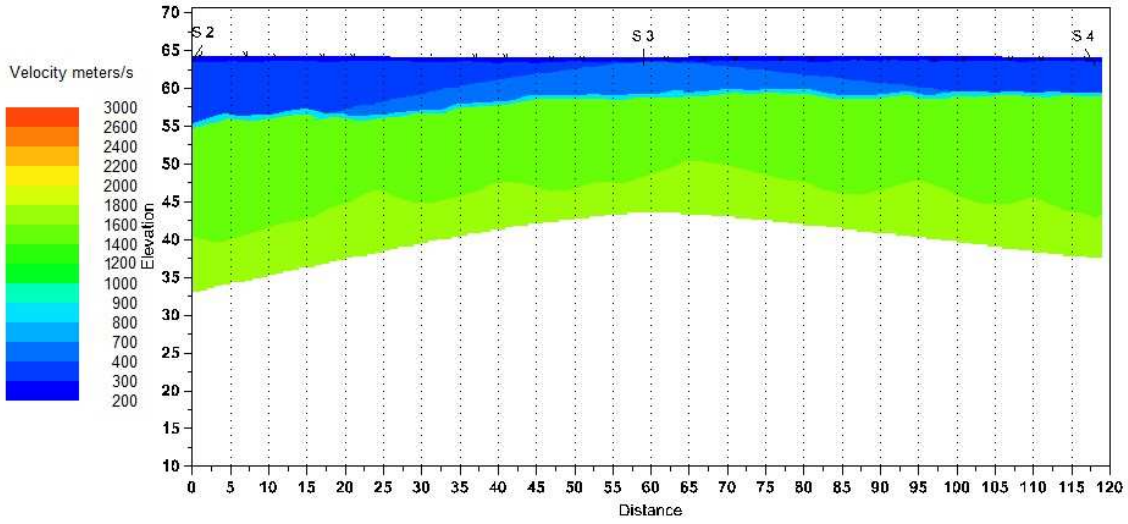
Along SRT-1 / L1S1



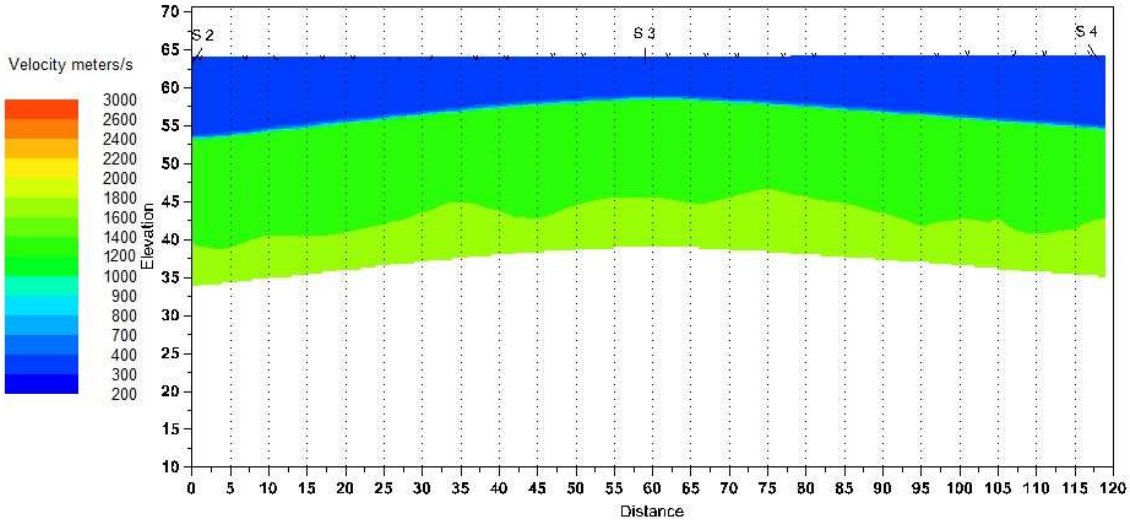
Along SRT-1 / L1S2



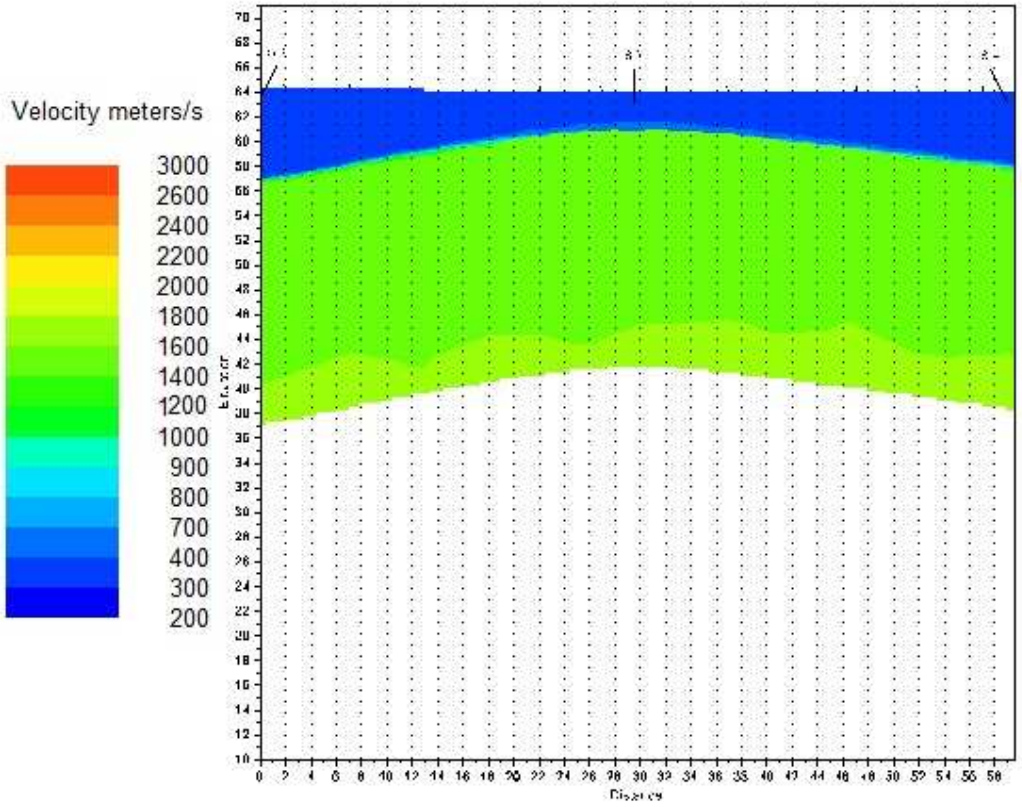
Along SRT-2 / L1S1



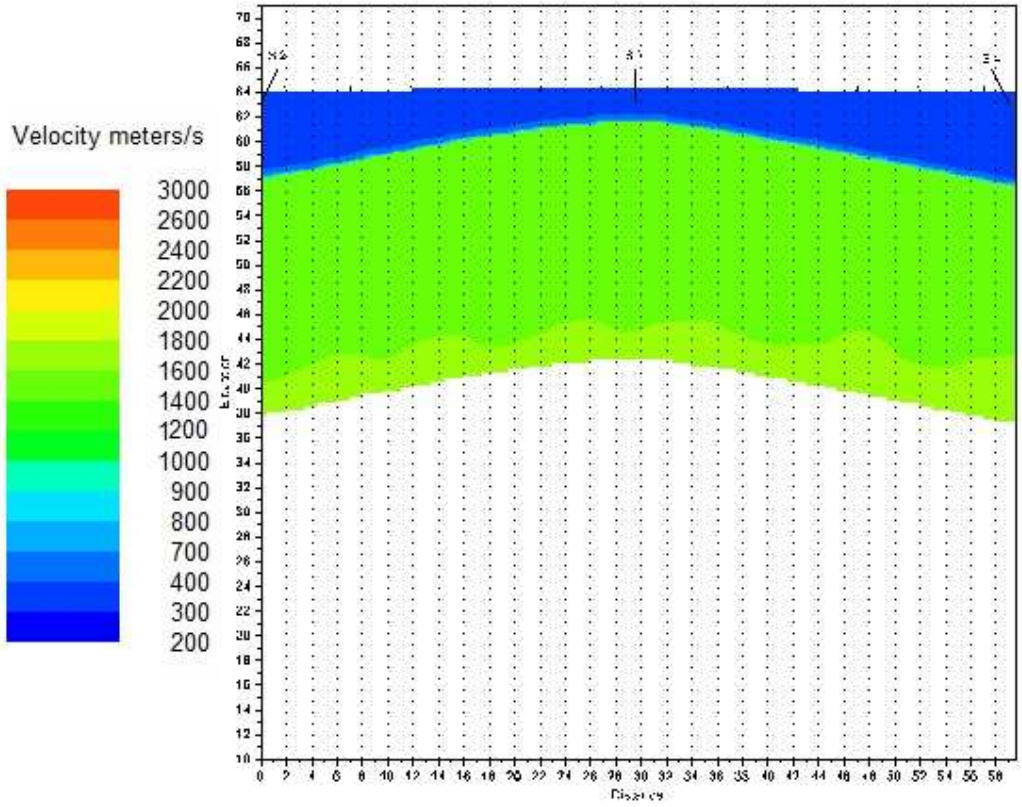
Along SRT-2 / L1S2



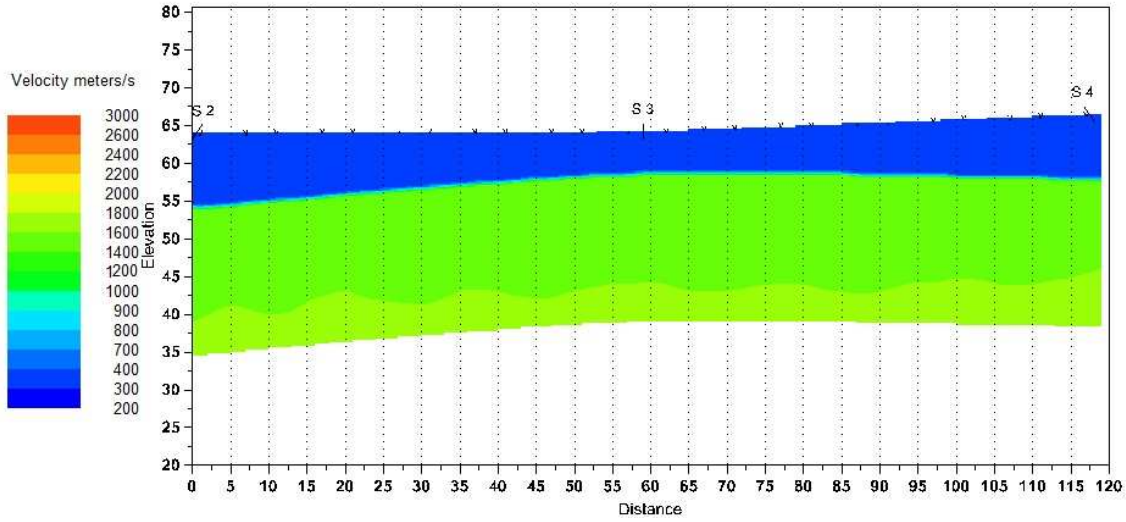
Along SRT-2 / L1S3



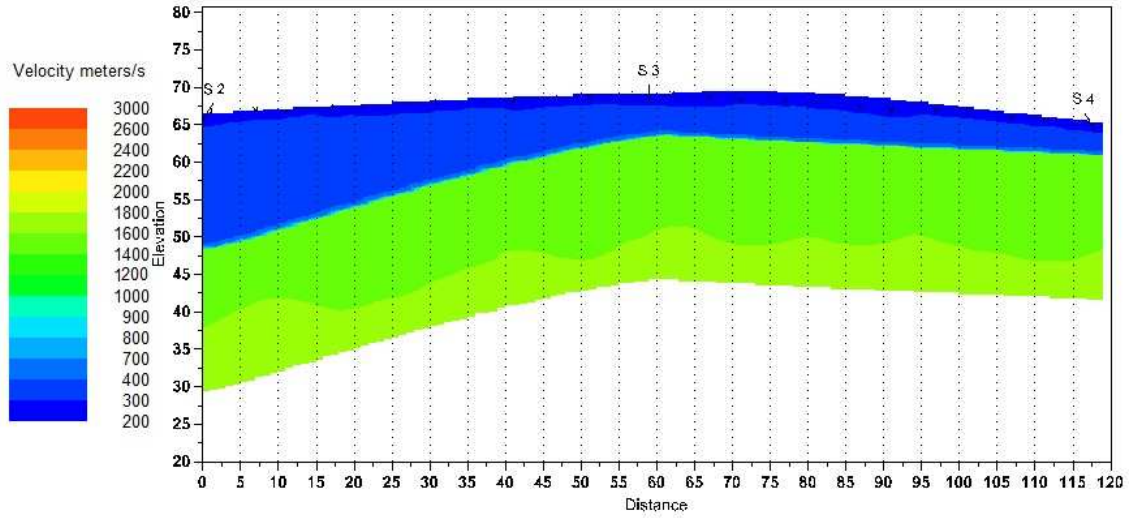
Along SRT-3 / L1S1



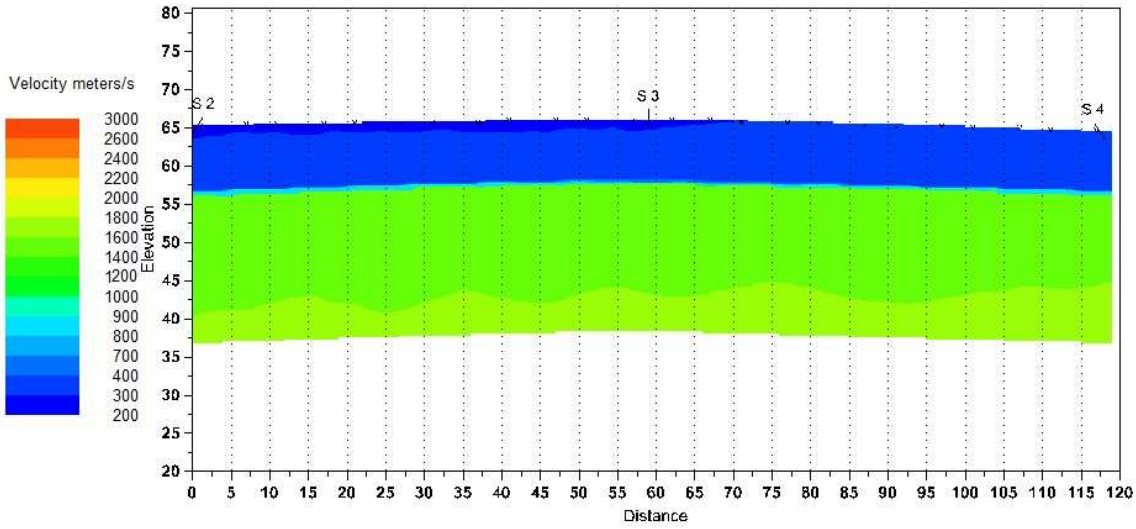
Along SRT-3 / L1S2



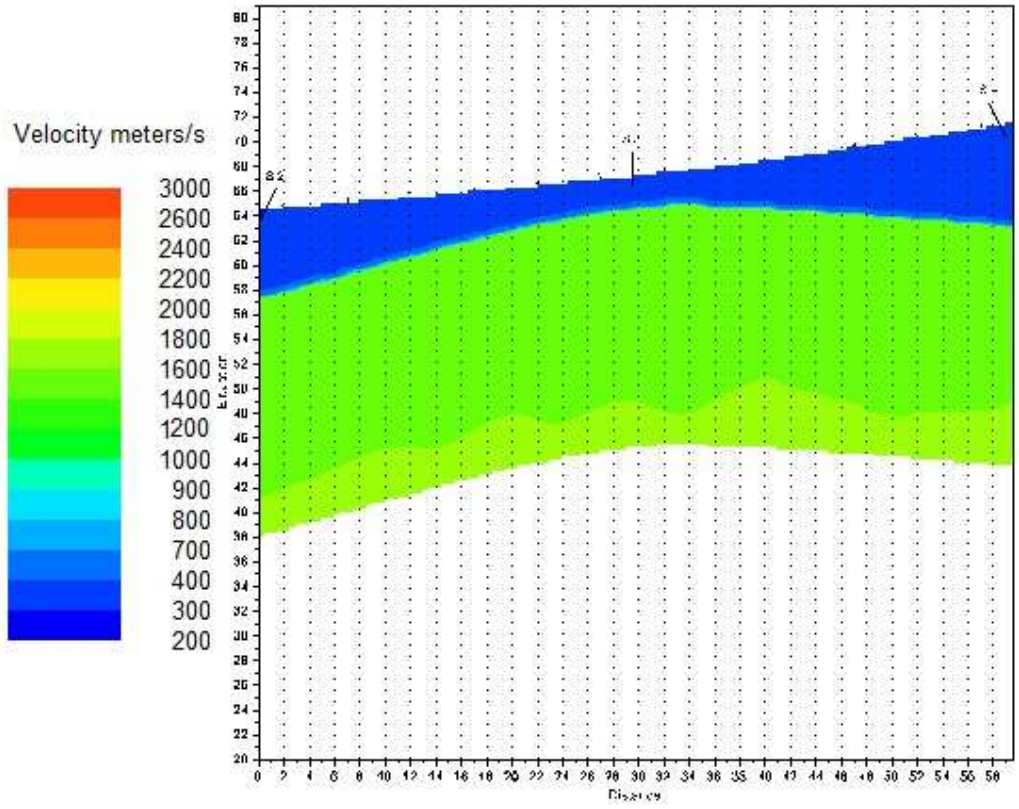
Along SRT-4 / L1S1



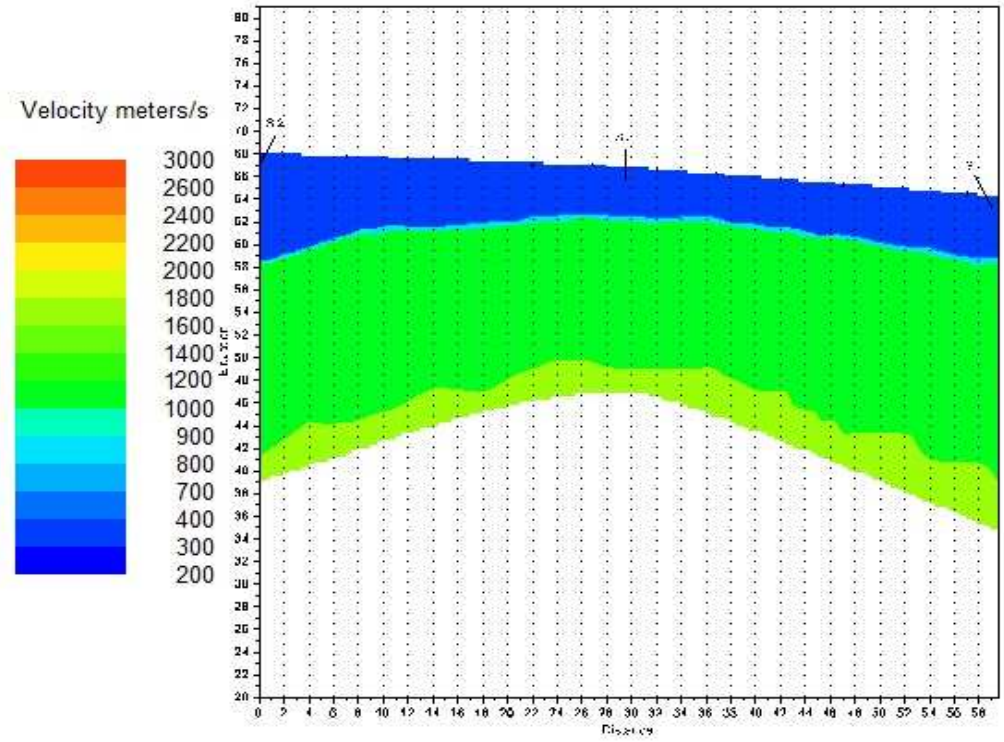
Along SRT-4 / L1S2



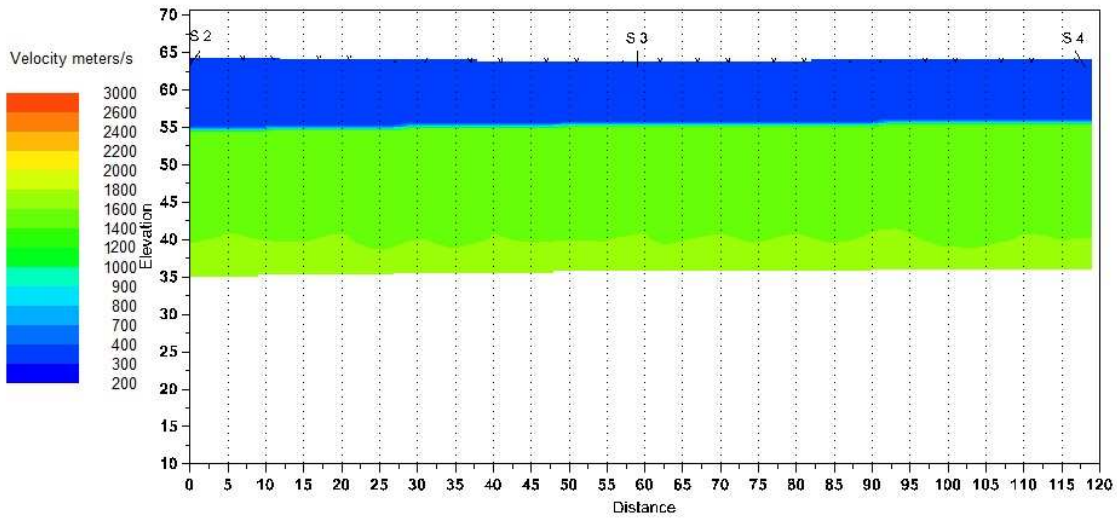
Along SRT-4 / L1S3



Along SRT-5 / L1S1



Along SRT-5 / L1S2



9. PRESSUREMETER TEST

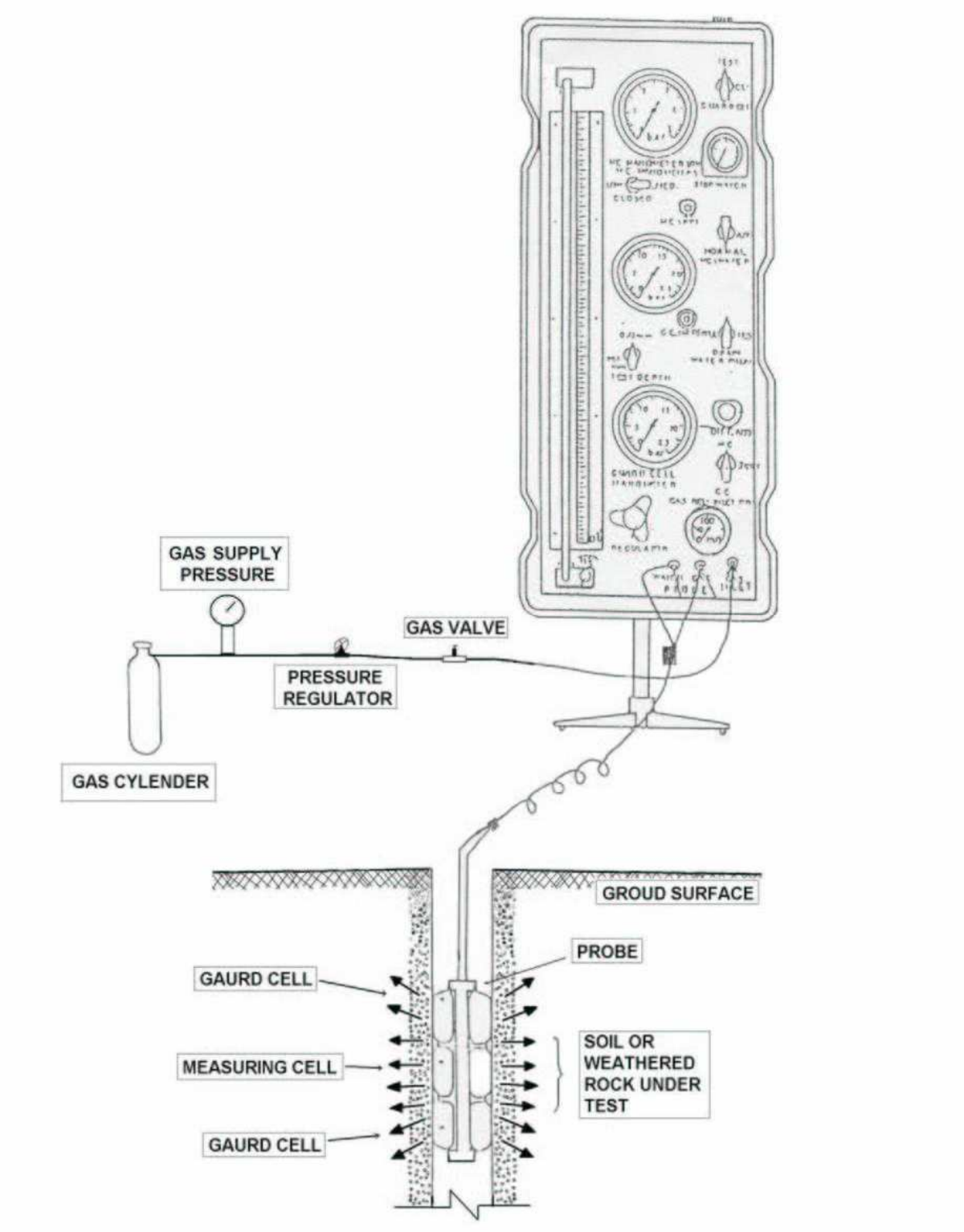


FIG. 1. SCHEMATIC REPRESENTATION OF PRESSUREMETER

PRESSUREMETER TEST

1. INTRODUCTION :

The Pressure meter equipment (Ref. Fig.1) consists of mainly of three components, namely the probe, the control panel and the tubing. The probe consists of rubber membranes stretched over a core. Only the central portion known as the measuring cell is used for measurement. The two end portions known as guard cells serve merely to avoid end convergence over the measured portion. The control panel consists of a water reservoir for the measuring cell which is connected by means of a hole. A coaxial outlet with quick release nipples for connecting to the water and gas outlets meant for measuring cell and guard cells respectively is connected to the water and gas outlets meant for measuring cell and guard cells respectively is connected to the one end of a coaxial tubing. Pressure is applied to the water through pneumatic control equipment and resulting soil deformations are indicated by volume changes which one read on a sight tube.

2. FIELD INVESTIGATIONS & ANALYSIS OF TEST RESULTS :

Total four nos. Pressuremeter tests were conducted at different depths varying from about 2.00m to a maximum of 30.00m below the existing ground surface. The details of test locations are as under:

Test Location	Test No.	Co-ordinates (m)		RL (m)	Date of Testing
		E	N		
PMT-01	01/12	700.000	155.000	63.601	11.12.14
	02/12				11.12.14
	03/12				11.12.14
	04/12				11.12.14
	05/12				11.12.14
	06/12				11.12.14
	07/12				12.12.14
	08/12				12.12.14
	09/12				12.12.14
	10/12				13.12.14
	10/12				13.12.14
	12/12				13.12.14
PMT-02	01/12	628.000	130.000	64.006	14.12.14
	02/12				14.12.14
	03/12				14.12.14

Test Location	Test No.	Co-ordinates (m)		RL (m)	Date of Testing
		E	N		
PMT-02	04/12	628.000	130.000	64.006	14.12.14
	05/12				14.12.14
	06/12				14.12.14
	07/12				15.12.14
	08/12				15.12.14
	09/12				15.12.14
	10/12				16.12.14
	10/12				16.12.14
	12/12				16.12.14
PMT-03	01/12	667.000	91.000	63.686	08.12.14
	02/12				08.12.14
	03/12				08.12.14
	04/12				08.12.14
	05/12				09.12.14
	06/12				09.12.14
	07/12				09.12.14
	08/12				09.12.14
	09/12				10.12.14
	10/12				10.12.14
	10/12				10.12.14
	12/12				10.12.14
PMT-04	01/12	610.000	72.000	64.966	05.12.14
	02/12				06.12.14
	03/12				06.12.14
	04/12				06.12.14
	05/12				06.12.14
	06/12				06.12.14
	07/12				06.12.14
	08/12				07.12.14
	09/12				07.12.14
	10/12				07.12.14
	10/12				07.12.14
	12/12				08.12.14

All the tests were carried out in the bore hole of required size compatible to that of Nx probe of Pressuremeter as per instructions of Engineer-in-Charge. Before starting use of new Nx size probe air calibration was done. For conducting Pressuremeter tests each bore hole of Nx size was made upto the required depth by rotary drilling machine. The probe was attached to the drill rod, lowered into the bore hole and held at test depth. All valves were opened enabling the system to attain equilibrium under atmospheric pressure. Water table of the measuring cell reservoir was noted. The instruments was set ready for test by closing or opening the relevant valves. Then from a compressed gas cylinder a little amount of pressure was let into the system. This pressure caused the probe to expand and consequently the water level to fall. The pressure was maintained constant for that step and the measuring cell voltmeter readings were noted at 30 and 60 seconds. After that next pressure was let in and observations continued as before. This way the test was carried out upto the failure of the soil. Then the pressure was released. Probe was allowed to contract to its original size and withdrawn to the ground level. This constituted one test at a given depth.

□

For the Pressuremeter test conducted at different depths at the specified location the plots of applied pressure and volumetric deformation are shown in figures (2) to (64). From these plots the values of pressure at rest (P_o), limit pressure (P_l) & Creep pressure (P_f) were read. These values were corrected for probe air calibration pressure at corresponding volume & head due to water column.

A typical plot between applied pressure against volumetric deformation is shown in figure (3). The graph clearly shows three different parts. Part AB represents the expansion of the probe in the initial air gap. Part BC, which is a straight line, represents the stress deformation relationship of the soil. Part CD represents the progress of failure of the soil. At D the soil is completely failed. P_o represents the 'natural stress' in the soil. P_f and P_l are called 'Creep Pressure' and 'Limit pressure' respectively.

The Menard's modulus of deformation 'E_m' of the soil is calculated from the following relationship:

$$E_m = 2.66 \times \{V_c + (V_0+V_f)/2\} \times (P_f - P_0) / (V_f - V_0)$$

Where

E_m = Menard's Modulus of deformation in kg/cm^2.

P_o = At rest pressure in kg/cm^2.

P_f = Creep pressure in kg/cm^2.

V_c = Volume of probe before test under deflated condition in c.c.

V_o = Volume corresponding to pressure P_o in c.c.

V_f = Volume corresponding to pressure P_f in c.c.

By putting all the relevant values in the above relationship from the plot between applied pressure against volumetric deformation (Refer figures 2 to 64), the following values of limit pressure & Menard's modulus of deformation have been arrived at : -

Sl. No.	Test Location No.	Test No.	Test depth below existing ground surface (m)	Corrected Limit pressure (Kg/cm^2)	Young's Modulus, E (Kg/cm^2)
1	PMT-01	01/12	2.00	1.35	13.02
2		02/12	4.00	4.00	32.48
3		03/12	6.00	9.40	92.31
4		04/12	8.00	7.10	85.60
5		05/12	10.00	7.20	58.33
6		06/12	12.00	11.15	86.97
7		07/12	15.00	16.85	245.89
8		08/12	18.00	21.65	258.65
9		09/12	21.00	17.70	127.32
10		10/12	24.00	22.25	283.49
11		11/12	27.00	20.80	203.36
12		12/12	30.00	23.40	188.46
13	PMT-02	01/12	2.00	1.25	1.68
14		02/12	4.00	2.95	23.59
15		03/12	6.00	5.40	52.61
16		04/12	8.00	8.85	117.88
17		05/12	10.00	8.55	74.35
18		06/12	12.00	8.95	76.01
19		07/12	15.00	13.75	149.29
20		08/12	18.00	20.05	249.17
21		09/12	21.00	17.80	150.11
22		10/12	24.00	22.60	185.43

Sl. No.	Test Location No.	Test No.	Test depth below existing ground surface (m)	Corrected Limit pressure (Kg/cm^2)	Young's Modulus, E (Kg/cm^2)
23	PMT-02	11/12	27.00	21.80	173.12
24		12/12	30.00	23.10	172.23
25	PMT-03	01/12	2.00	0.05	4.99
26		02/12	4.00	2.70	12.34
27		03/12	6.00	9.35	118.56
28		04/12	8.00	11.05	104.09
29		05/12	10.00	15.80	269.75
30		06/12	12.00	9.50	142.90
31		07/12	15.00	11.30	117.04
32		08/12	18.00	17.85	151.10
33		09/12	21.00	18.30	207.10
34		10/12	24.00	21.10	228.23
35		11/12	27.00	20.40	340.00
36		12/12	30.00	20.70	228.02
37	PMT-04	01/12	2.00	1.15	4.50
38		02/12	4.00	1.55	1.36
39		03/12	6.00	3.60	56.35
40		04/12	8.00	6.05	73.13
41		05/12	10.00	10.55	189.13
42		06/12	12.00	6.50	62.15
43		07/12	15.00	12.05	131.14
44		08/12	18.00	21.60	425.60
45		09/12	21.00	18.55	197.96
46		10/12	24.00	20.60	216.46
47		11/12	27.00	16.90	222.03
48		12/12	30.00	21.45	250.04

SAMPLE CALCULATION:

Test Location = PMT01 / 1

Test depth = 2.00 m

Refer Figure No. = 3

Head due to water column = 0.30 kg/cm^2

Probe air calibration pressure corresponding to volume at limit pressure (P_l) = 1.30 kg/cm^2

Probe air calibration pressure corresponding to volume at Pressure at rest (P_o) = 0.20 kg/cm^2

Probe air calibration pressure corresponding to volume at Creep pressure (P_f) = 0.80 kg/cm^2

Volume of probe before test under deflated condition (V_c) = 705 cc

Limit pressure (P_l) = 2.35 kg/cm^2

Pressure at rest (P_o) = 0.25 kg/cm^2

Creep Pressure (P_f) = 2.05 kg/cm^2

V_o = 190 cm^3

V_f = 440 cm^3

So, corrected limit pressure (P_l) = 2.35 –1.30 + 0.30 = 1.35 kg/cm^2

Corrected pressure at rest (P_o) = 0.25 – 0.20 + 0.30 = 0.35 kg/cm^2

Corrected creep pressure (P_f) = 2.05 – 0.80 + 0.30 = 1.55 kg/cm^2

$E_m = 2.66 \times \{V_c + (V_0+V_f)/2\} \times (P_f - P_0) / (V_f - V_0)$

By substituting all the values in the equation as above, we get

$E_m = 2.66 \{705 + (190+440)/2\} \times (1.55 – 0.35)/(440 - 190) = 13.02$ kg/cm^2

Thus, the two parameters obtained at 2.00m depth below the existing ground surface at the location of PMT-01 are: -

(i) Limit pressure, P_l = 1.35 kg/cm^2

(ii) Young's Modulus, E = 13.02 kg/cm^2

3. CONCLUSIONS:

1. **Four nos. Pressuremeter tests were carried out at various locations** (i.e. PMT-01, 02, 03 & 04) at depths varying from 2.00m to 30.00m below the existing ground surface & shown in figures (2) to (64).

2. It is revealed that the limit pressure ranged from 0.05 to 23.40 kg/cm^2 & Young's modulus ranges from 1.36 to 425.6 kg/cm^2.

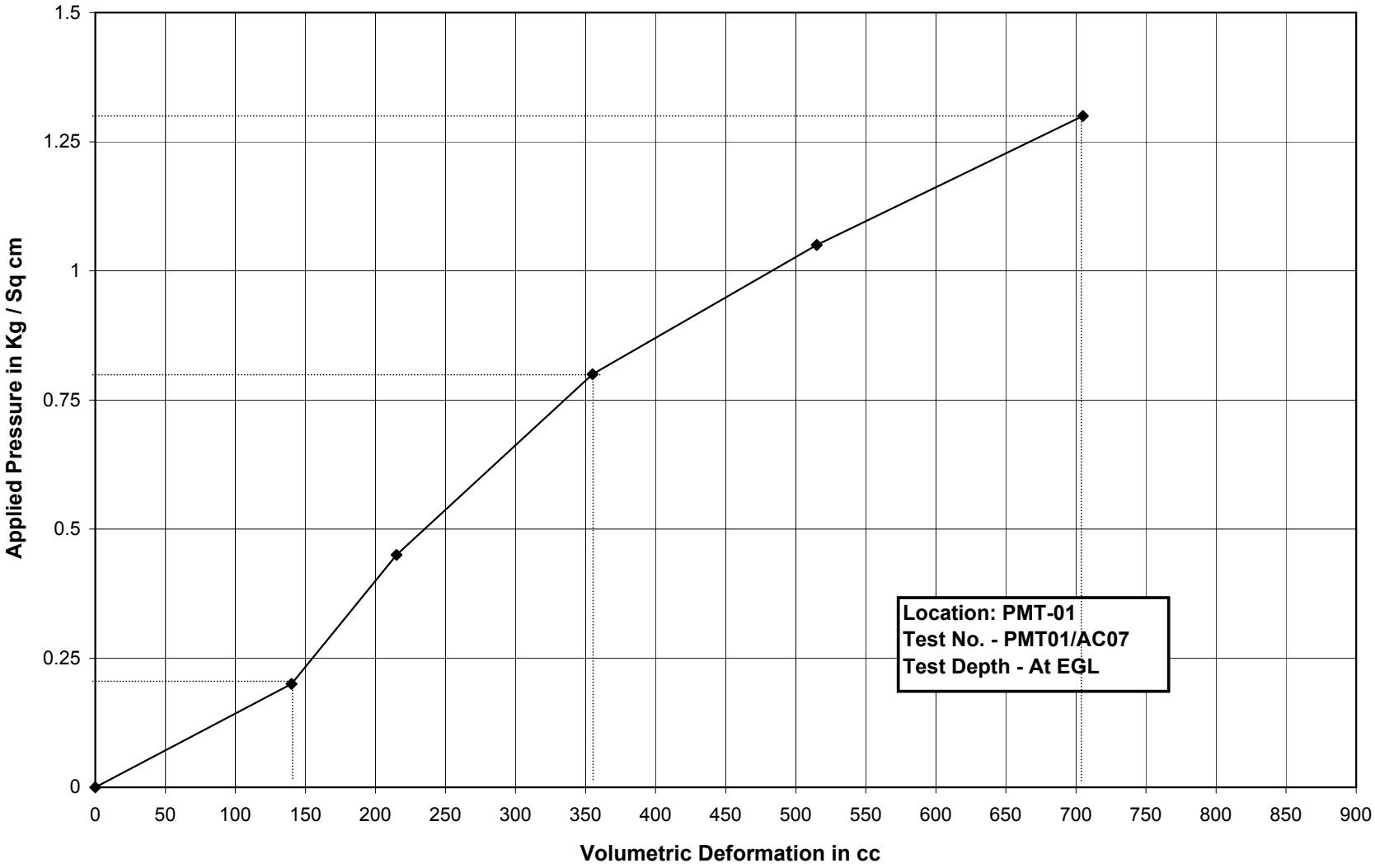


Fig. 2: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

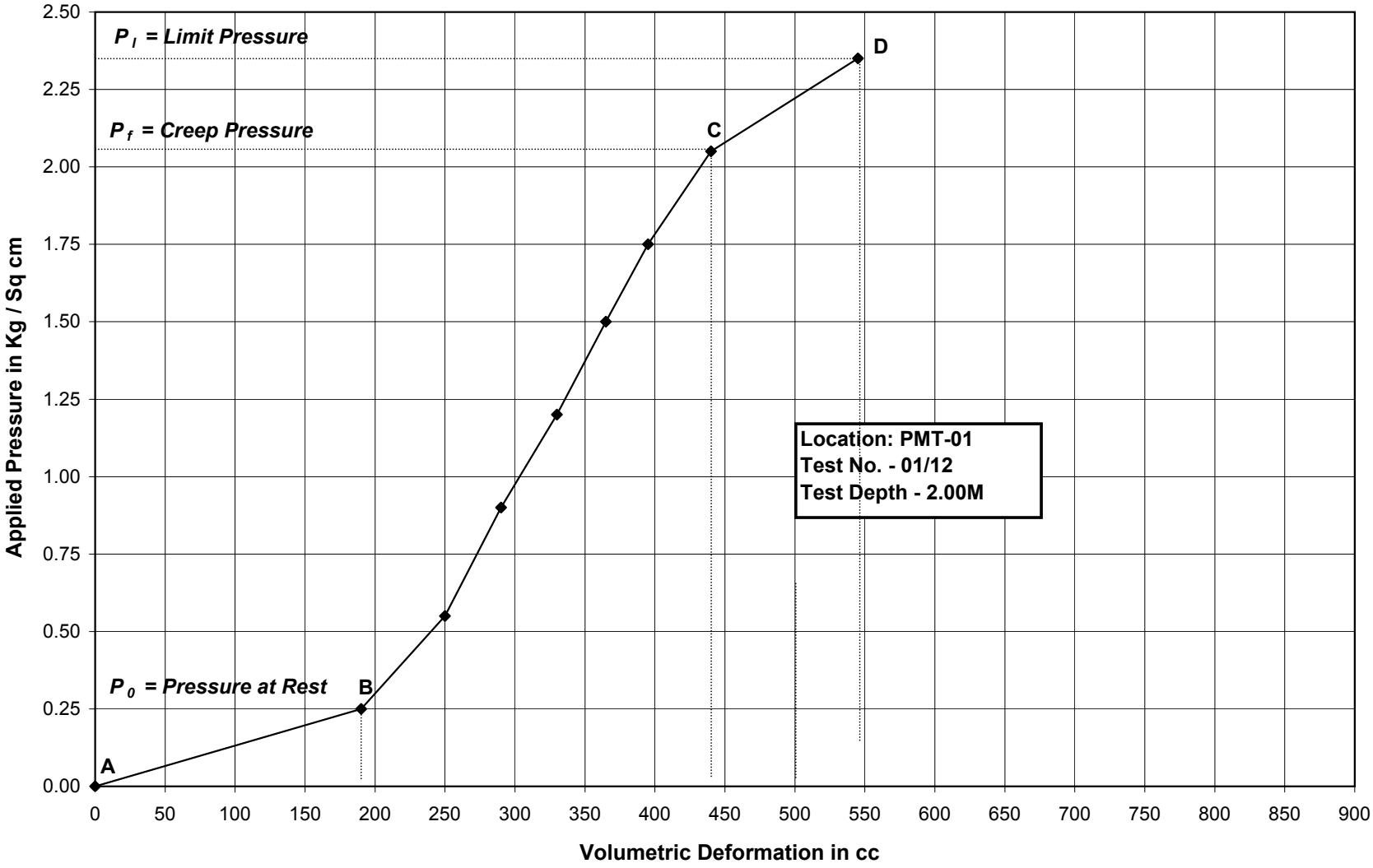


Fig. 3: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

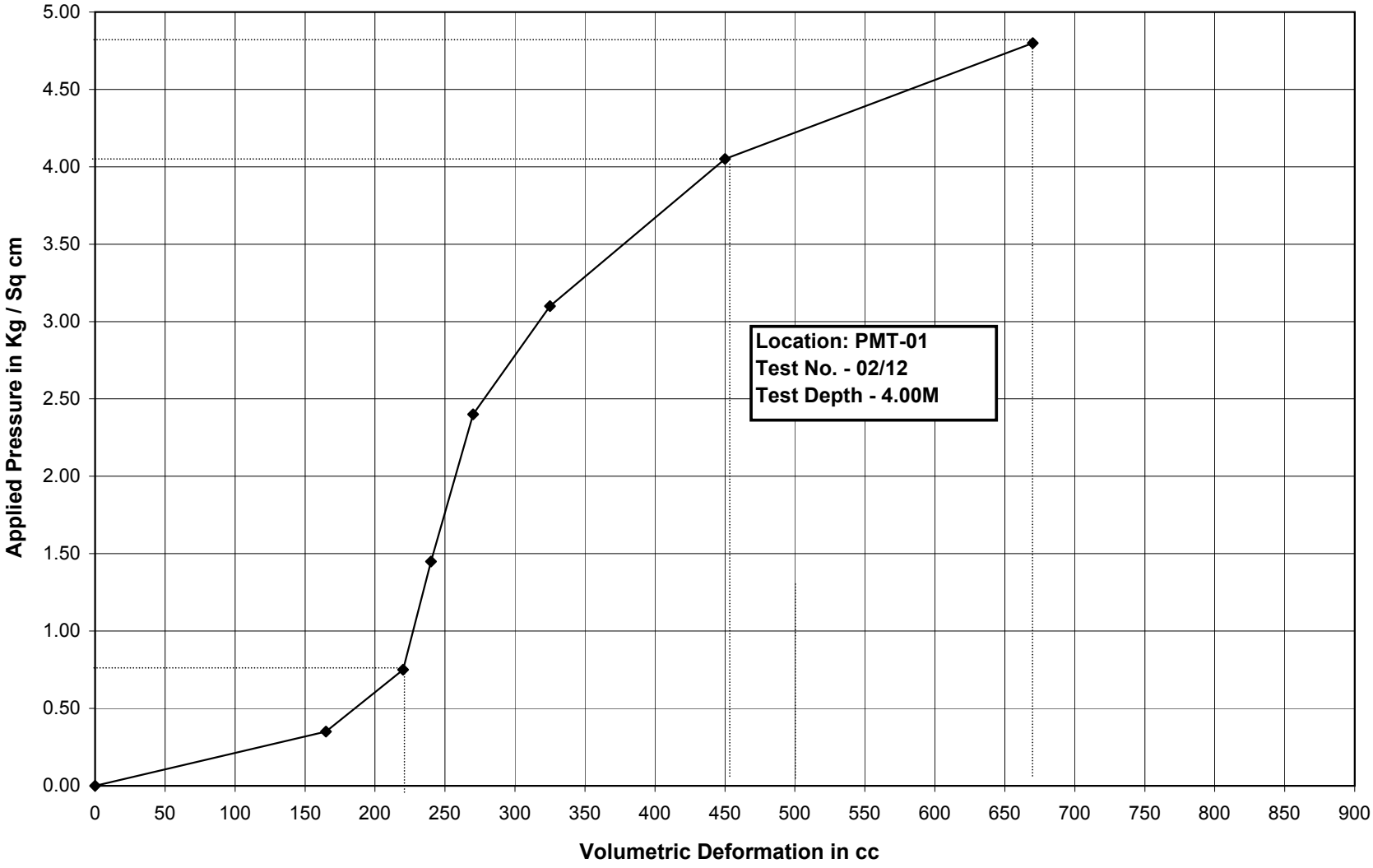


Fig. 4: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

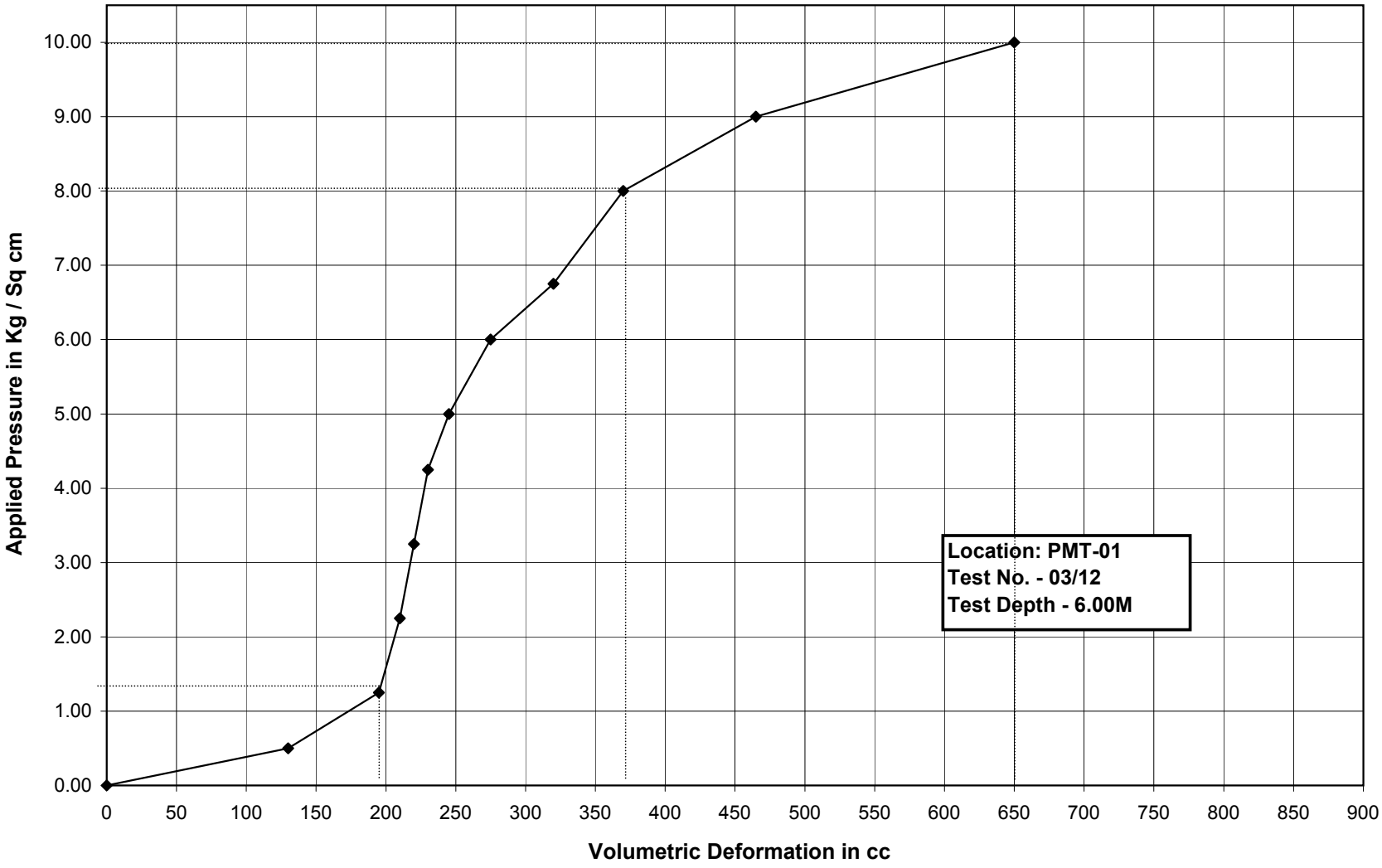


Fig. 5: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

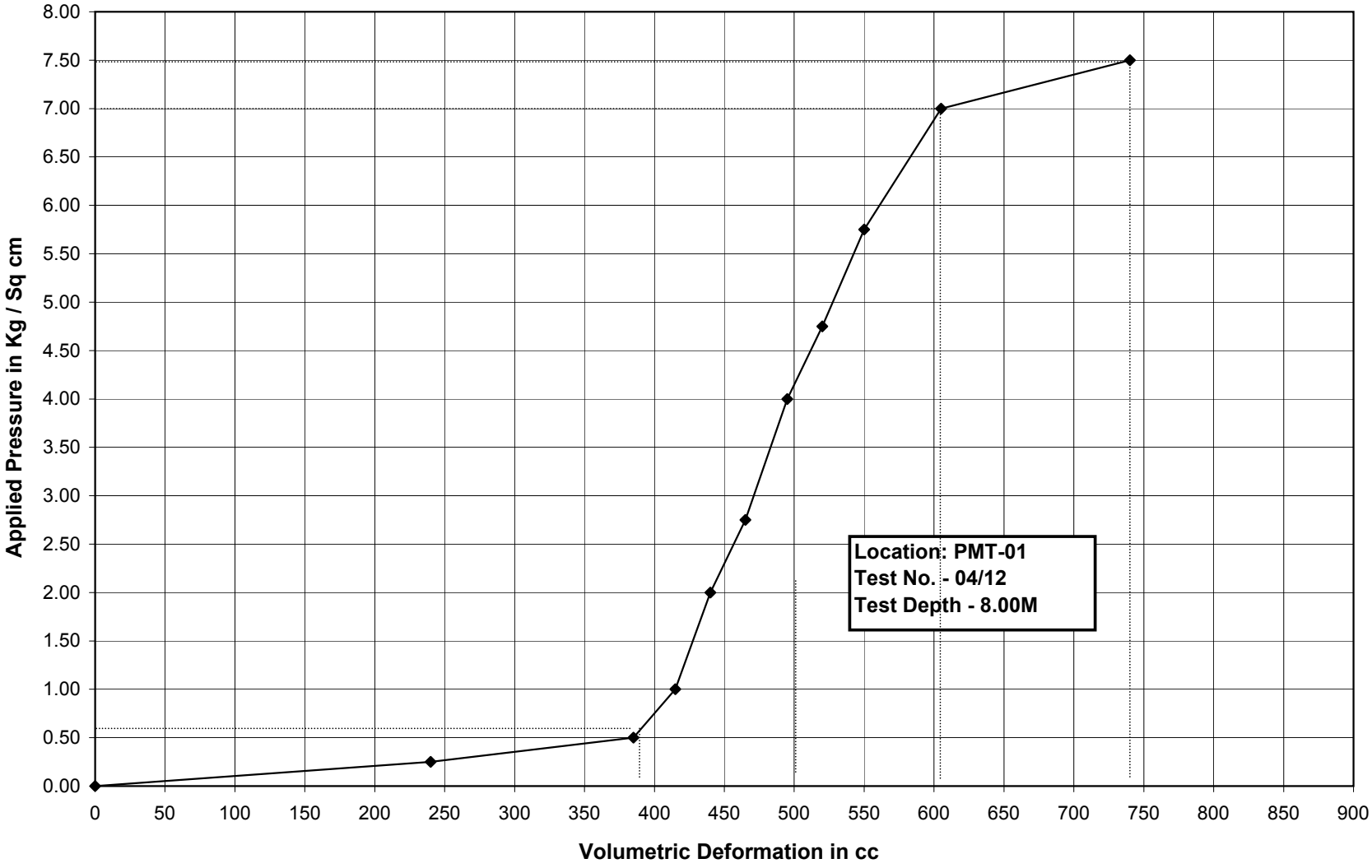


Fig. 6: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

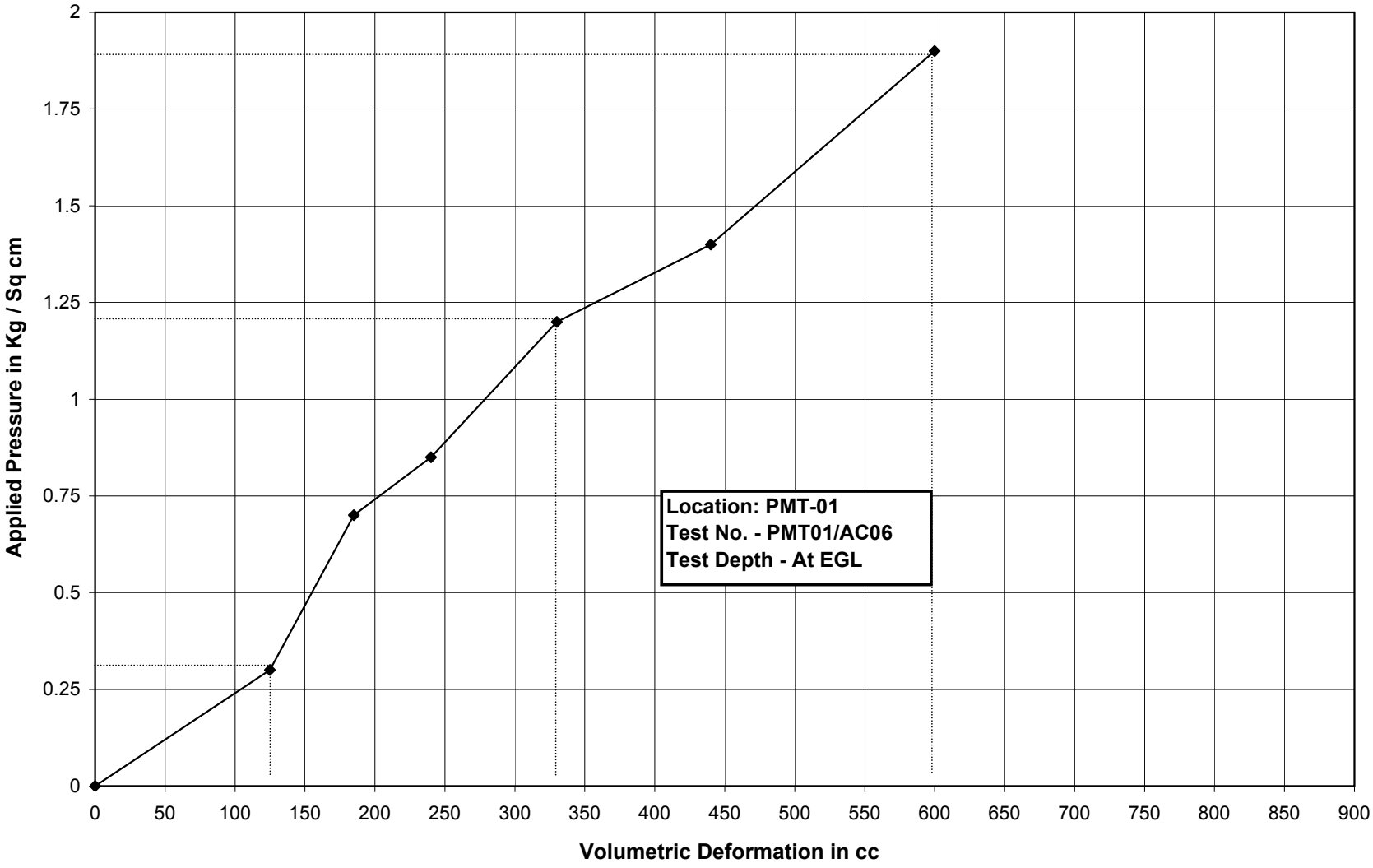


Fig. 7: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

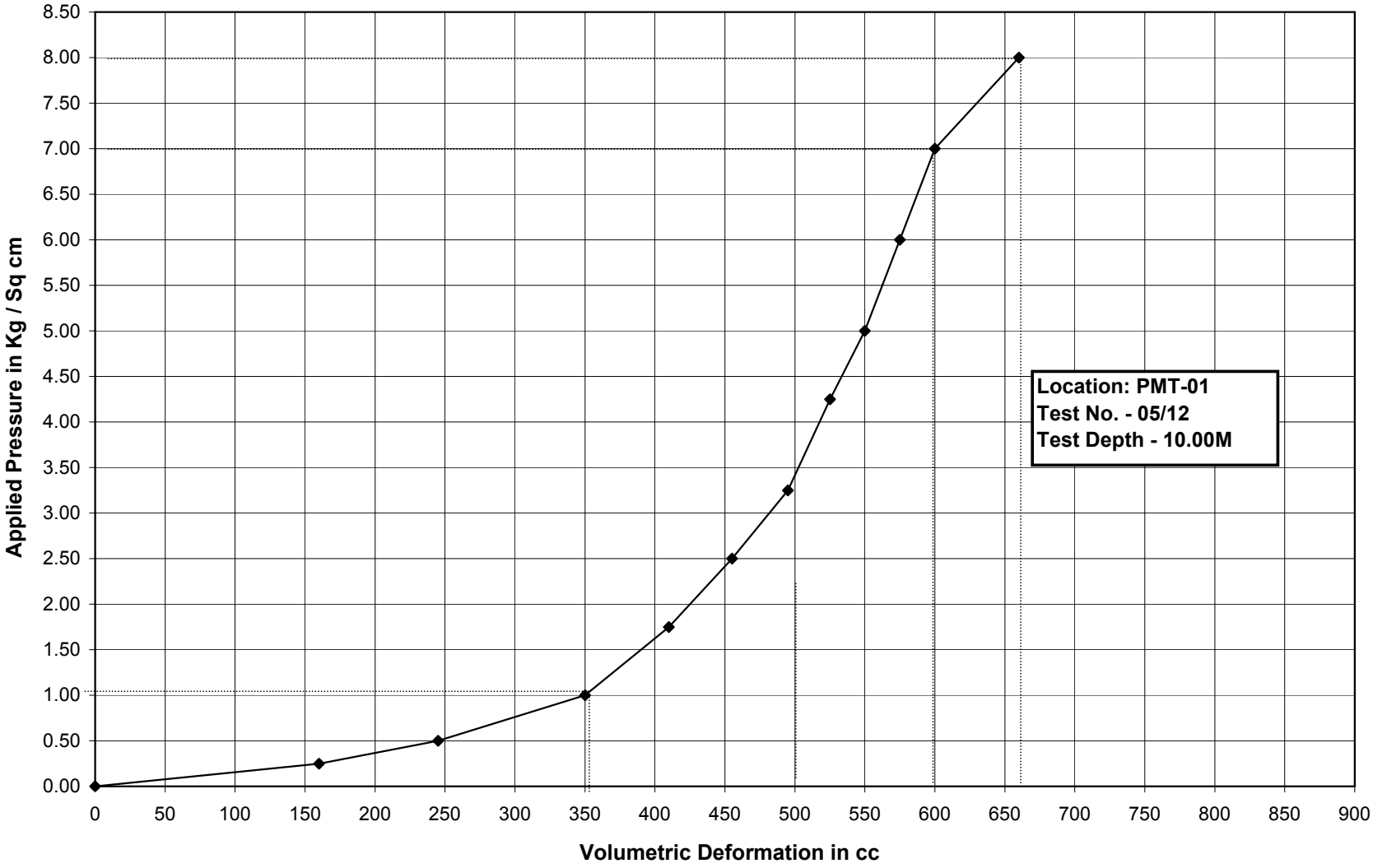


Fig. 8: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

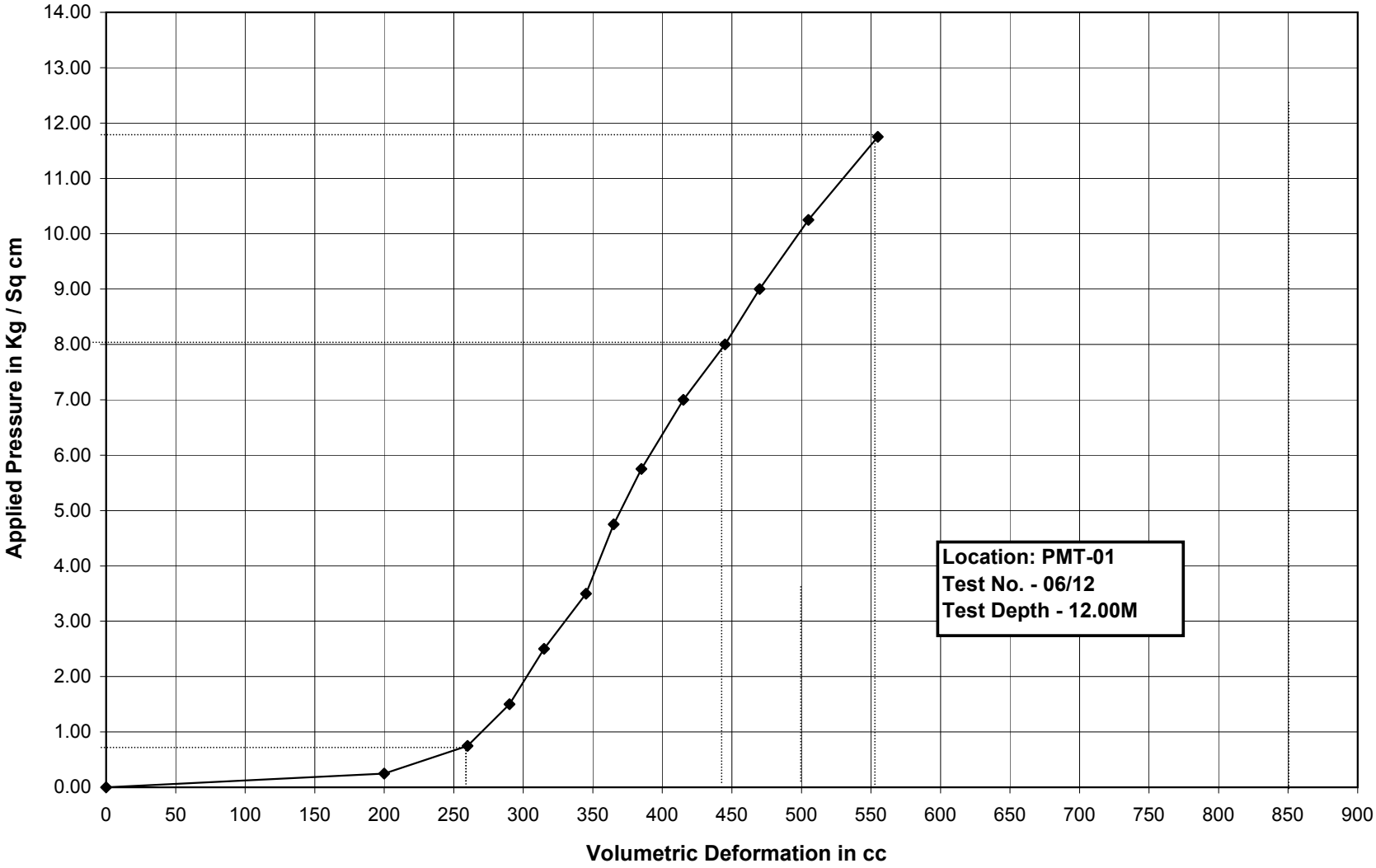


Fig. 9: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

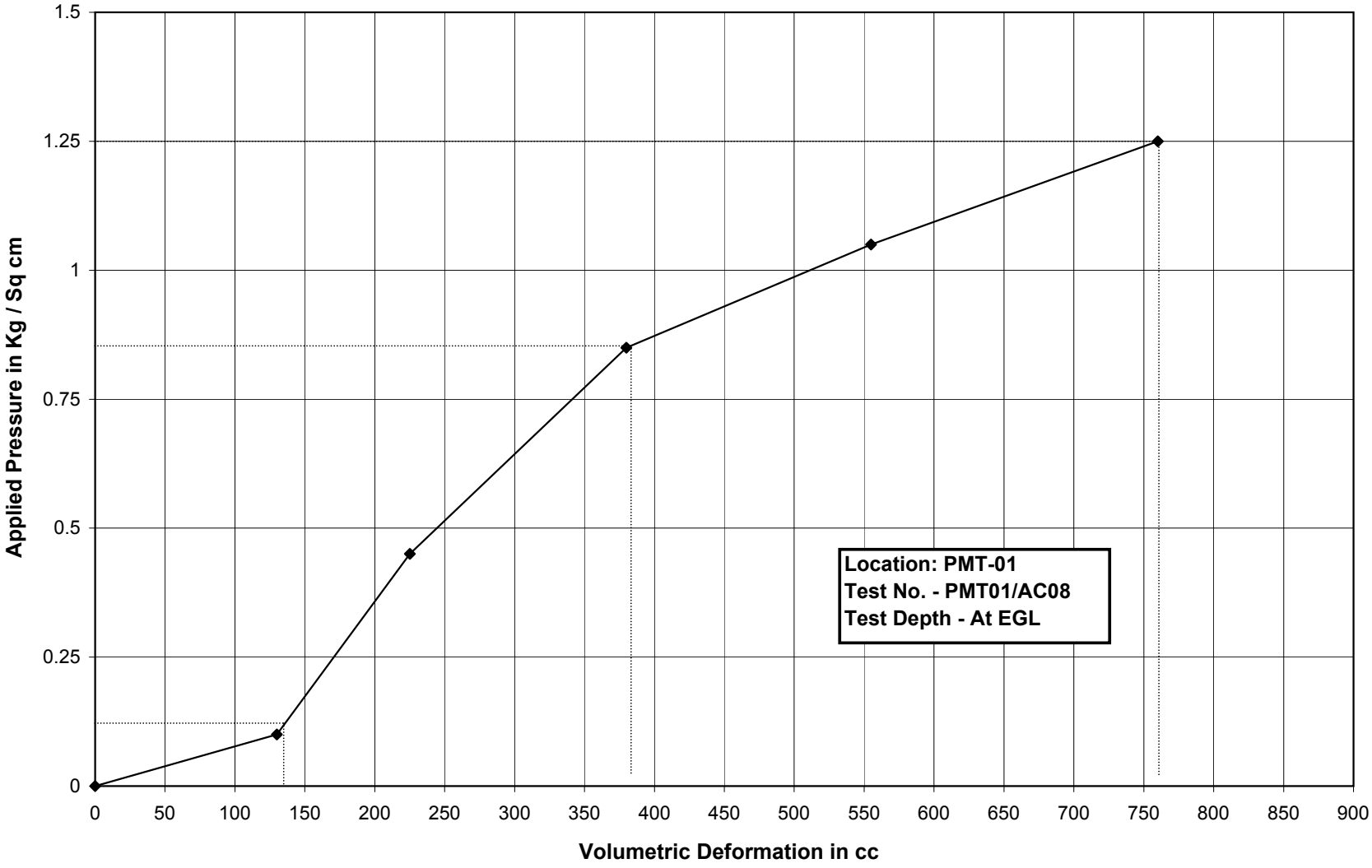


Fig. 10: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

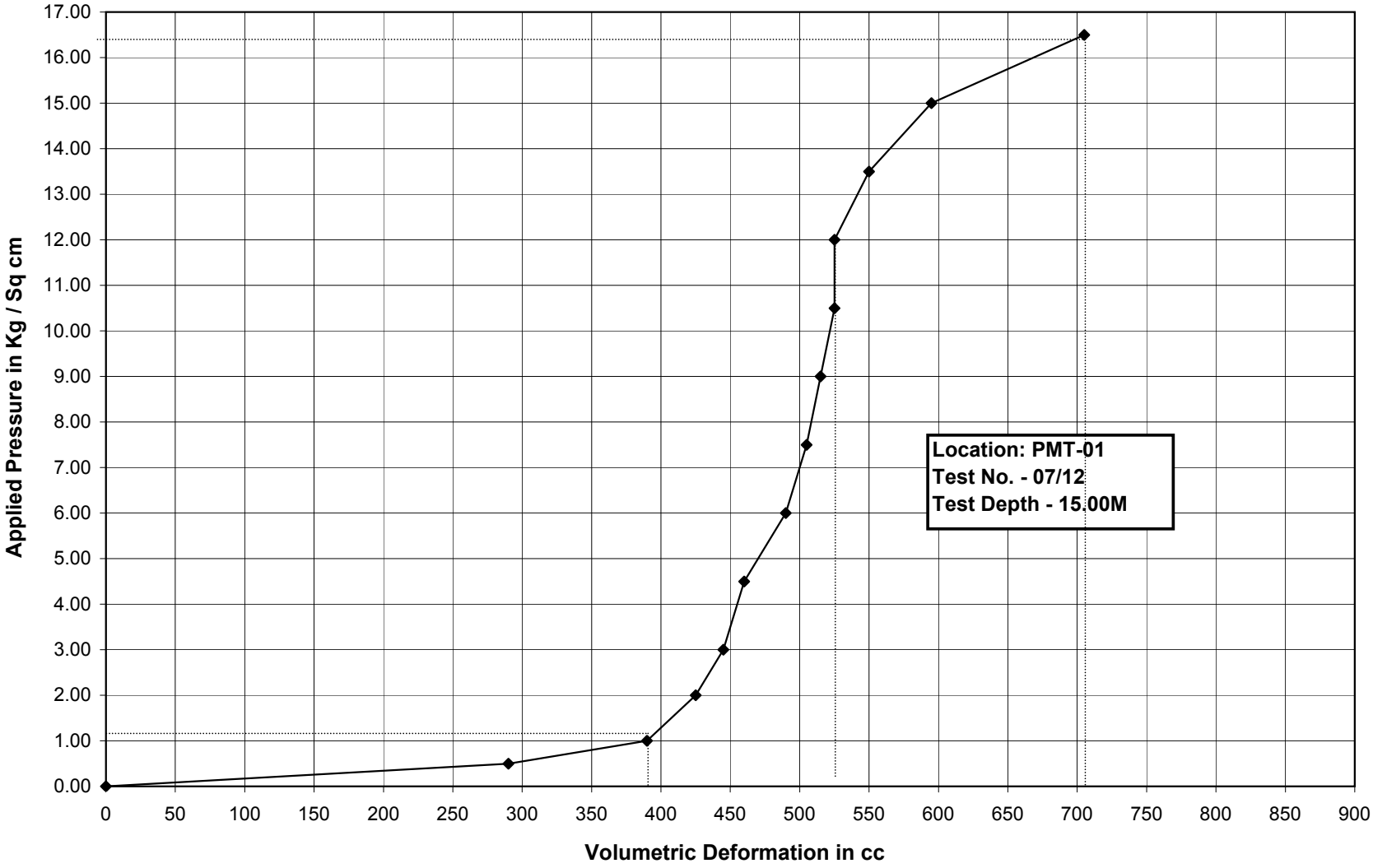


Fig. 11: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

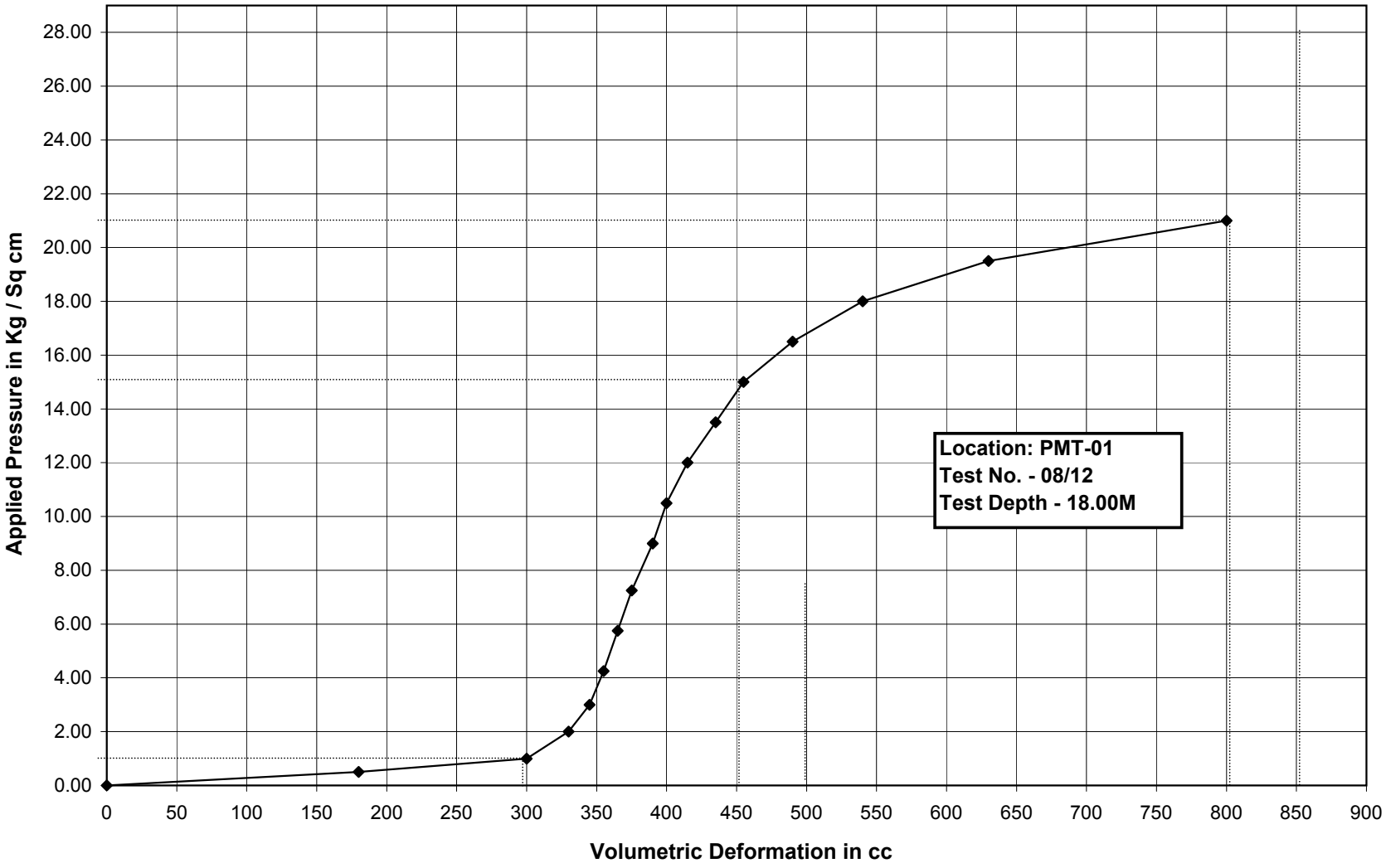


Fig. 12: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

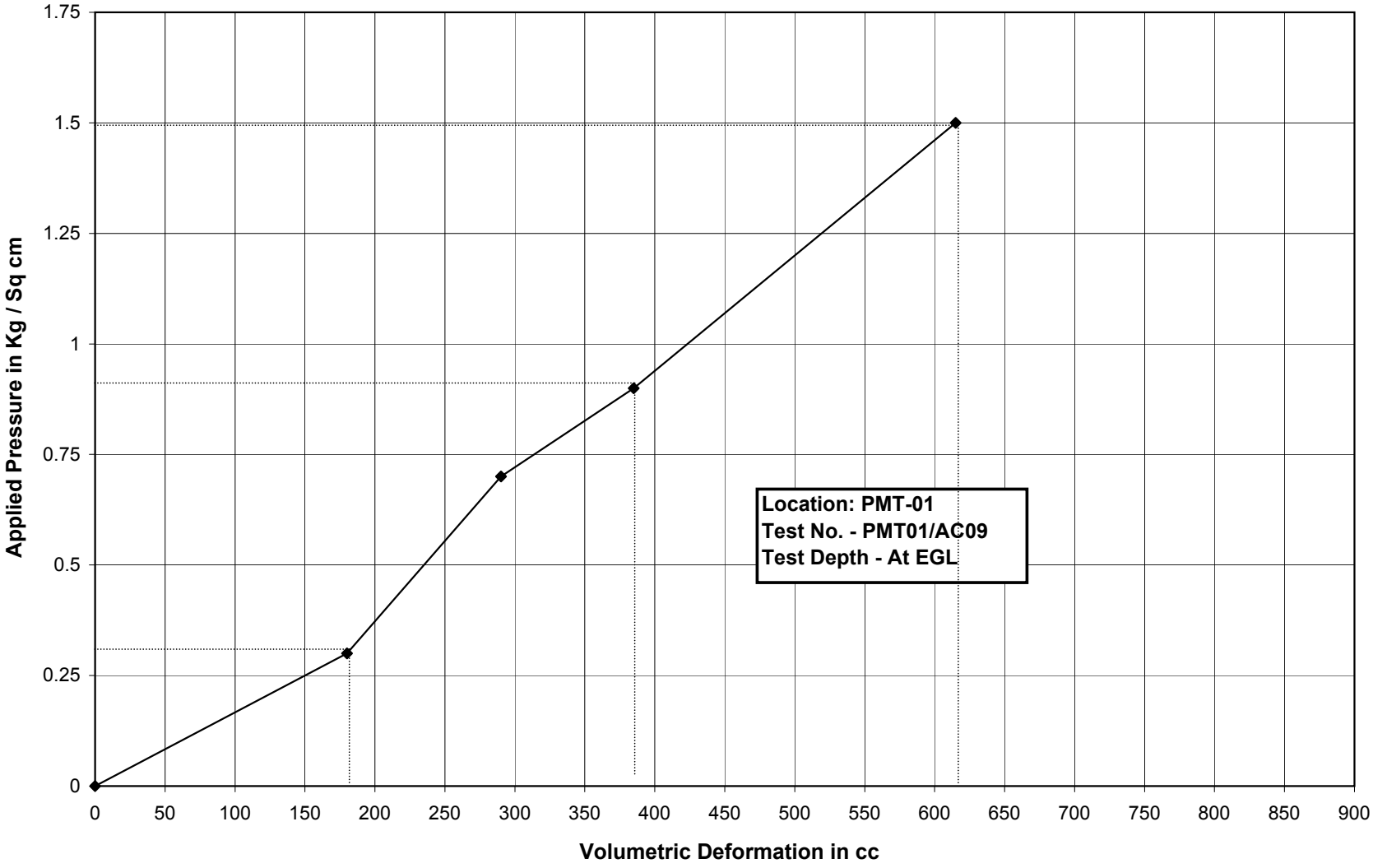


Fig. 13: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

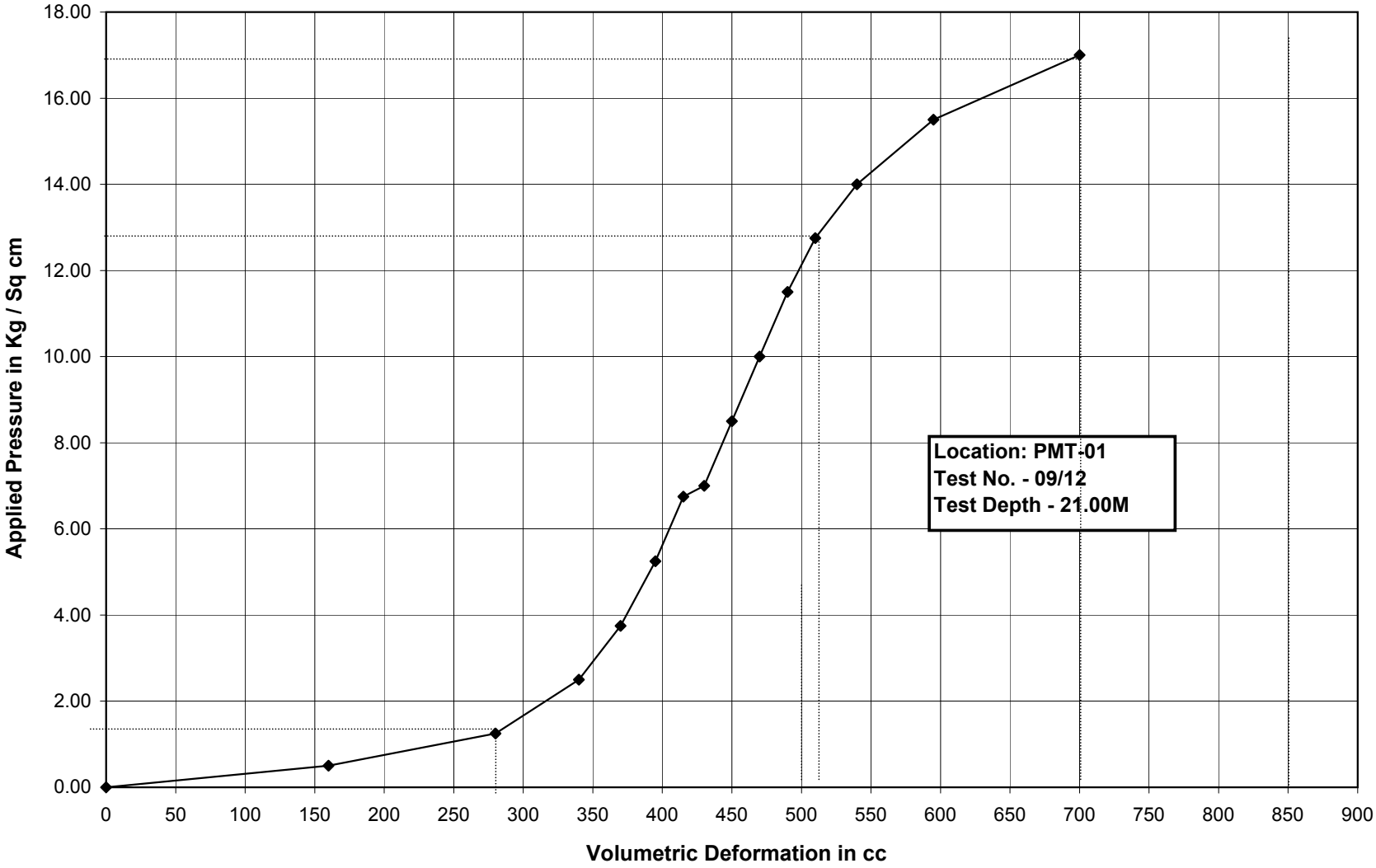


Fig. 14: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

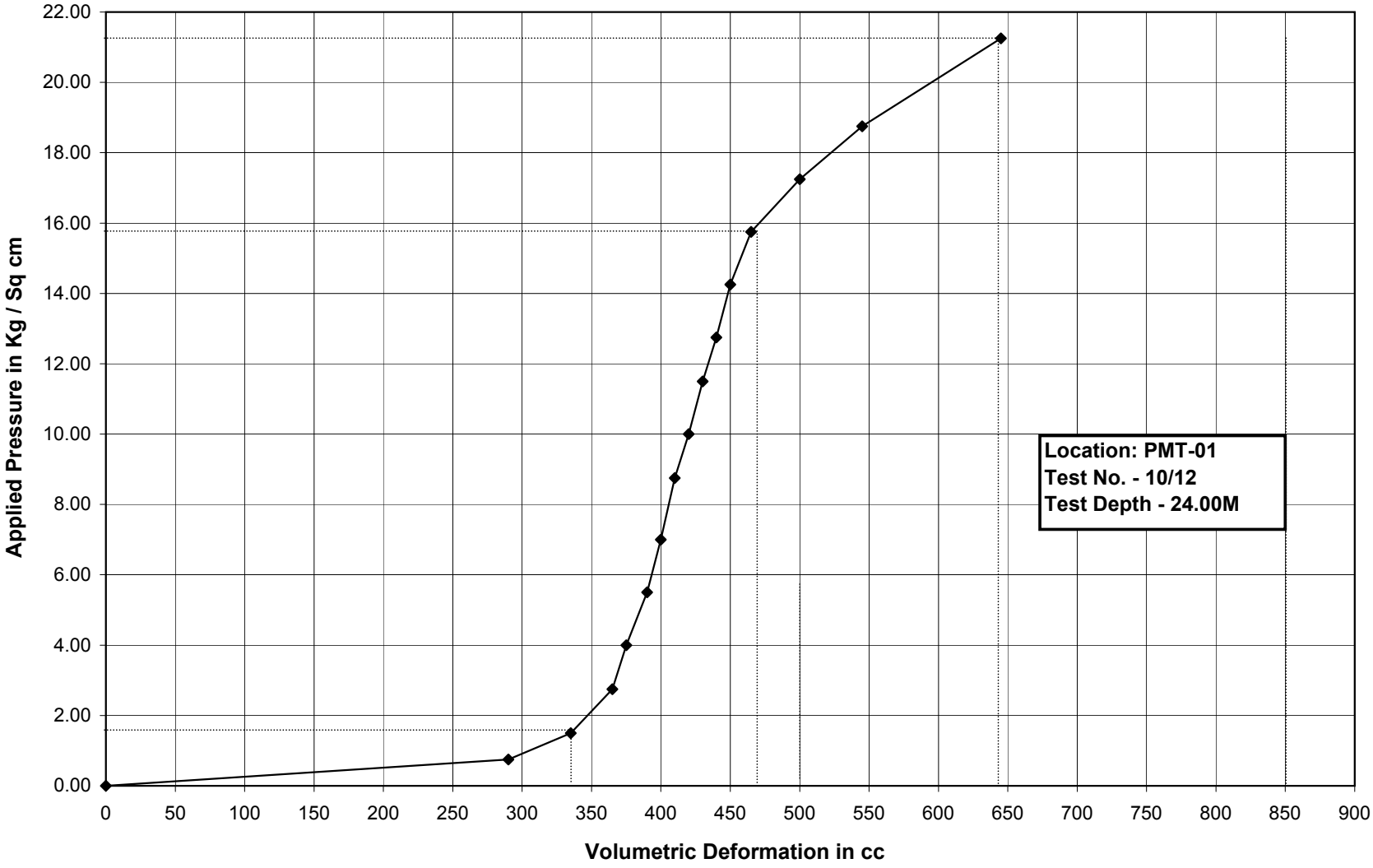


Fig. 15: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

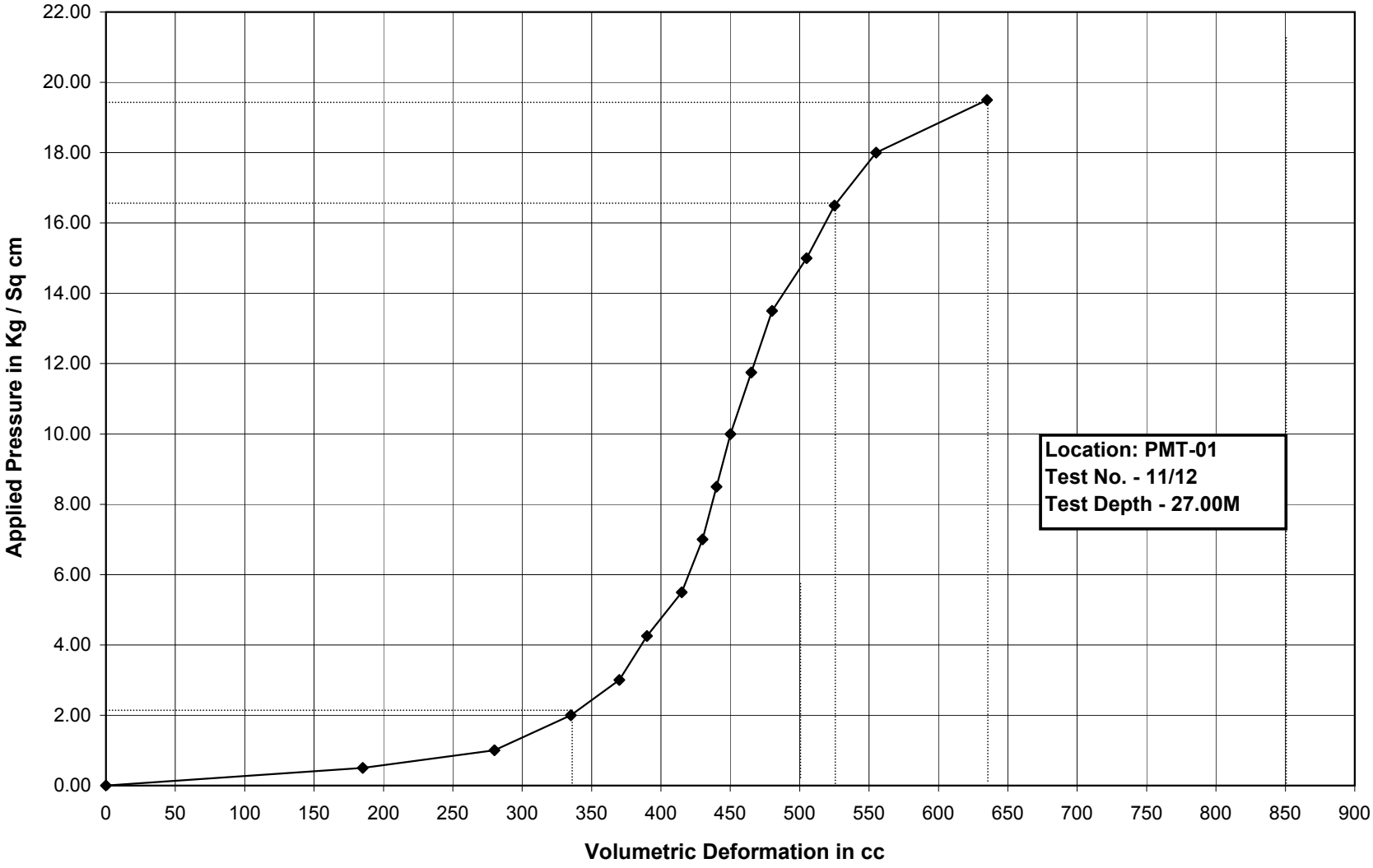


Fig. 16: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

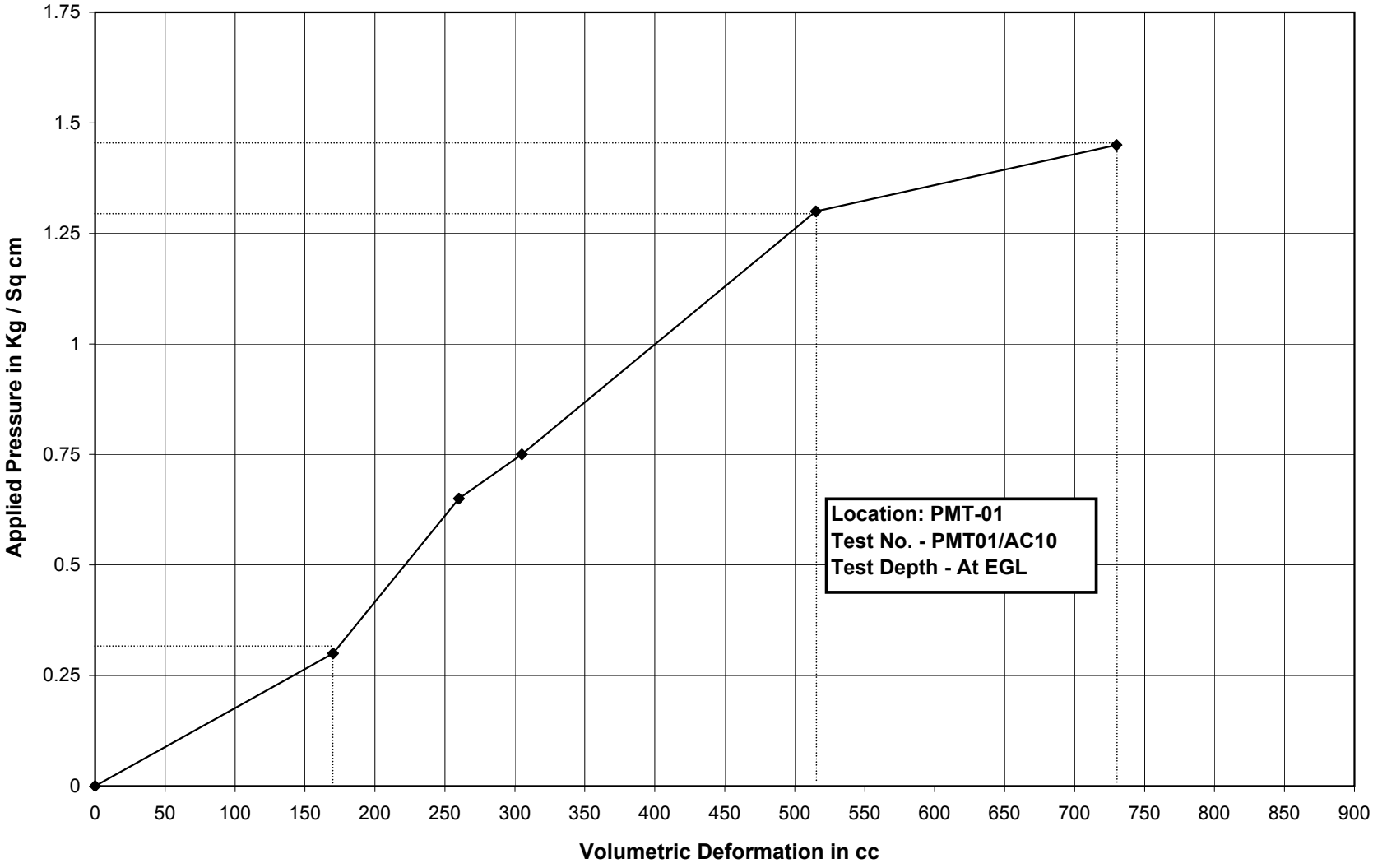


Fig. 17: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

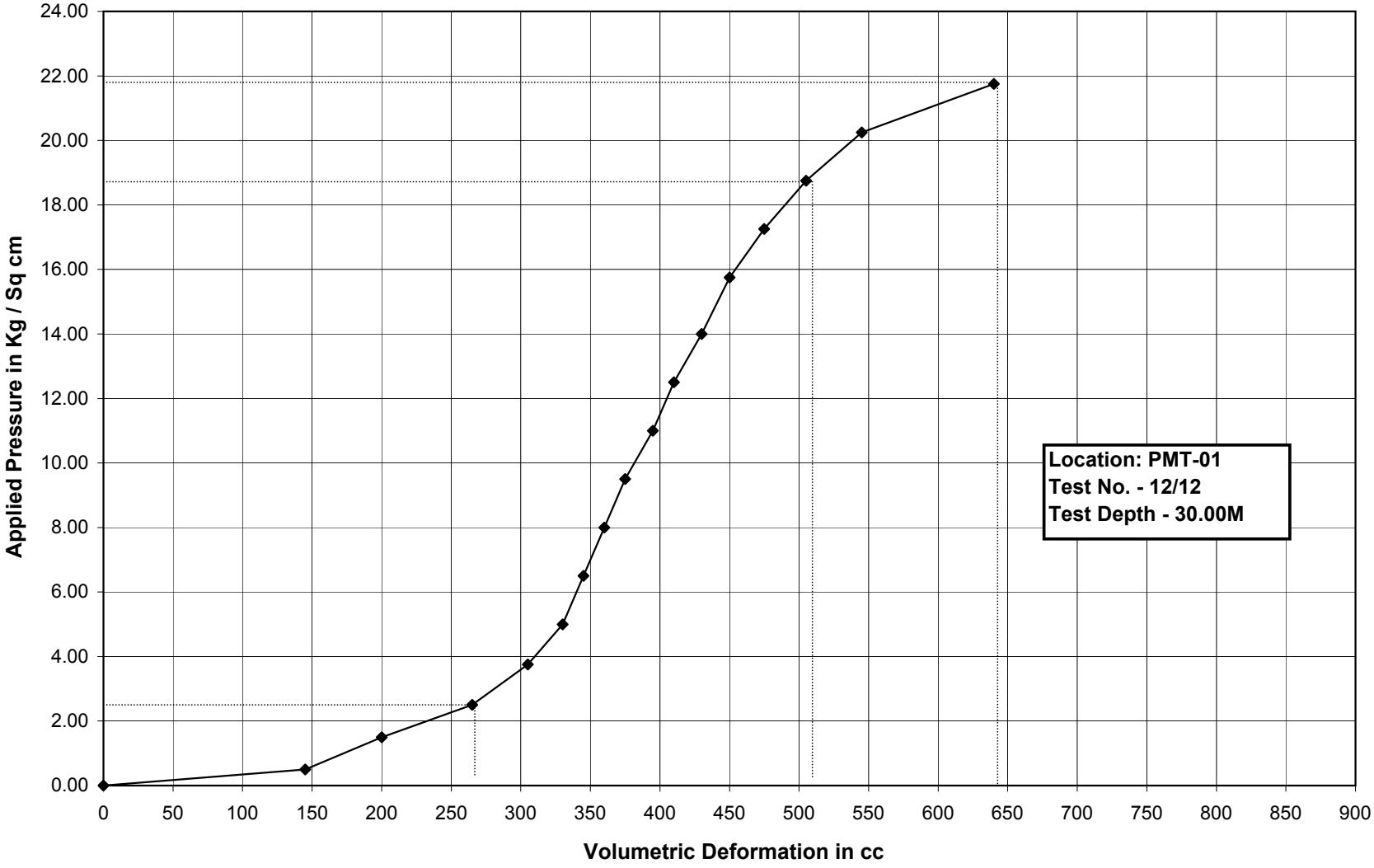


Fig. 18: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

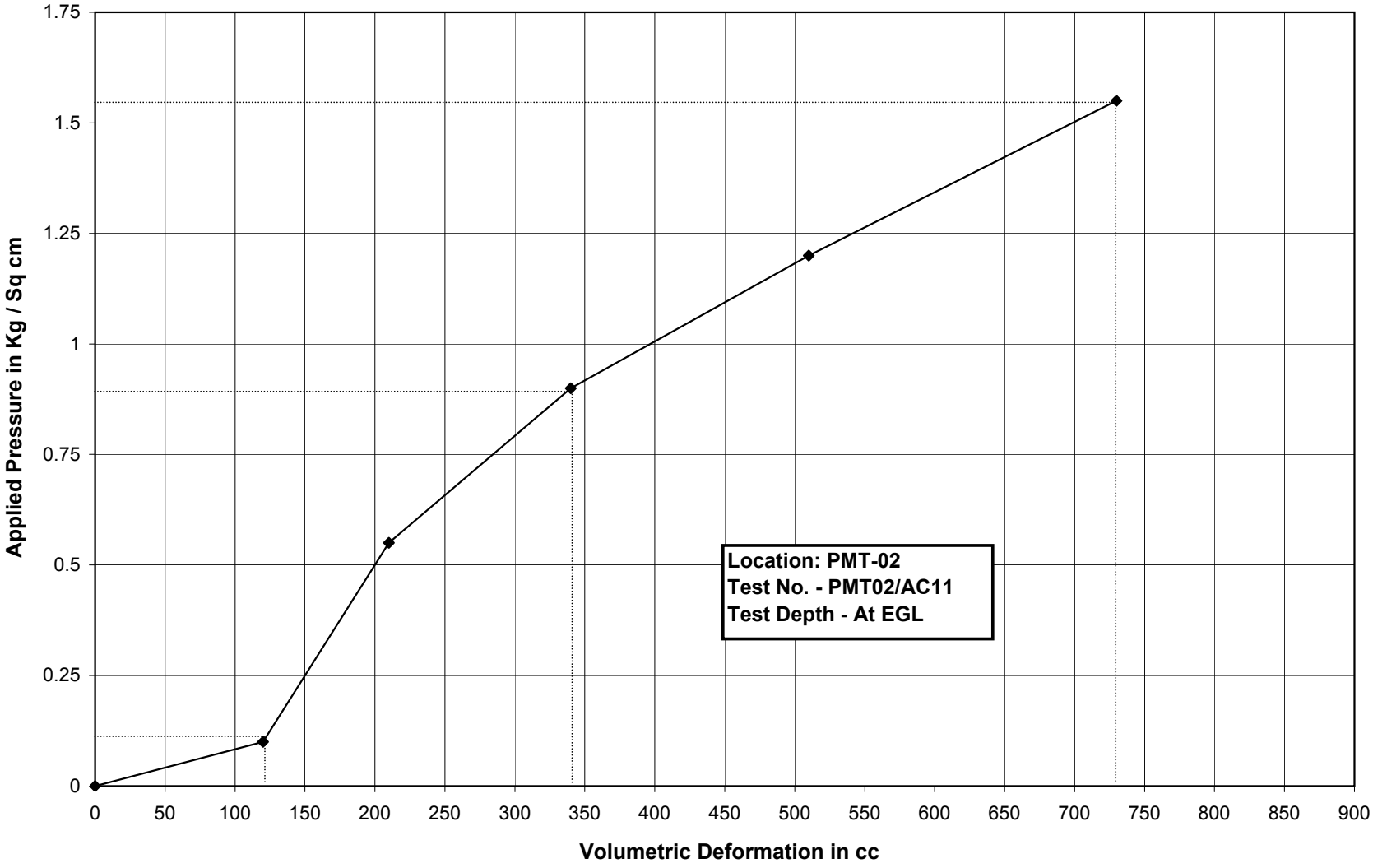


Fig. 19: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

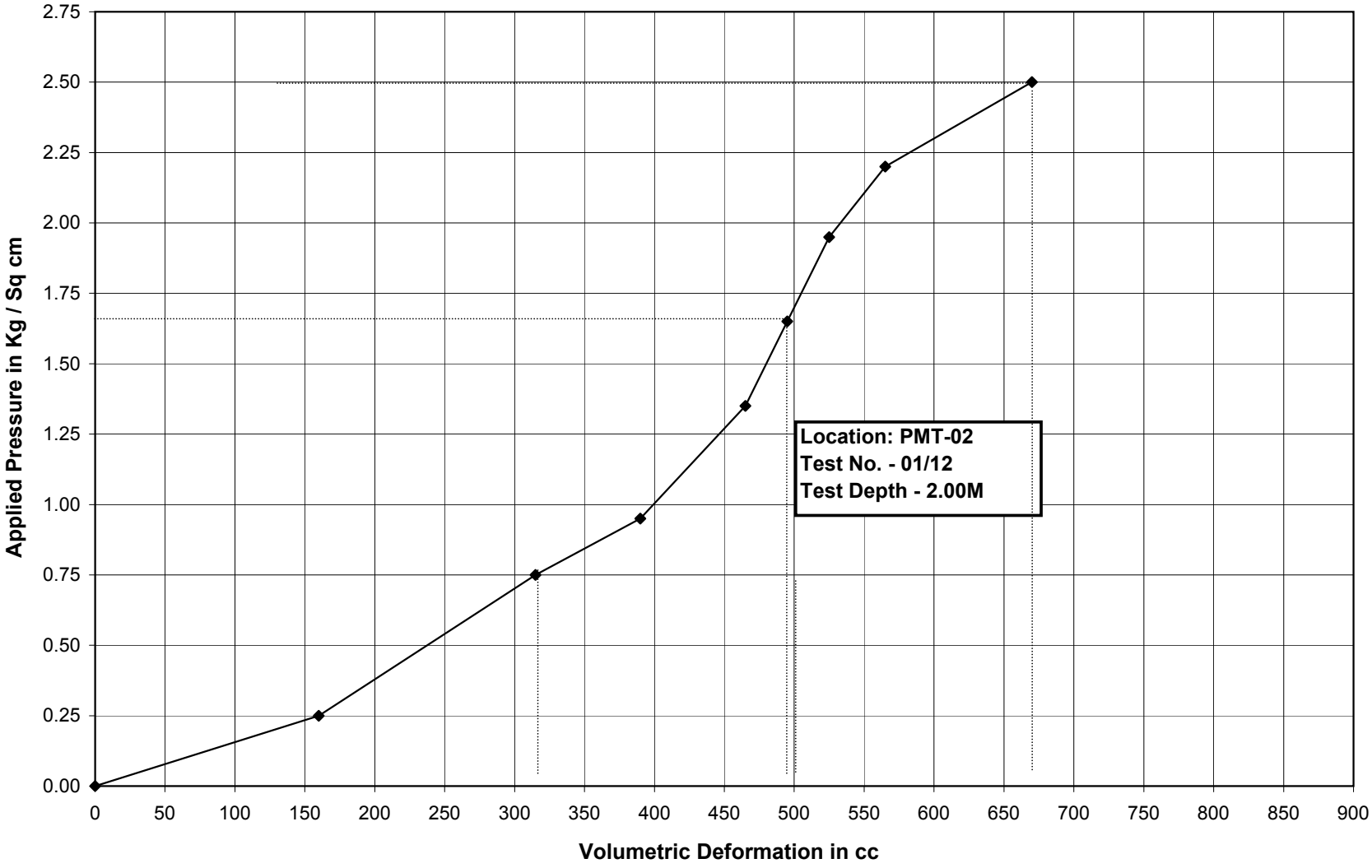


Fig. 20: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

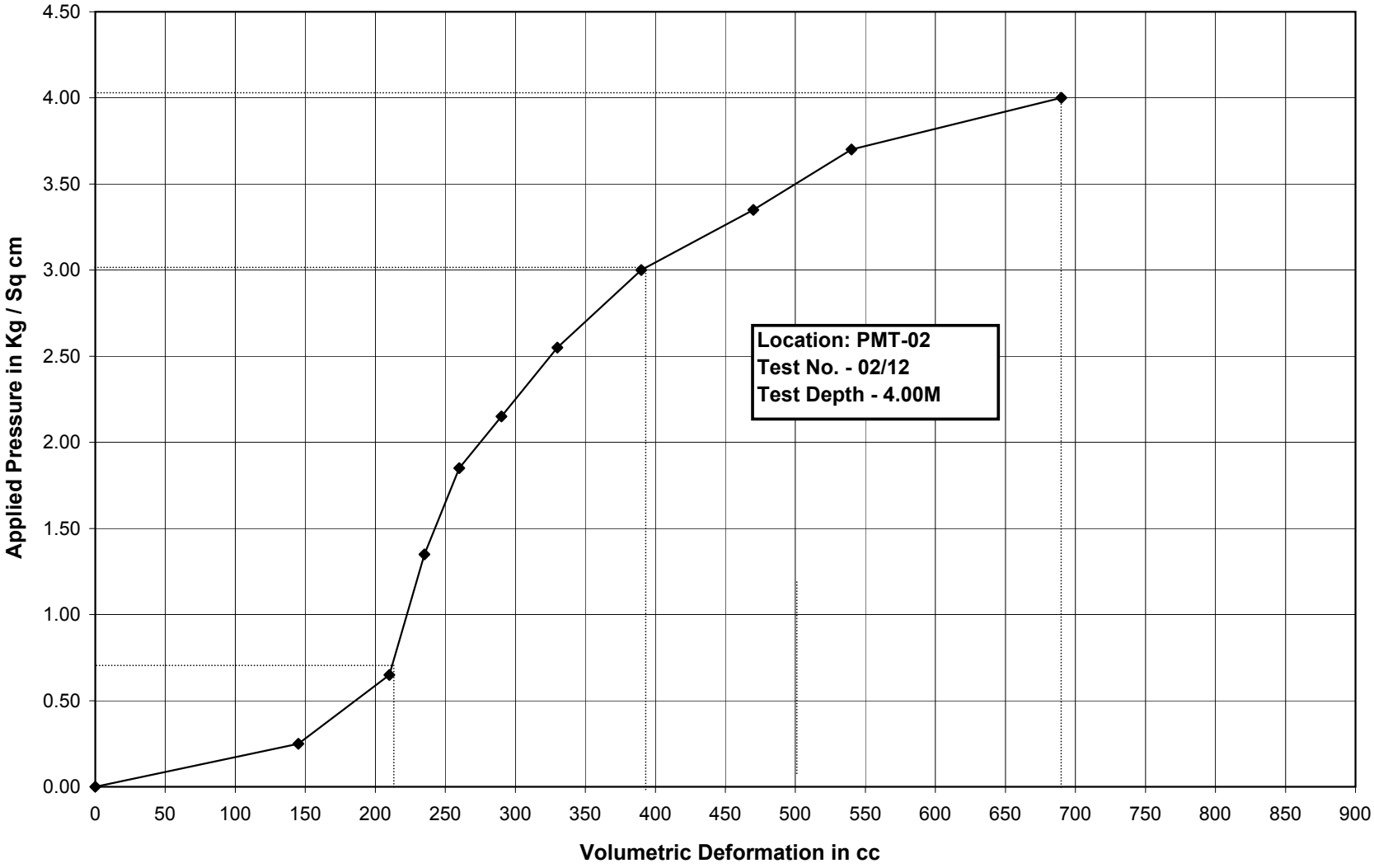


Fig. 21: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

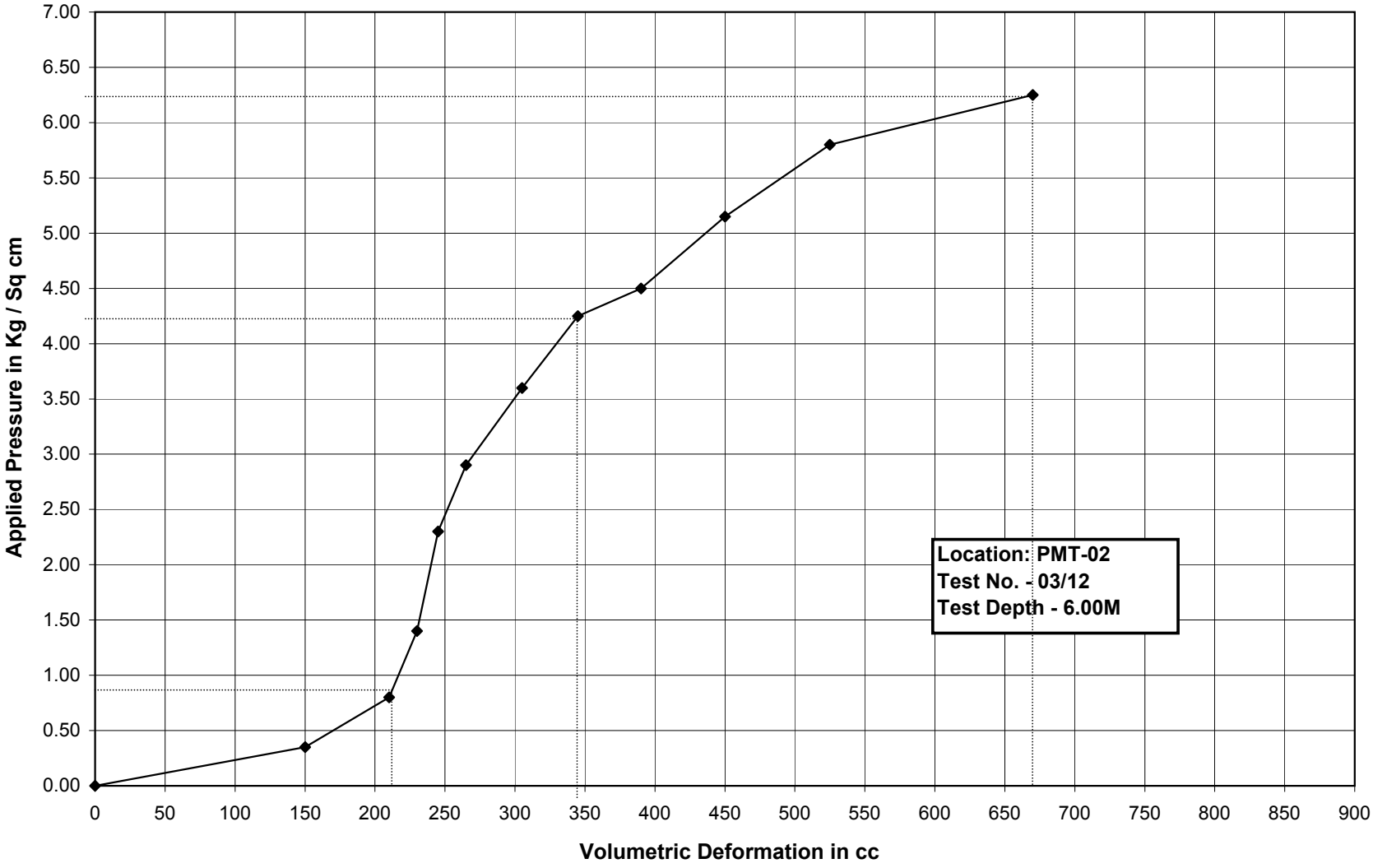


Fig. 22: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

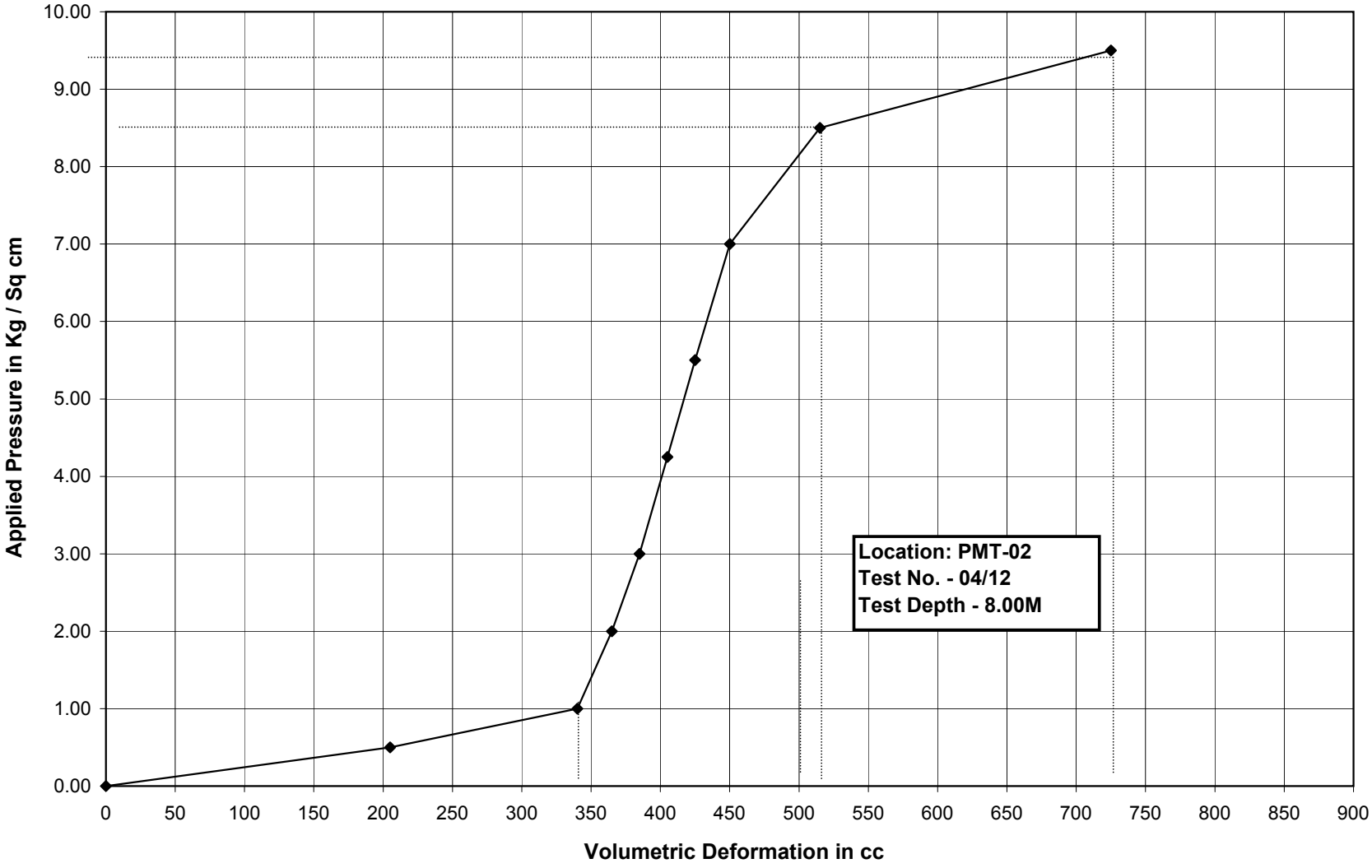


Fig. 23: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

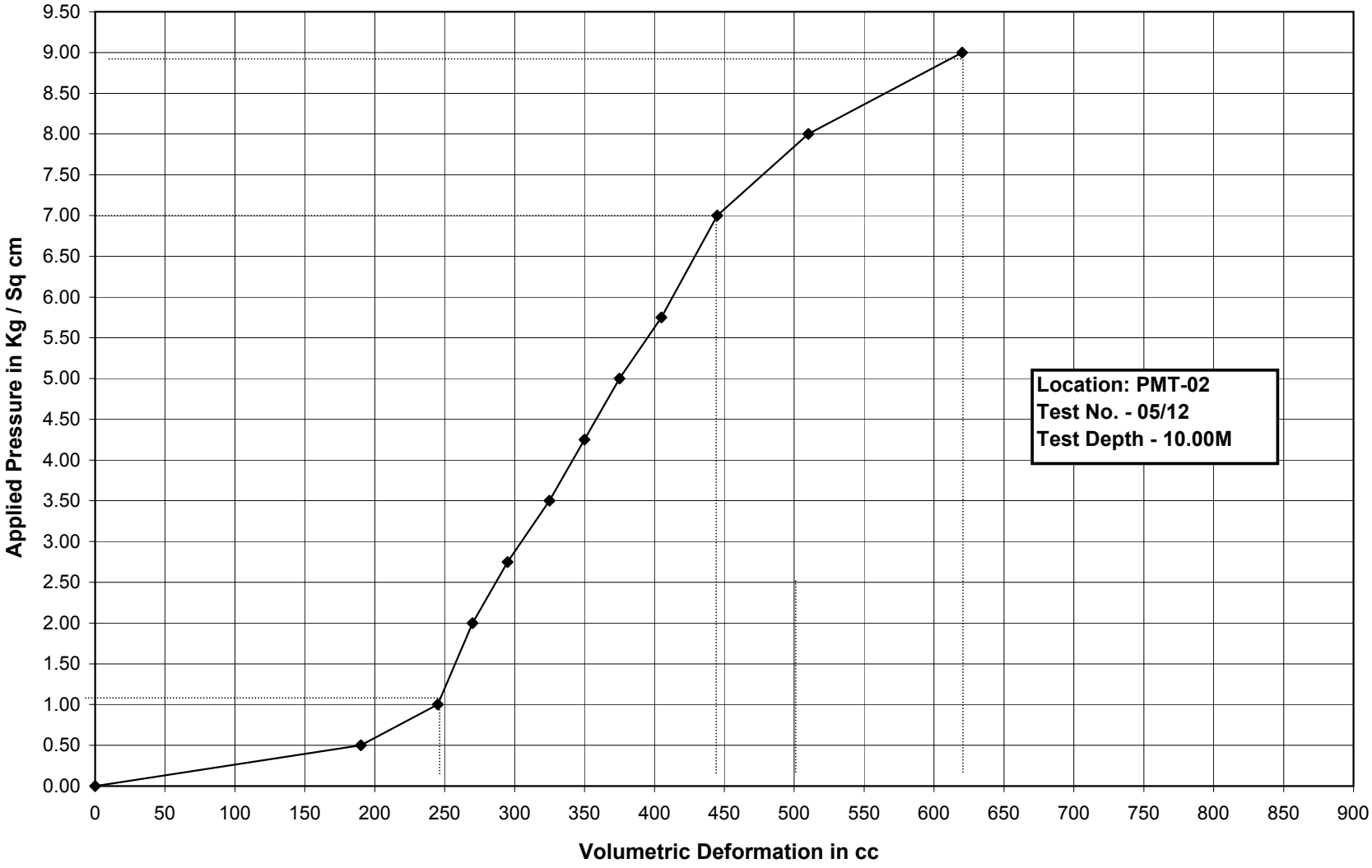


Fig. 24: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

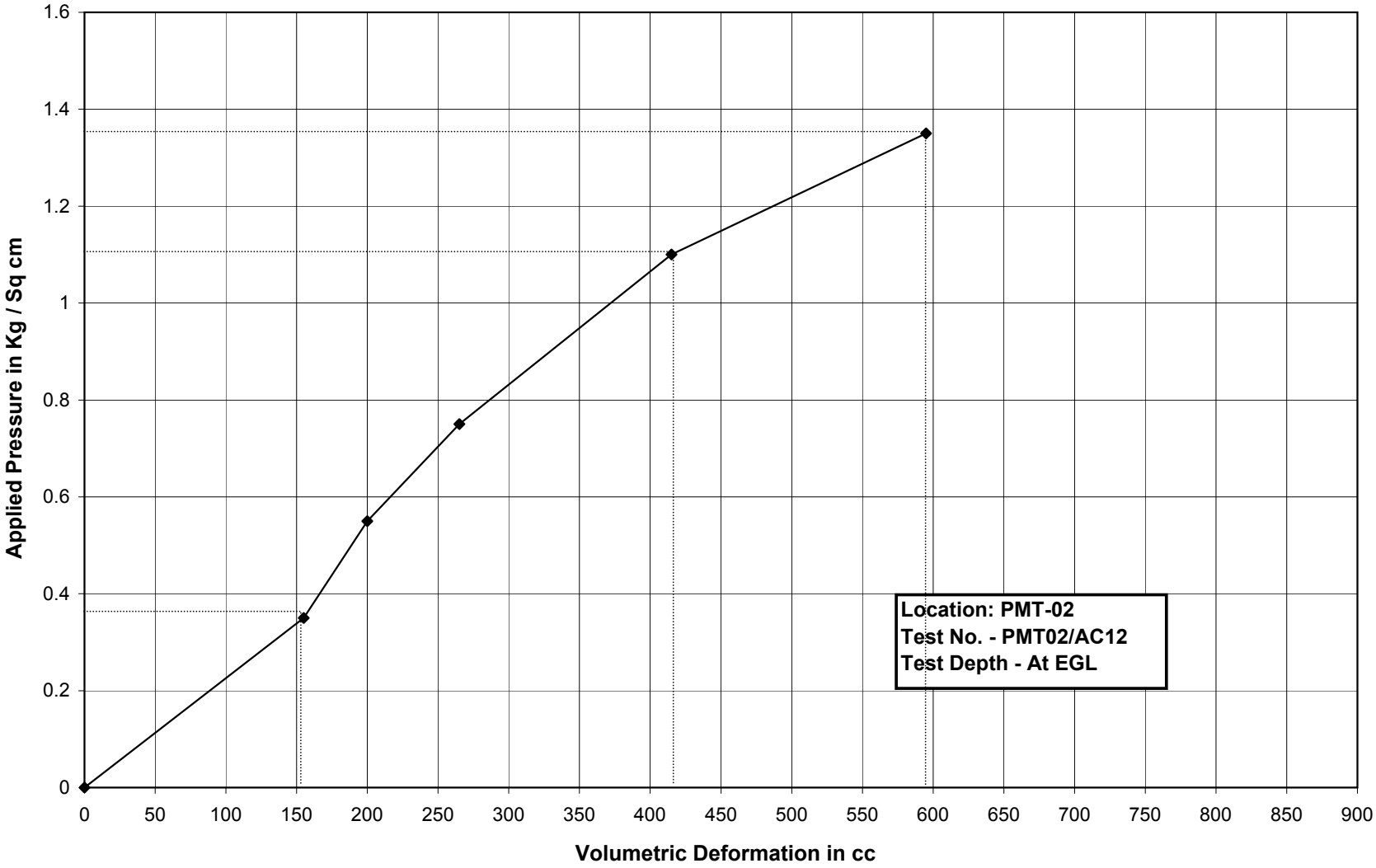


Fig. 25: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

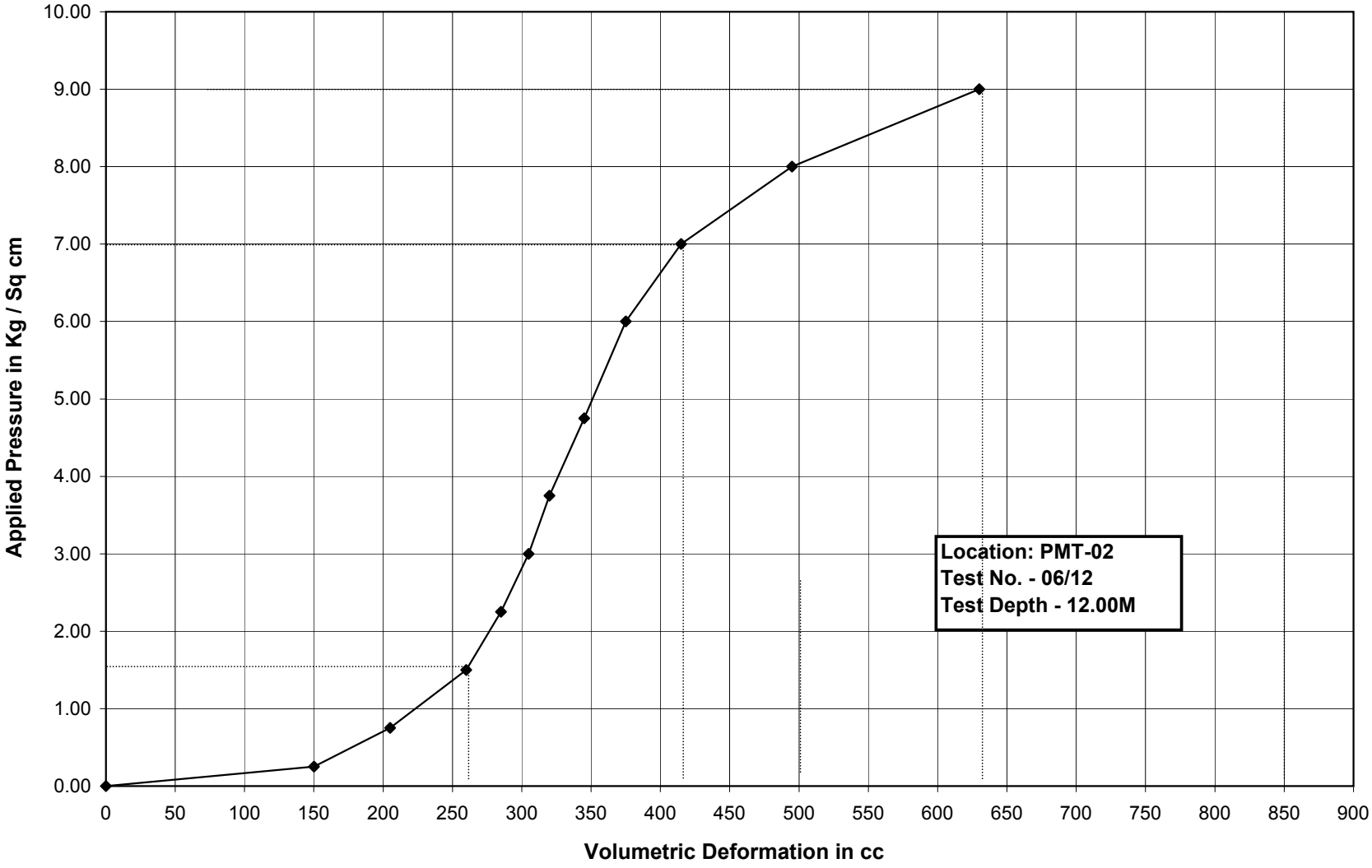


Fig. 26: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

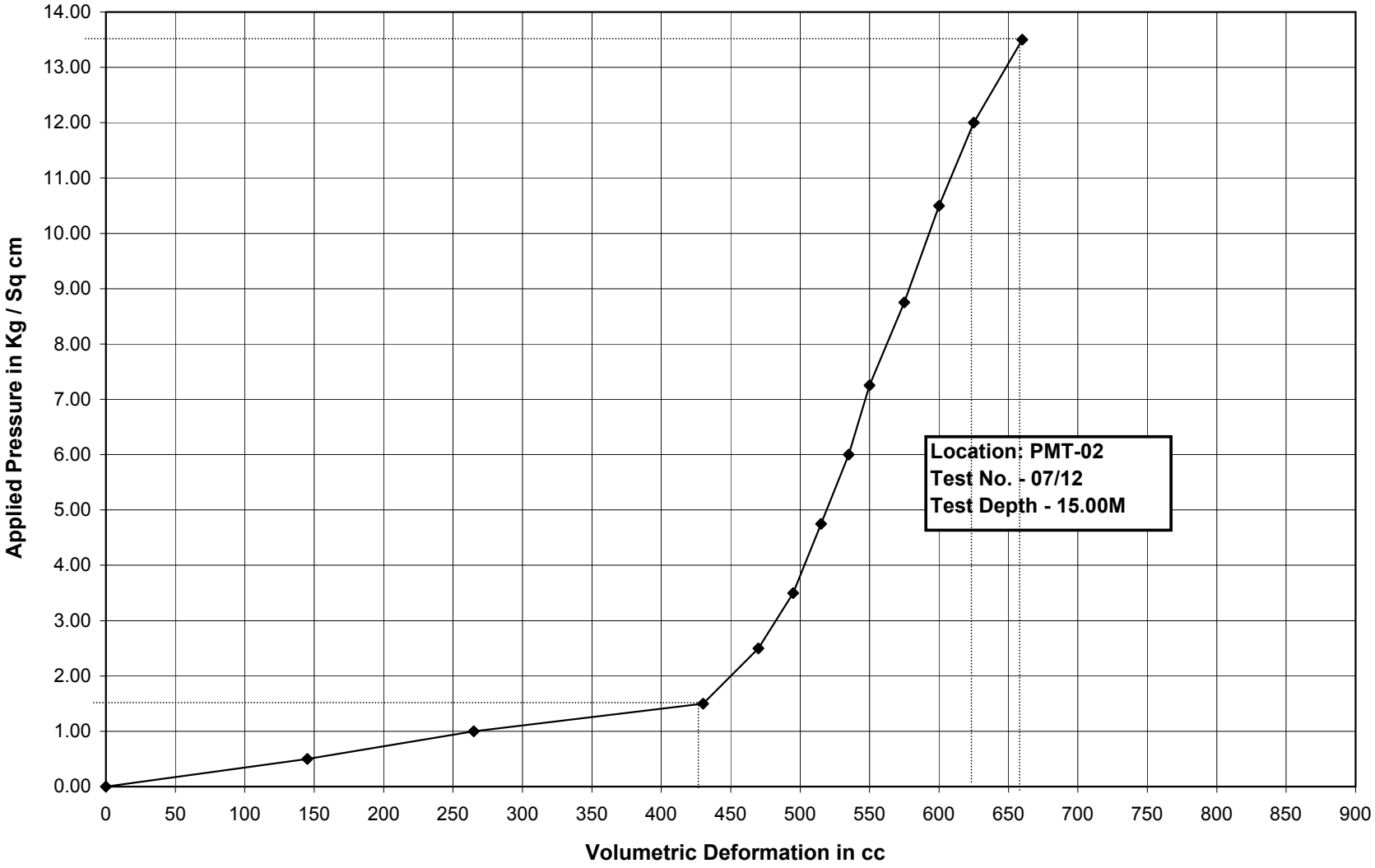


Fig. 27: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

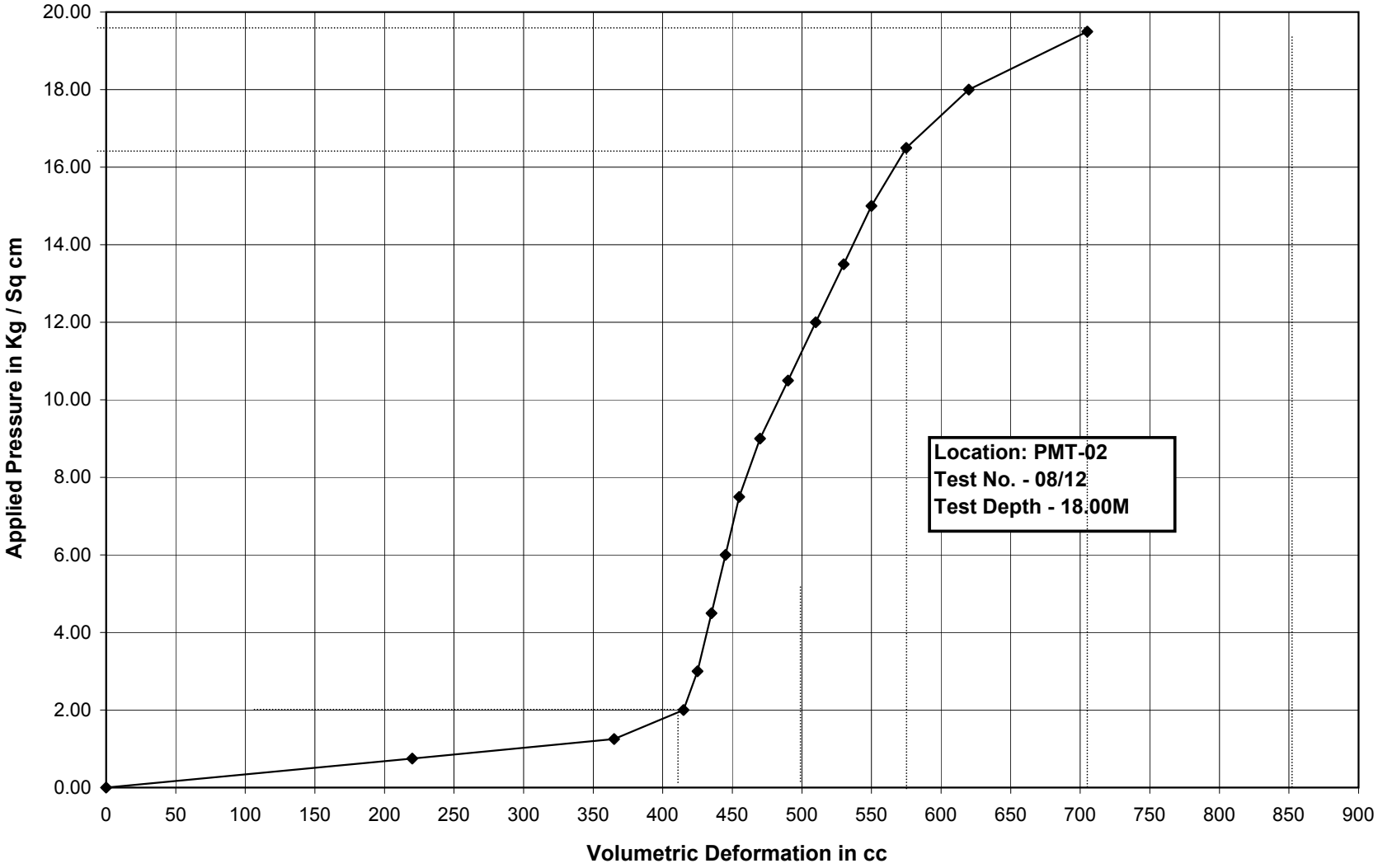


Fig. 28: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

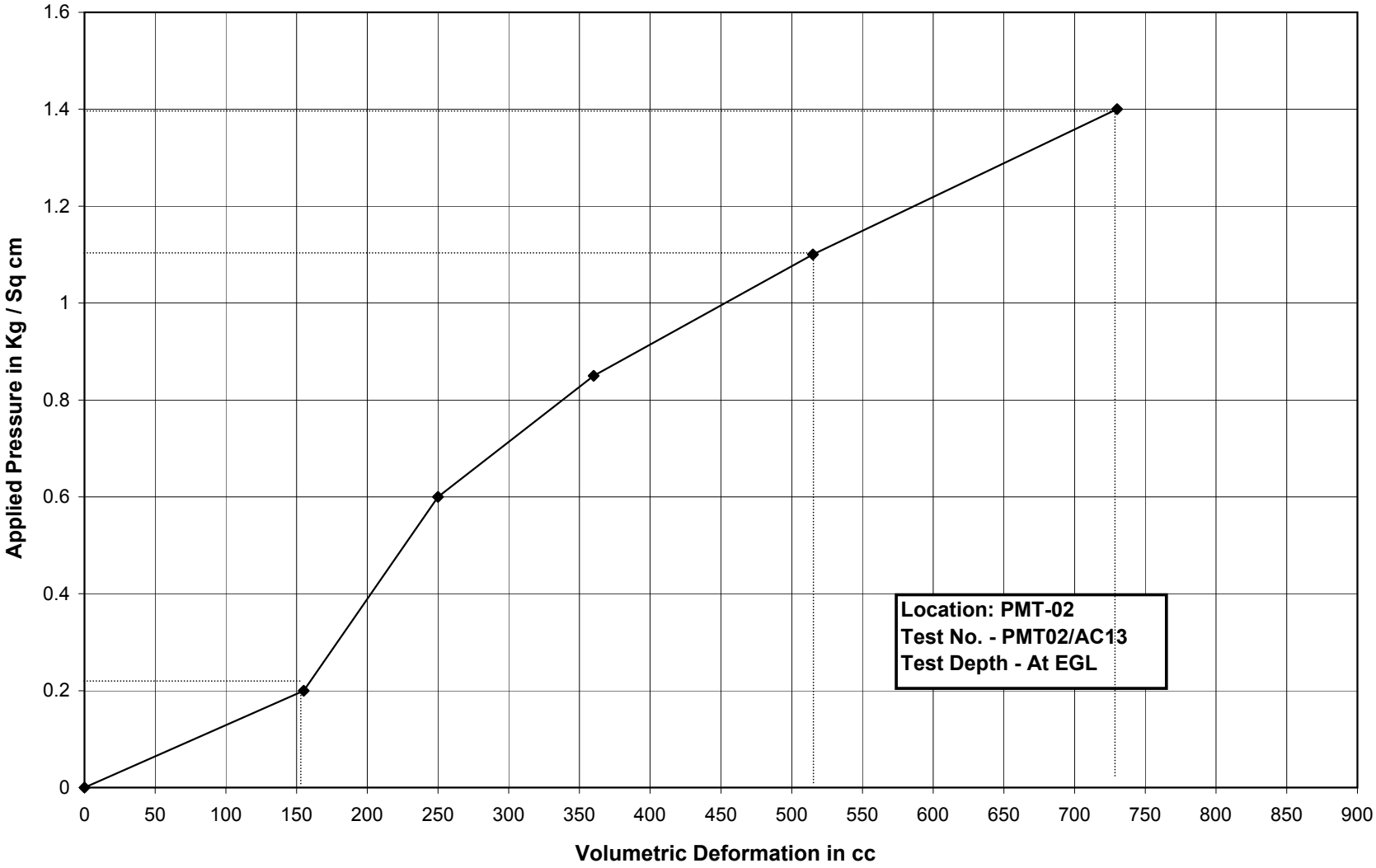


Fig. 29: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

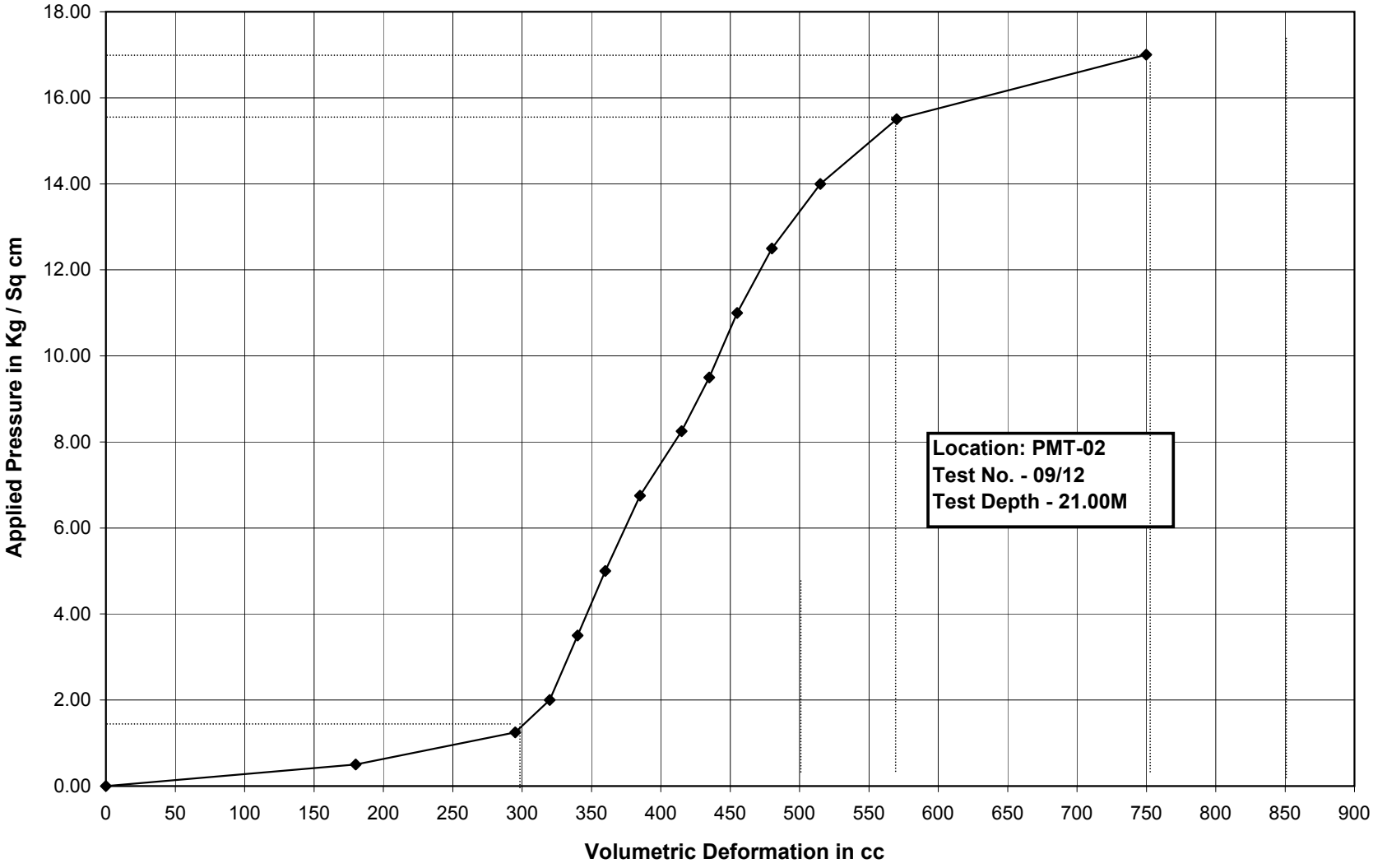


Fig. 30: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

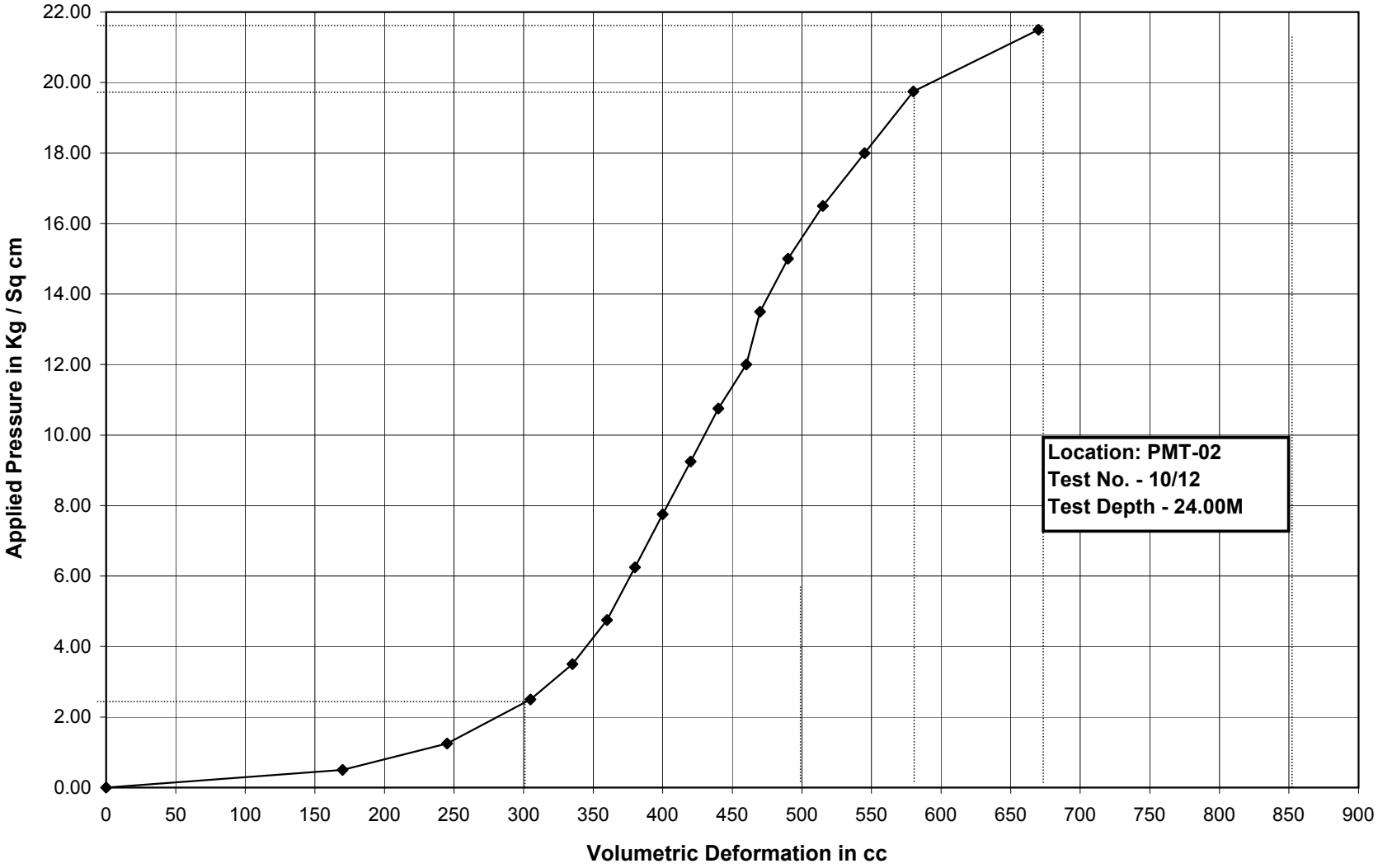


Fig. 31: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

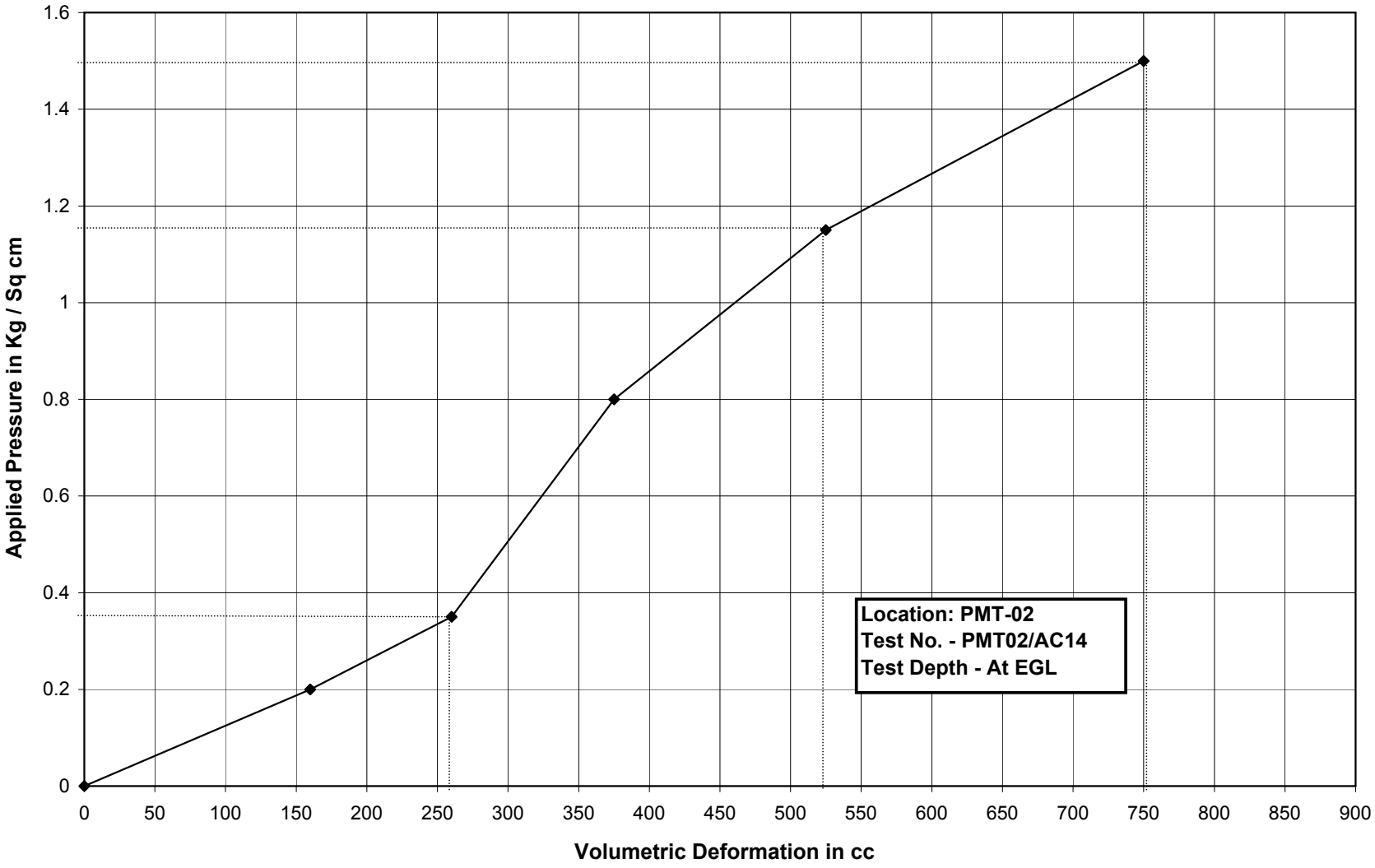


Fig. 32: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

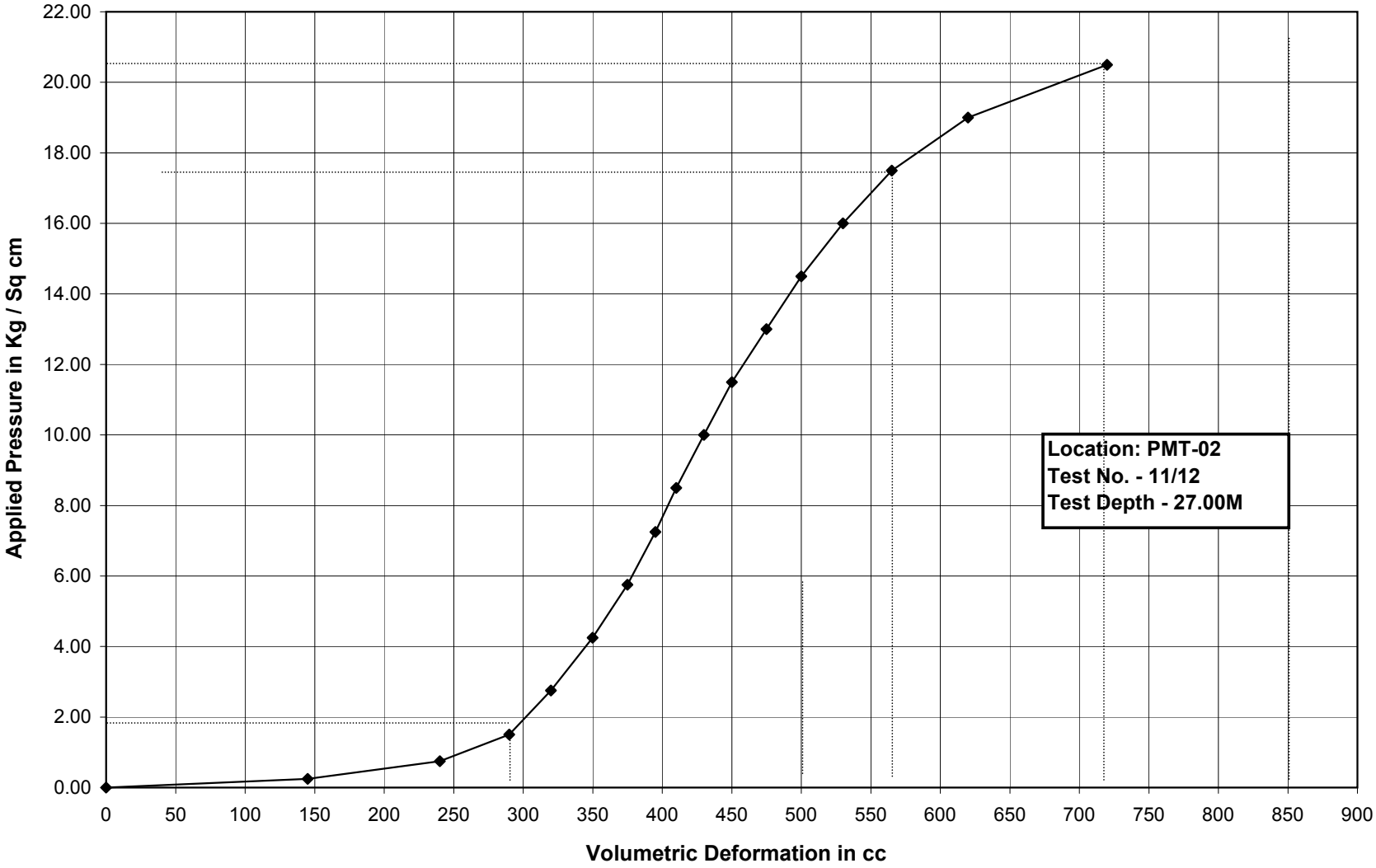


Fig. 33: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

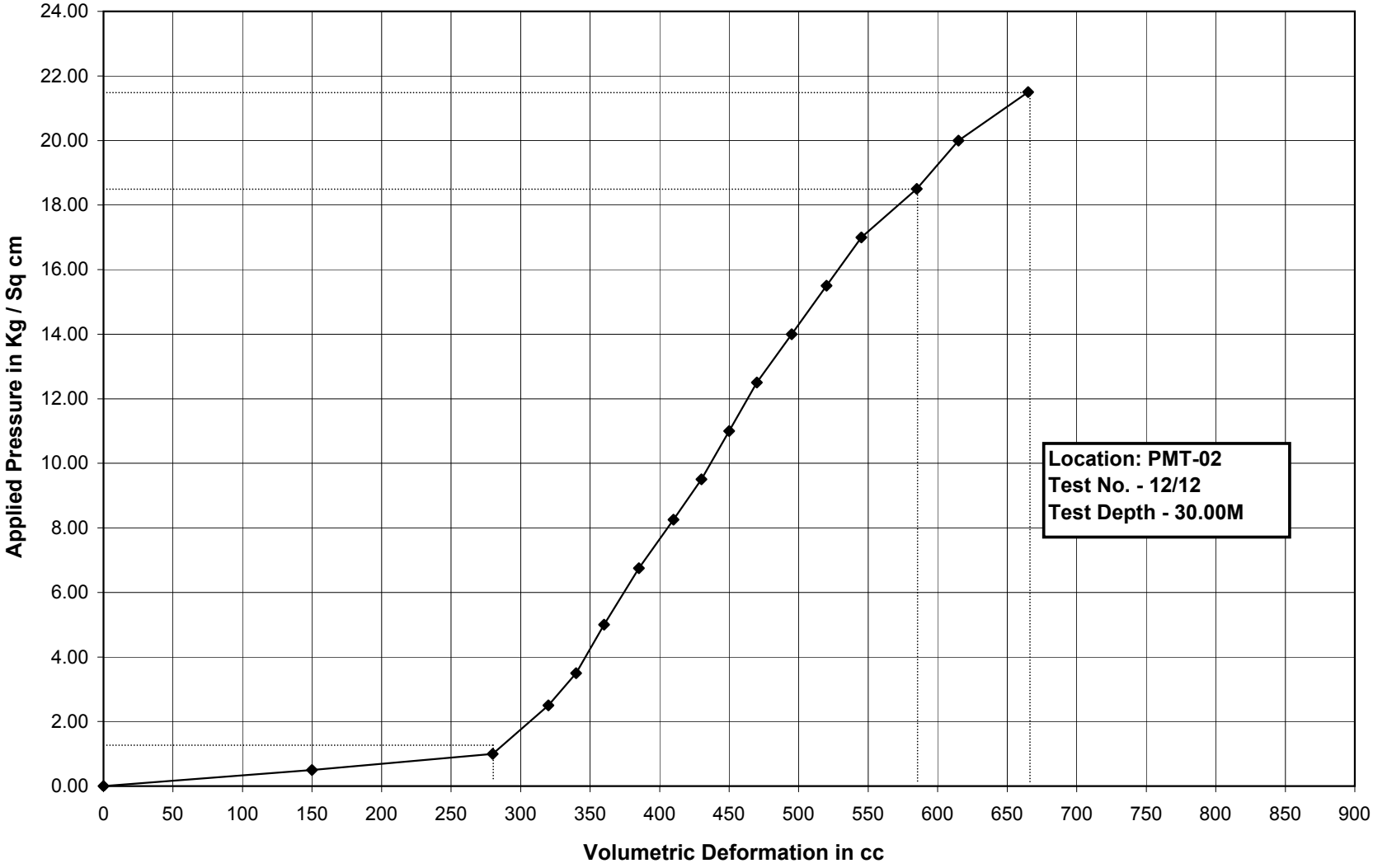


Fig. 34: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

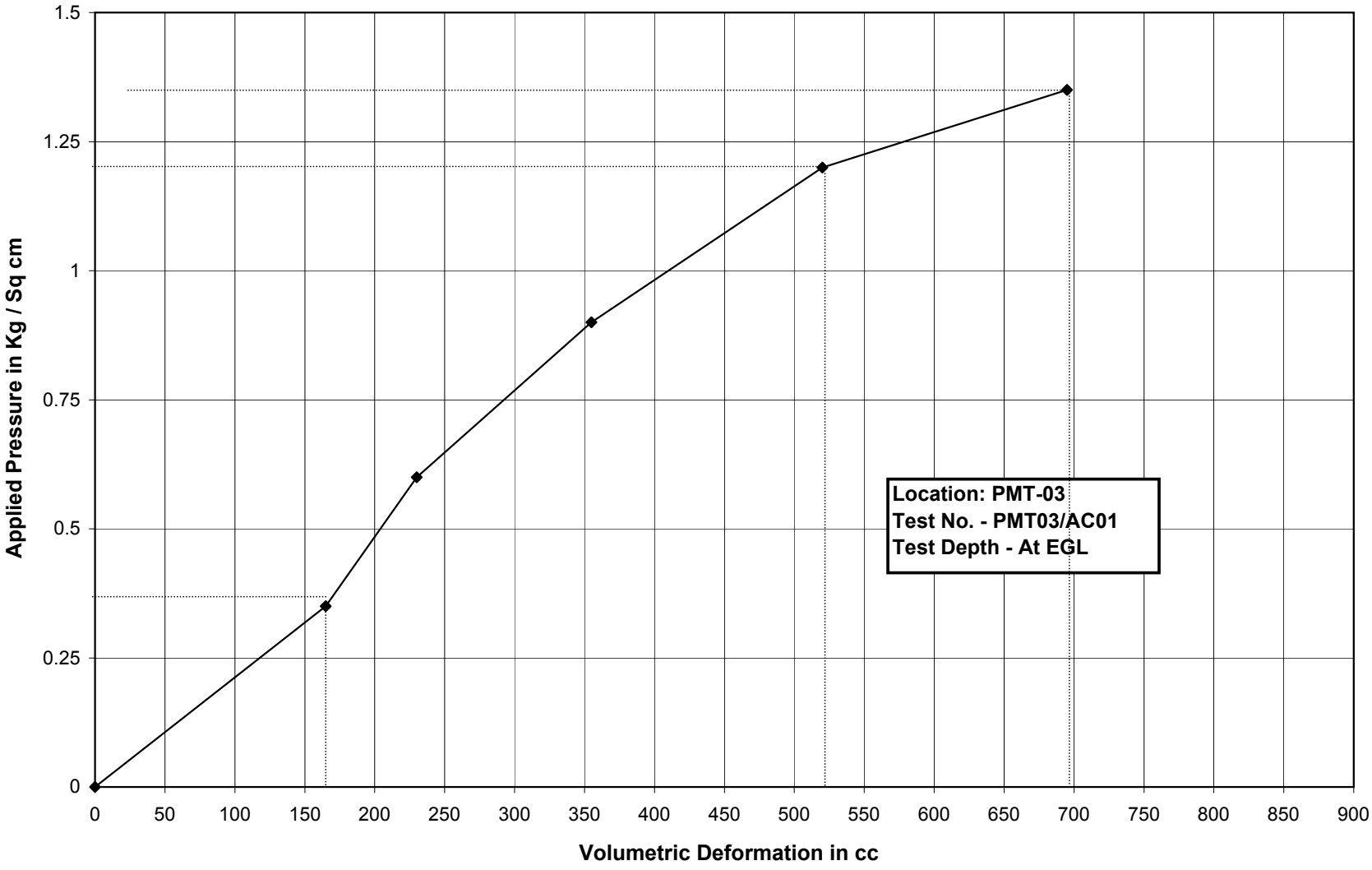


Fig. 35: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

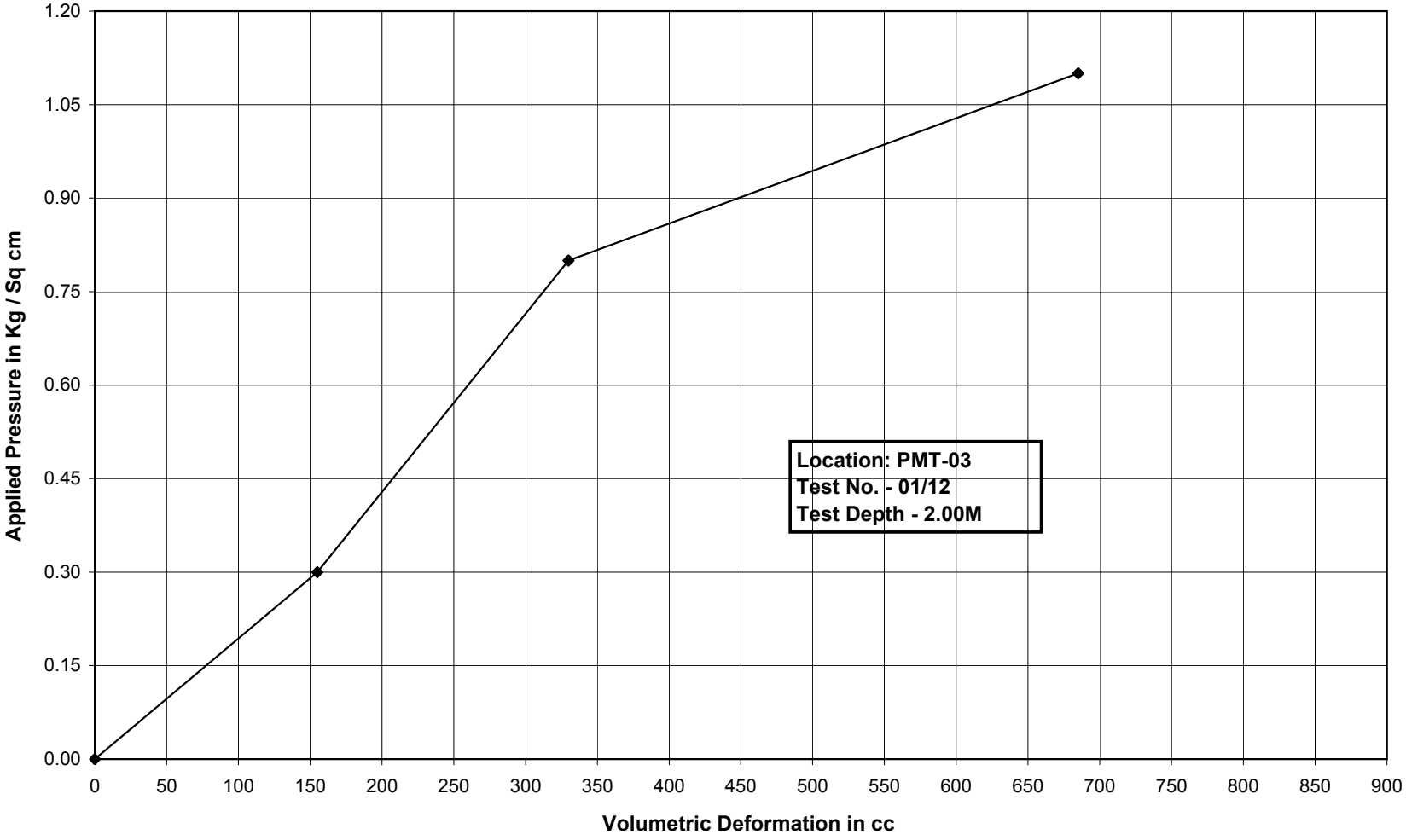


Fig. 36: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

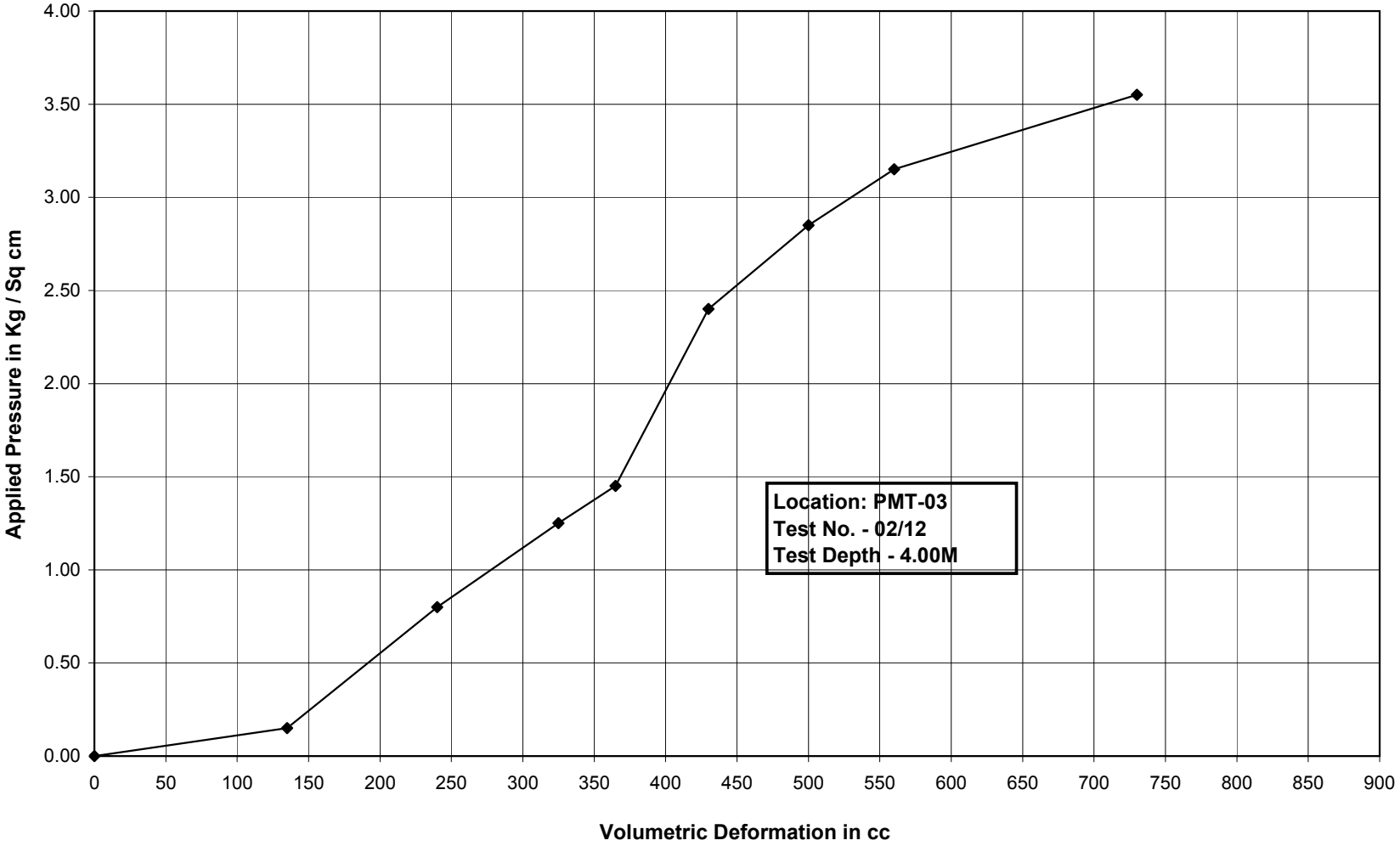


Fig. 37: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

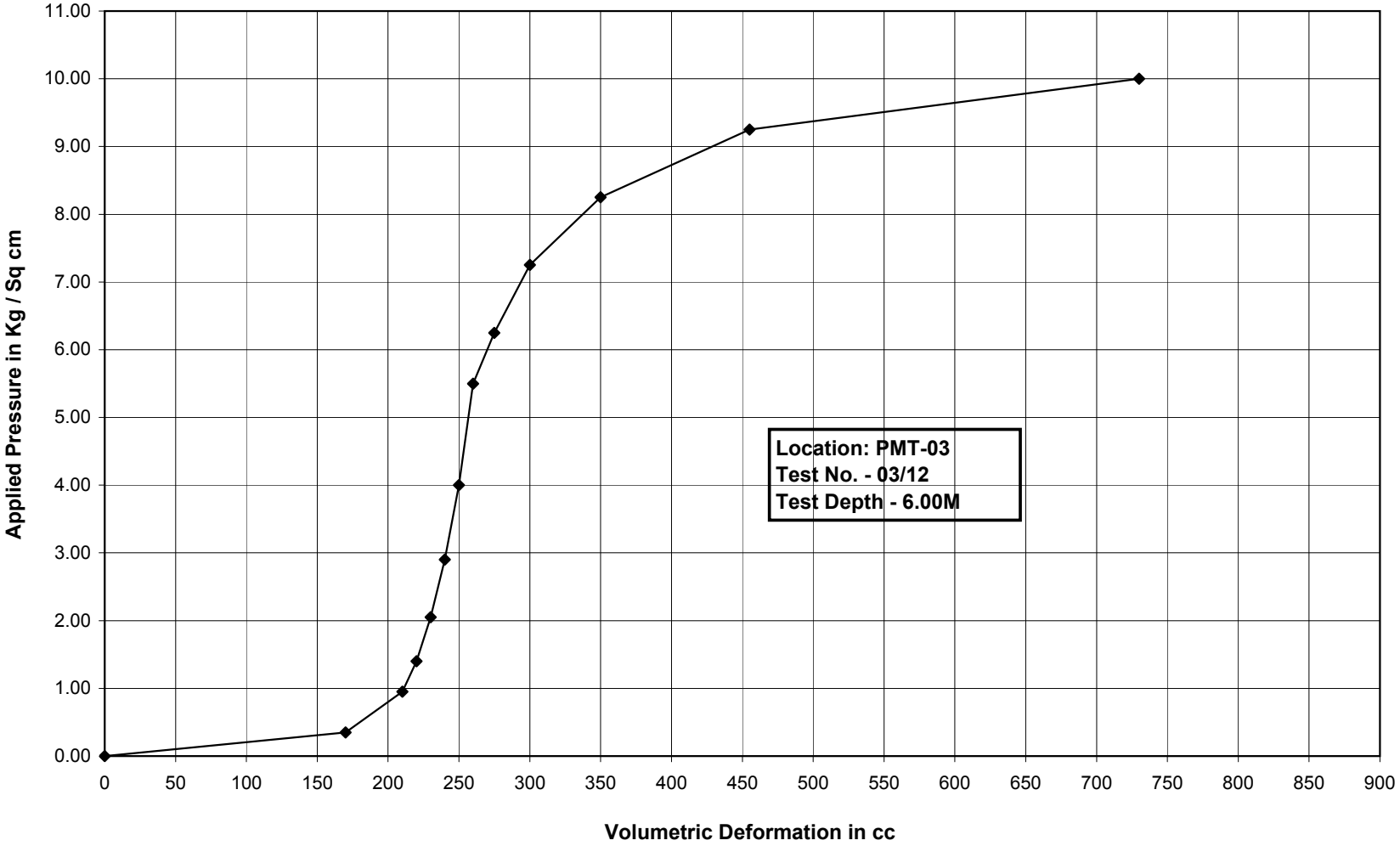


Fig. 38: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

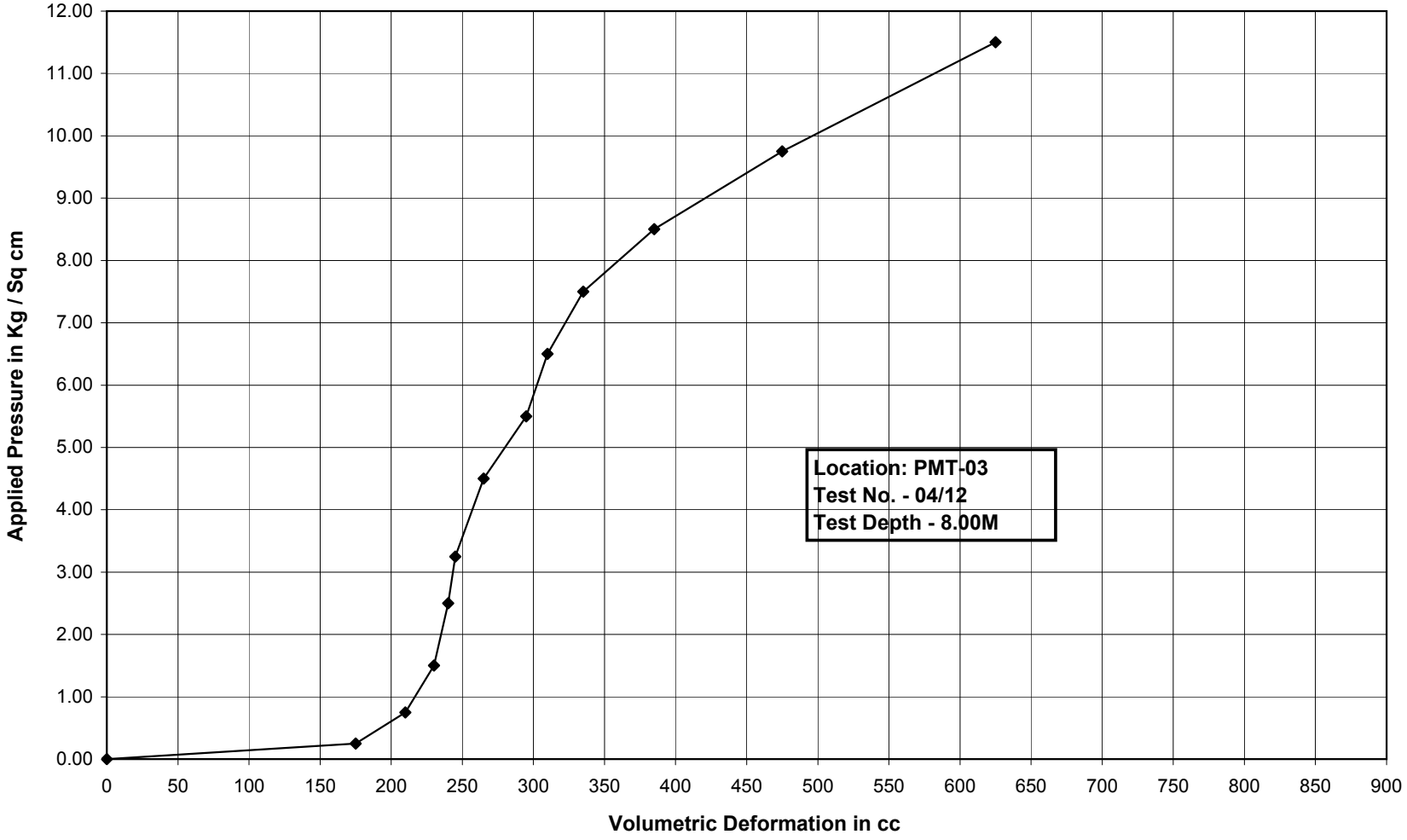


Fig. 39: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

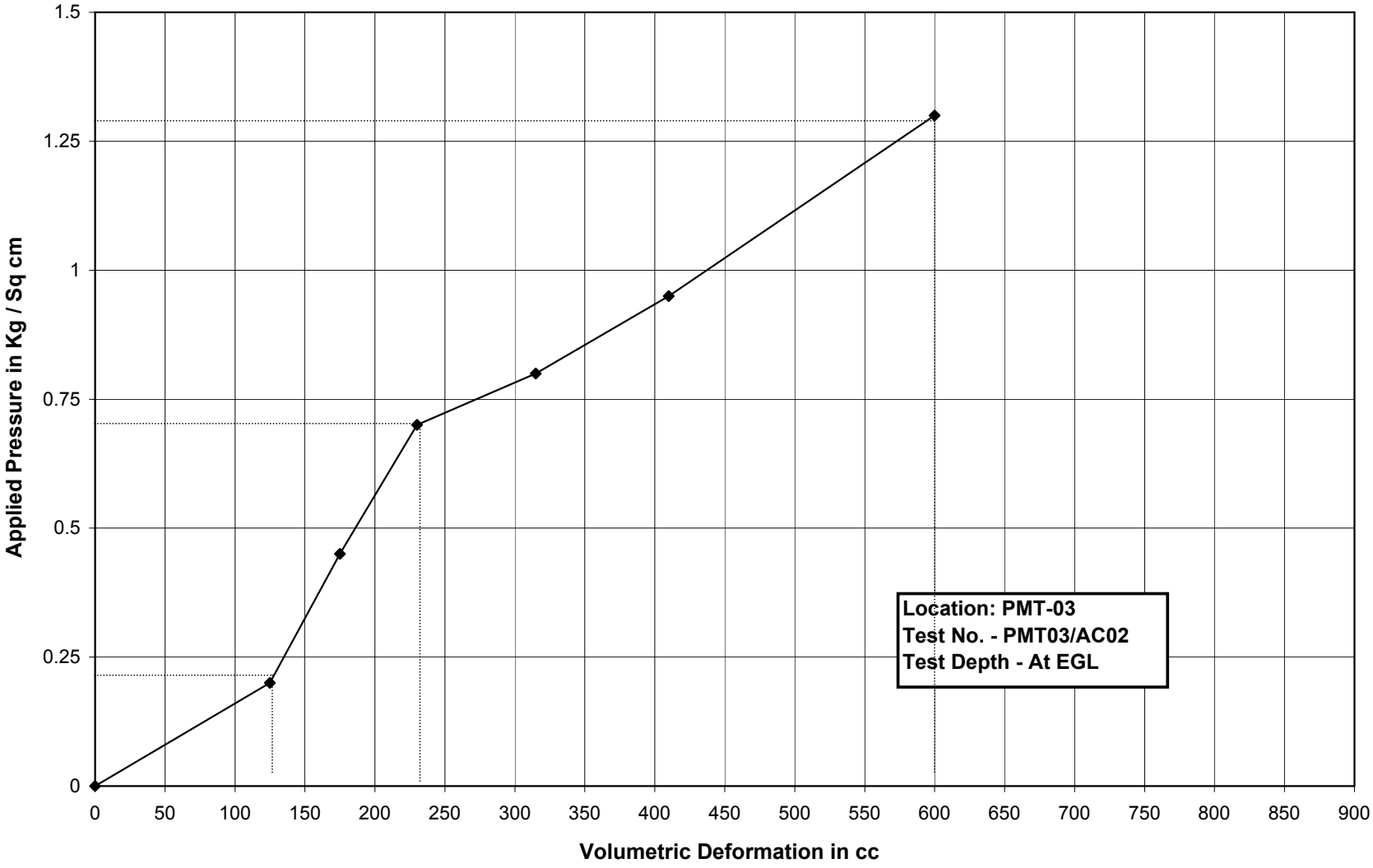

1.5
1.25
1
0.75
0.5
0.25
0
Applied Pressure in Kg / Sq cm
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800
850
900
Volumetric Deformation in cc
Location: PMT-03
Test No. - PMT03/AC02
Test Depth - At EGL

Fig. 40

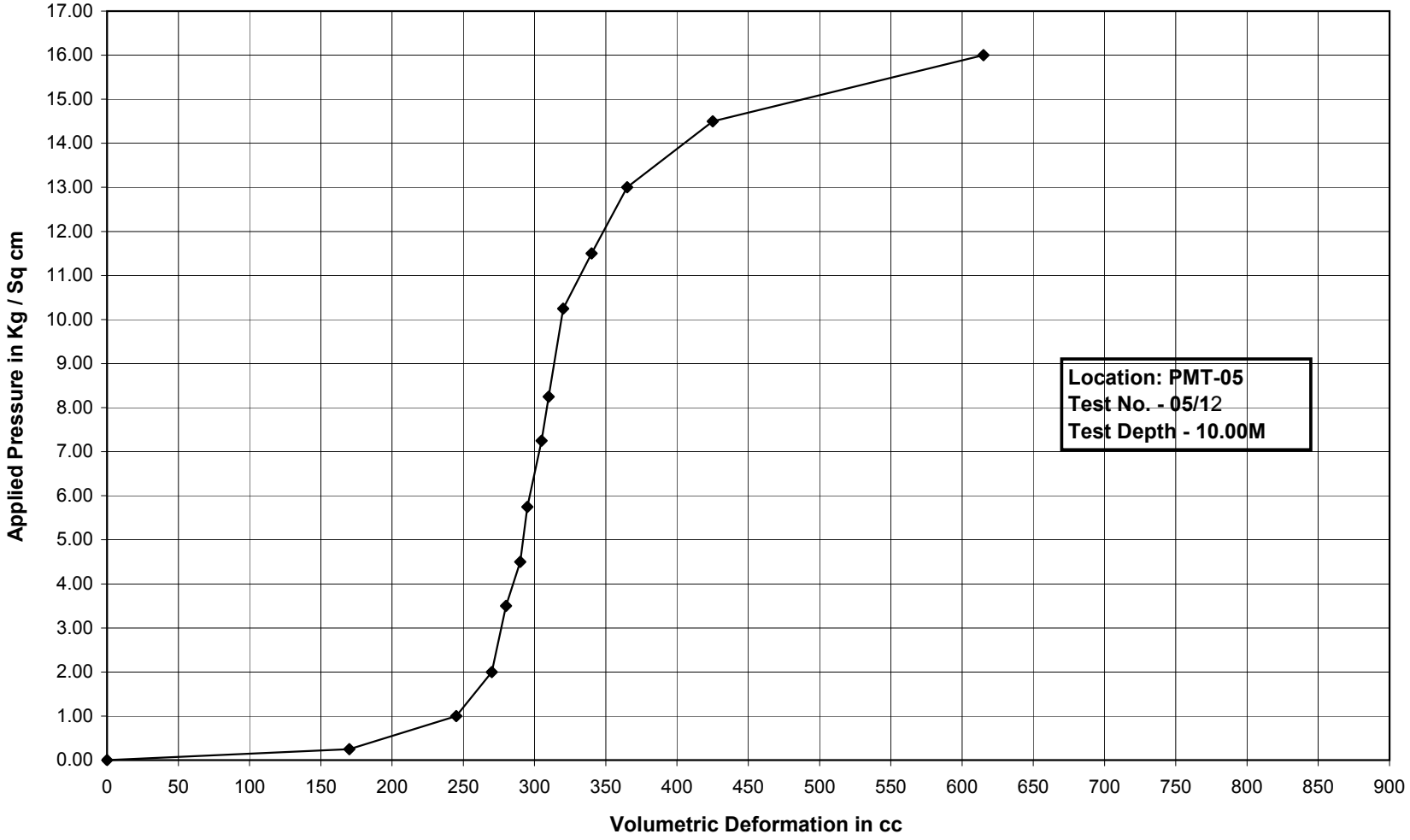


Fig. 41: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

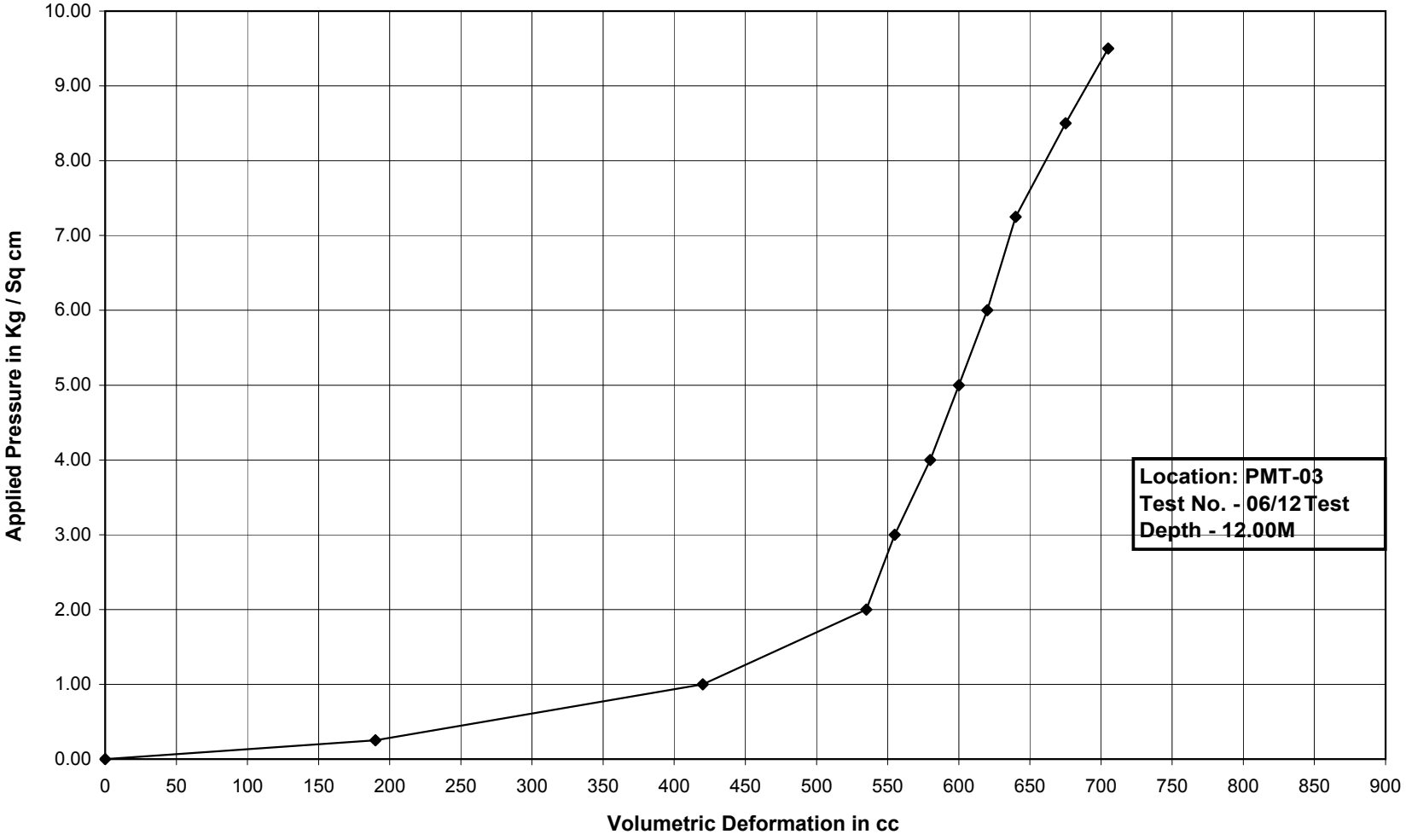


Fig. 42: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

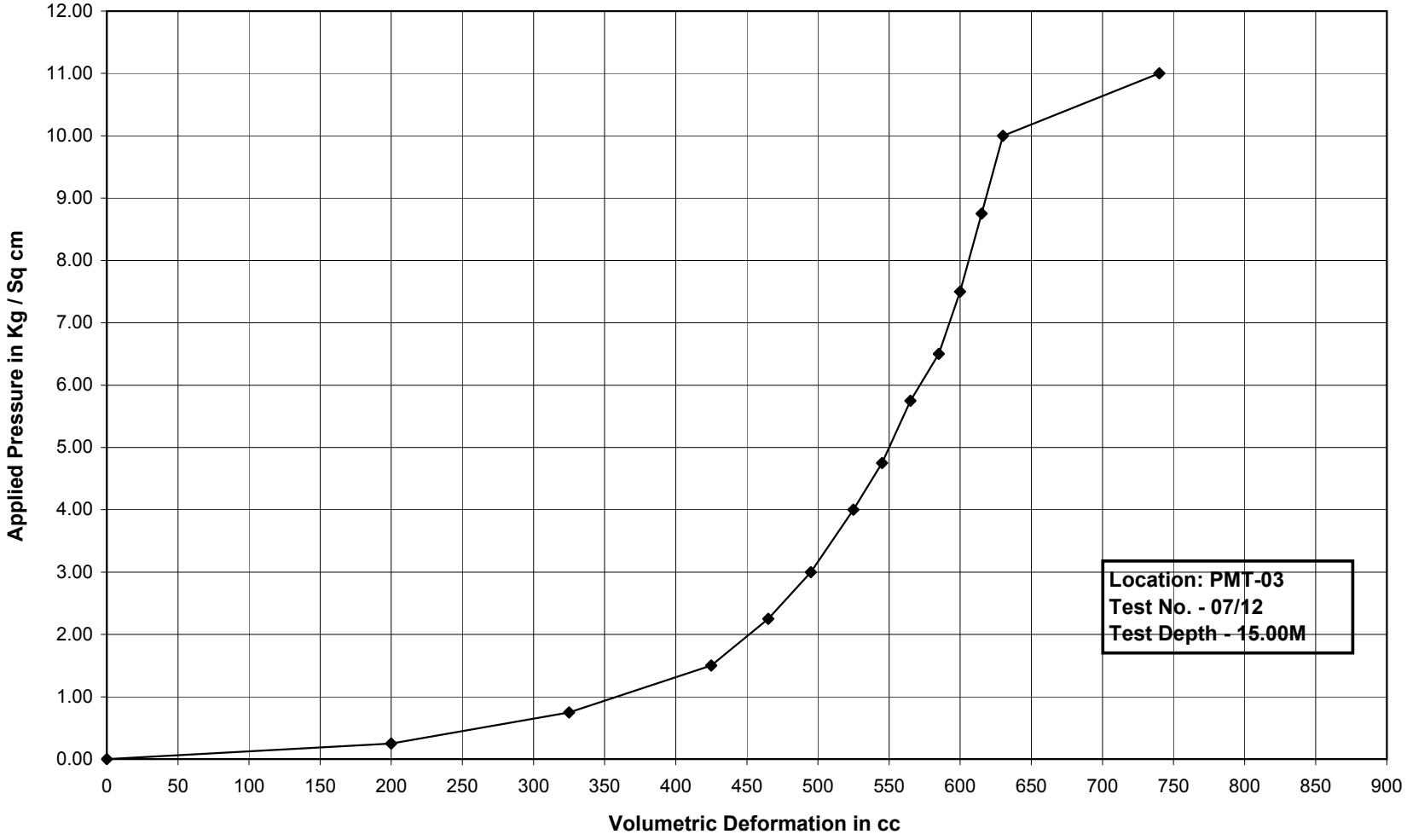


Fig. 43: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

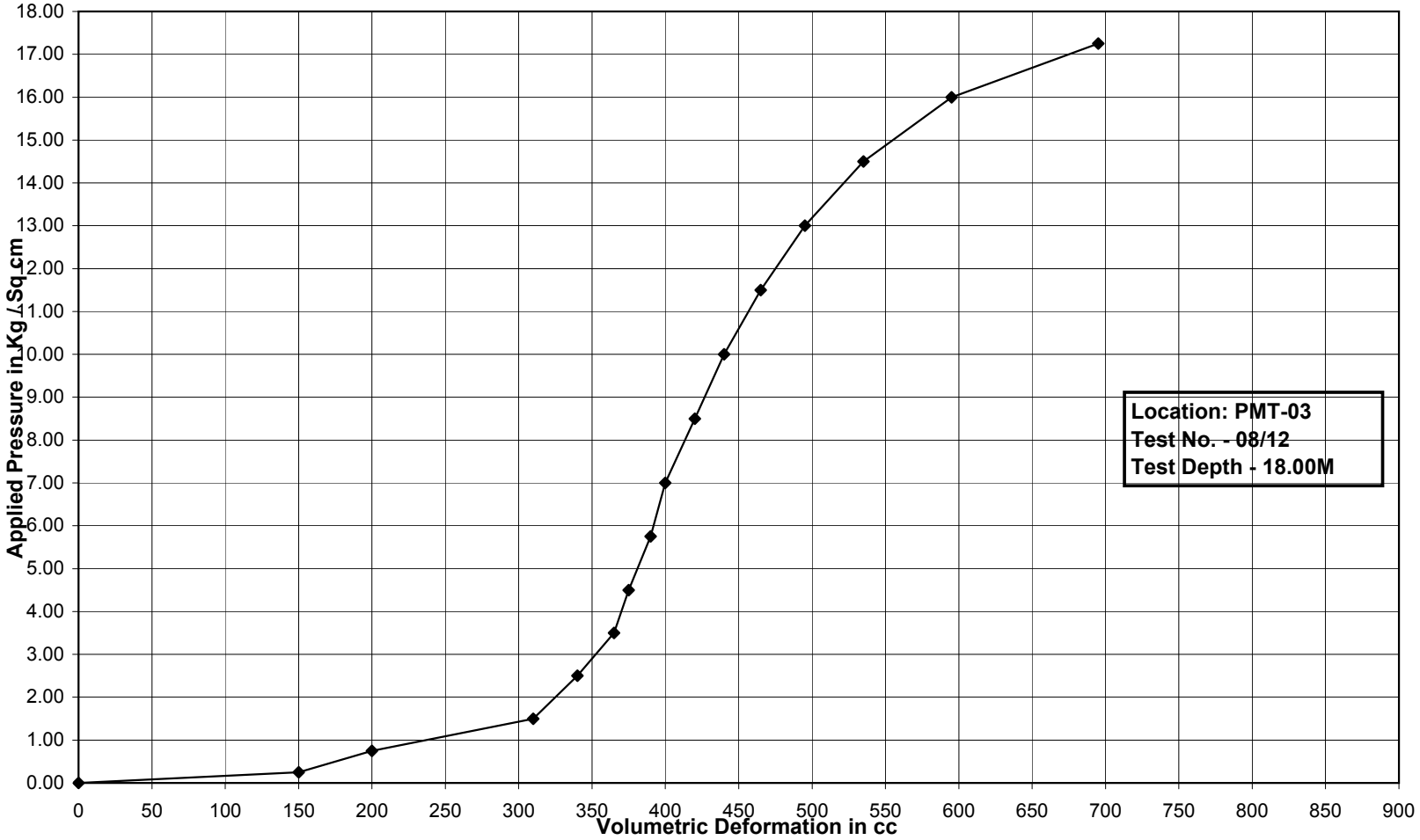


Fig. 44: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

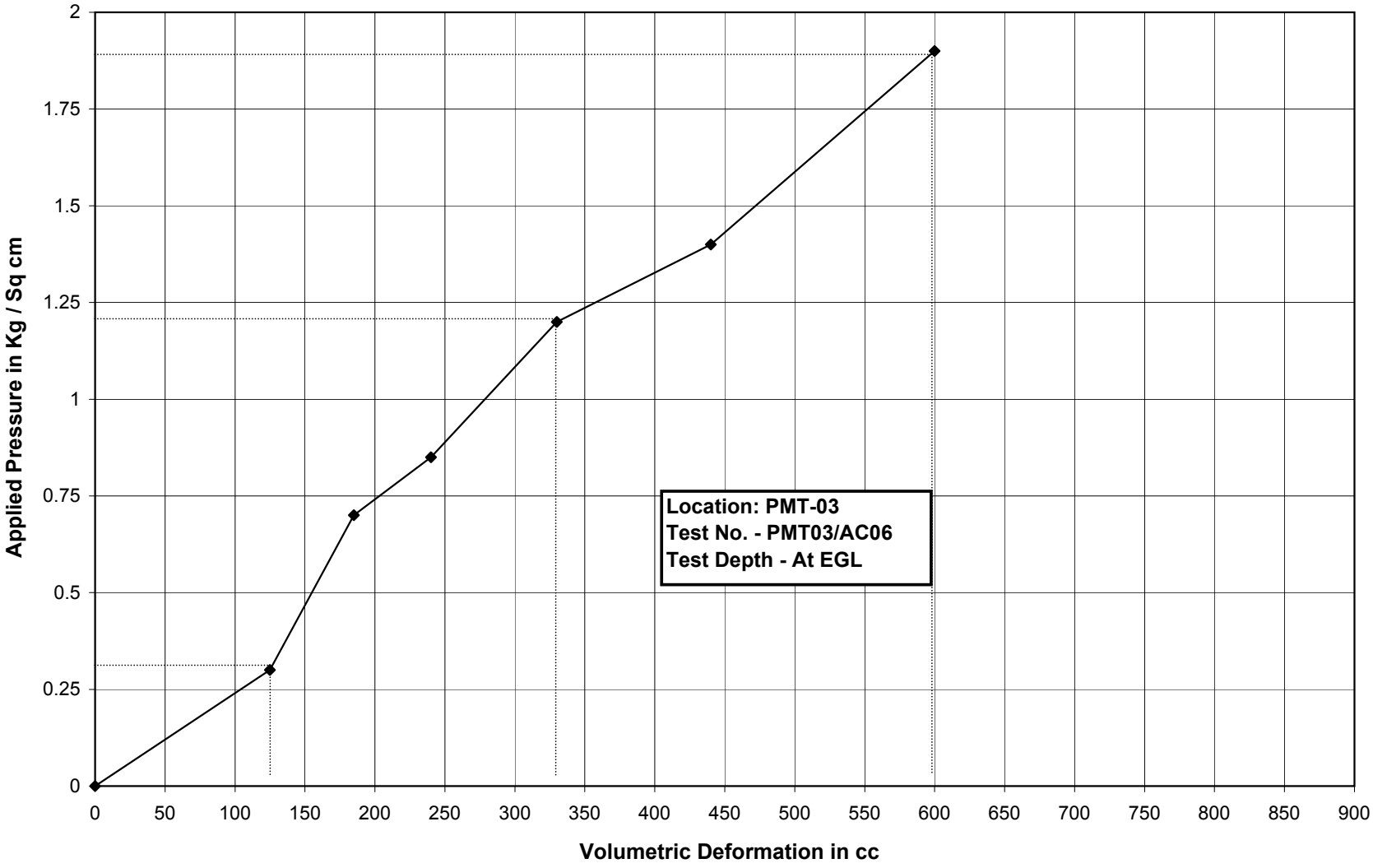


Fig. 45: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

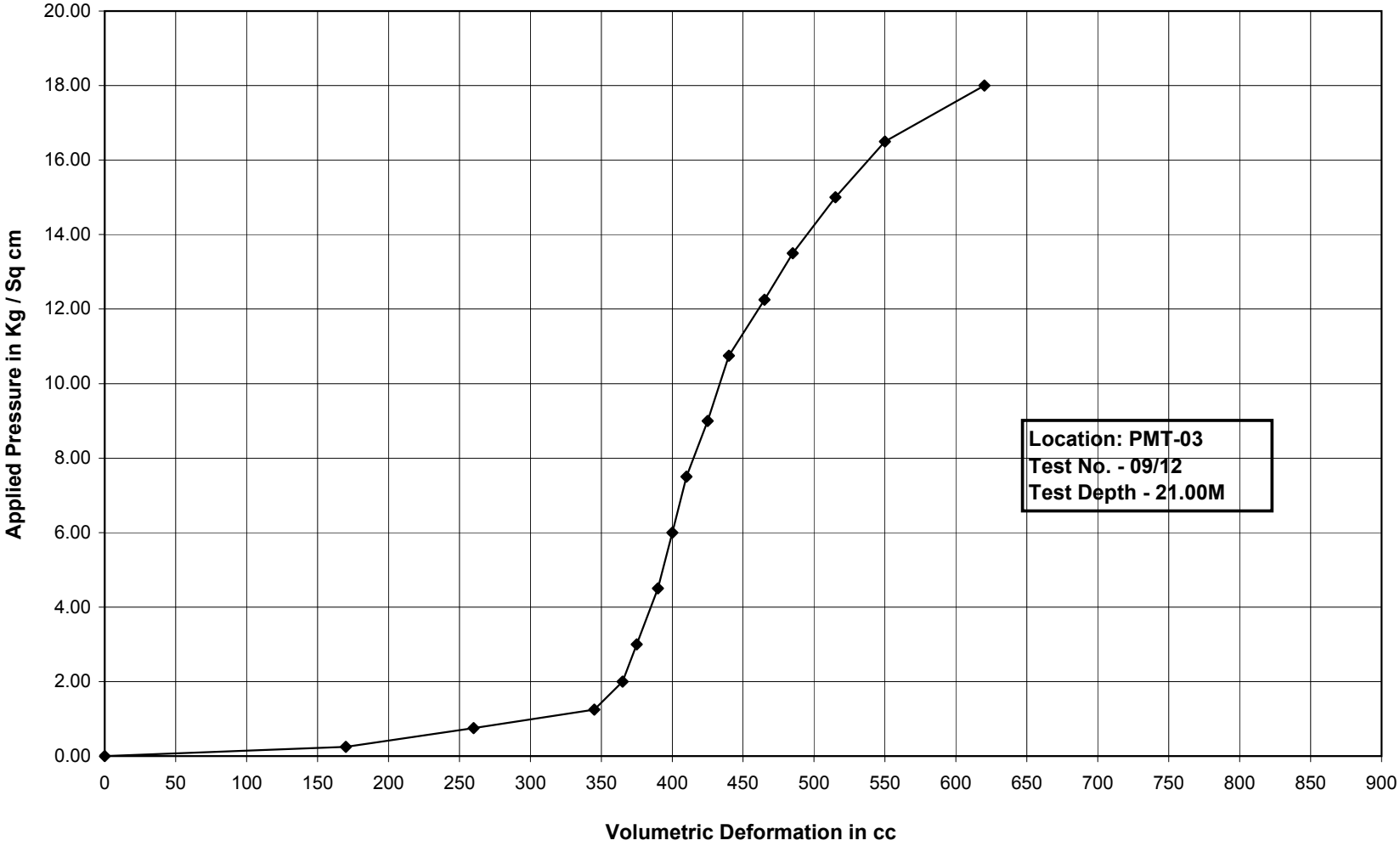


Fig. 46: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

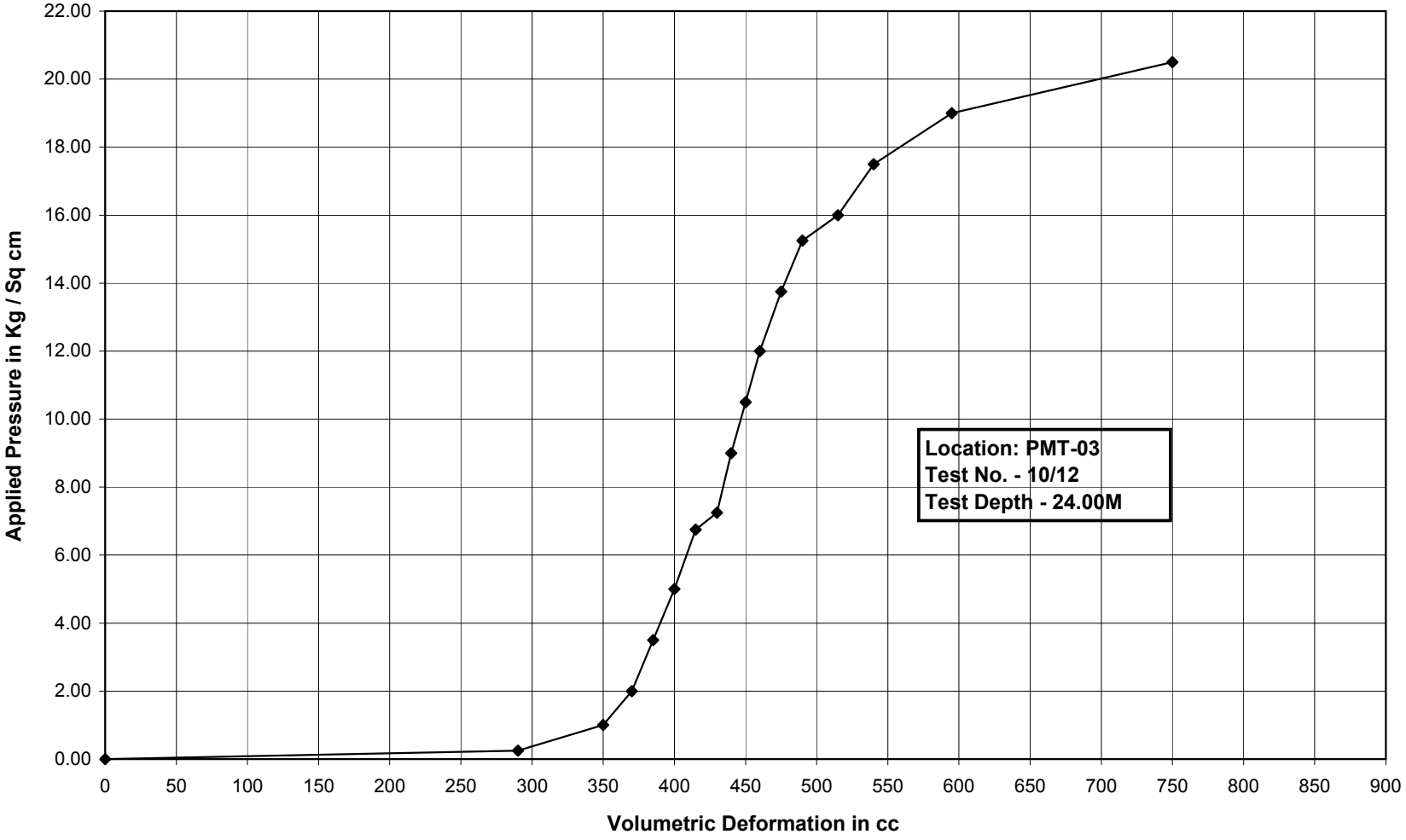


Fig. 47: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

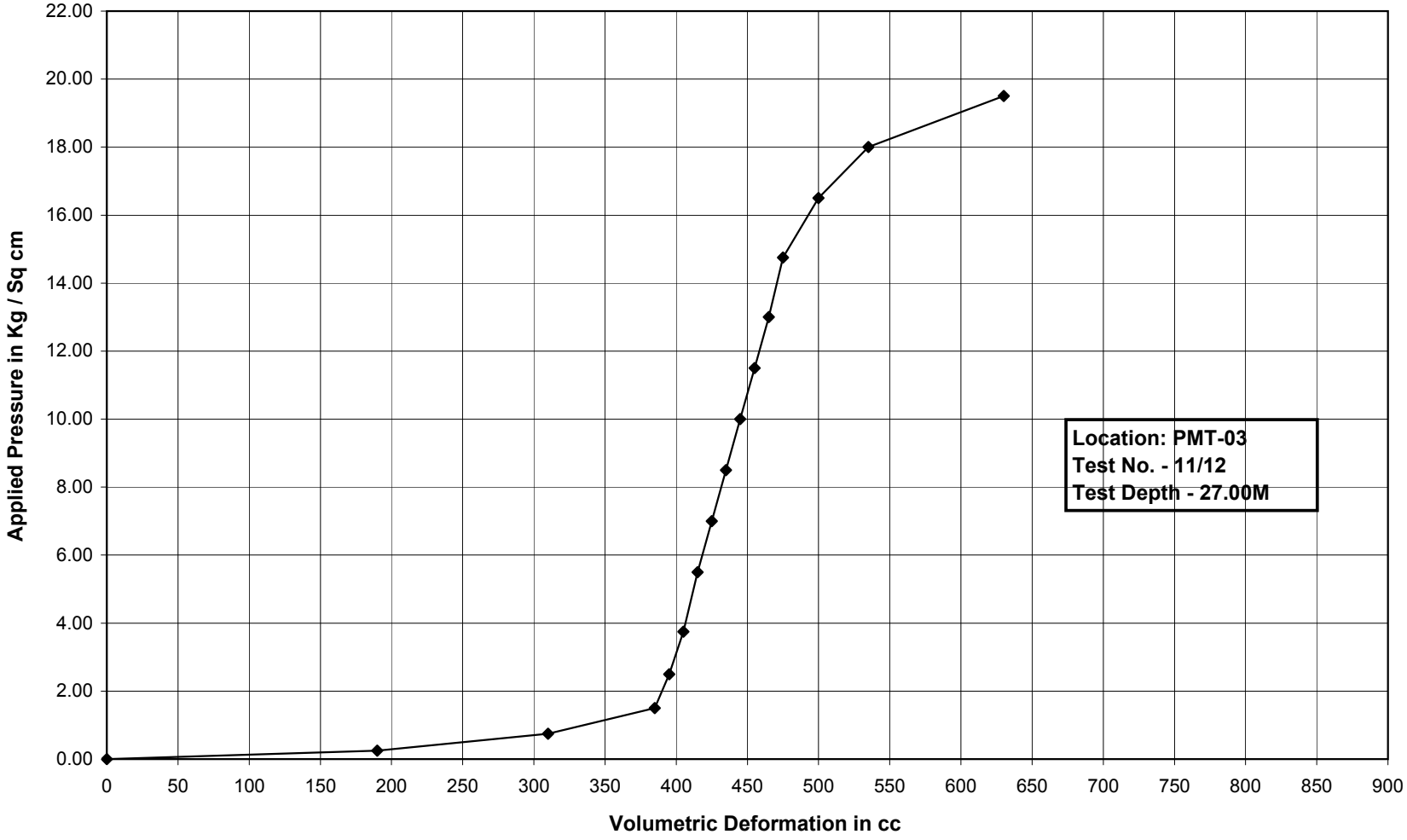


Fig. 48: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

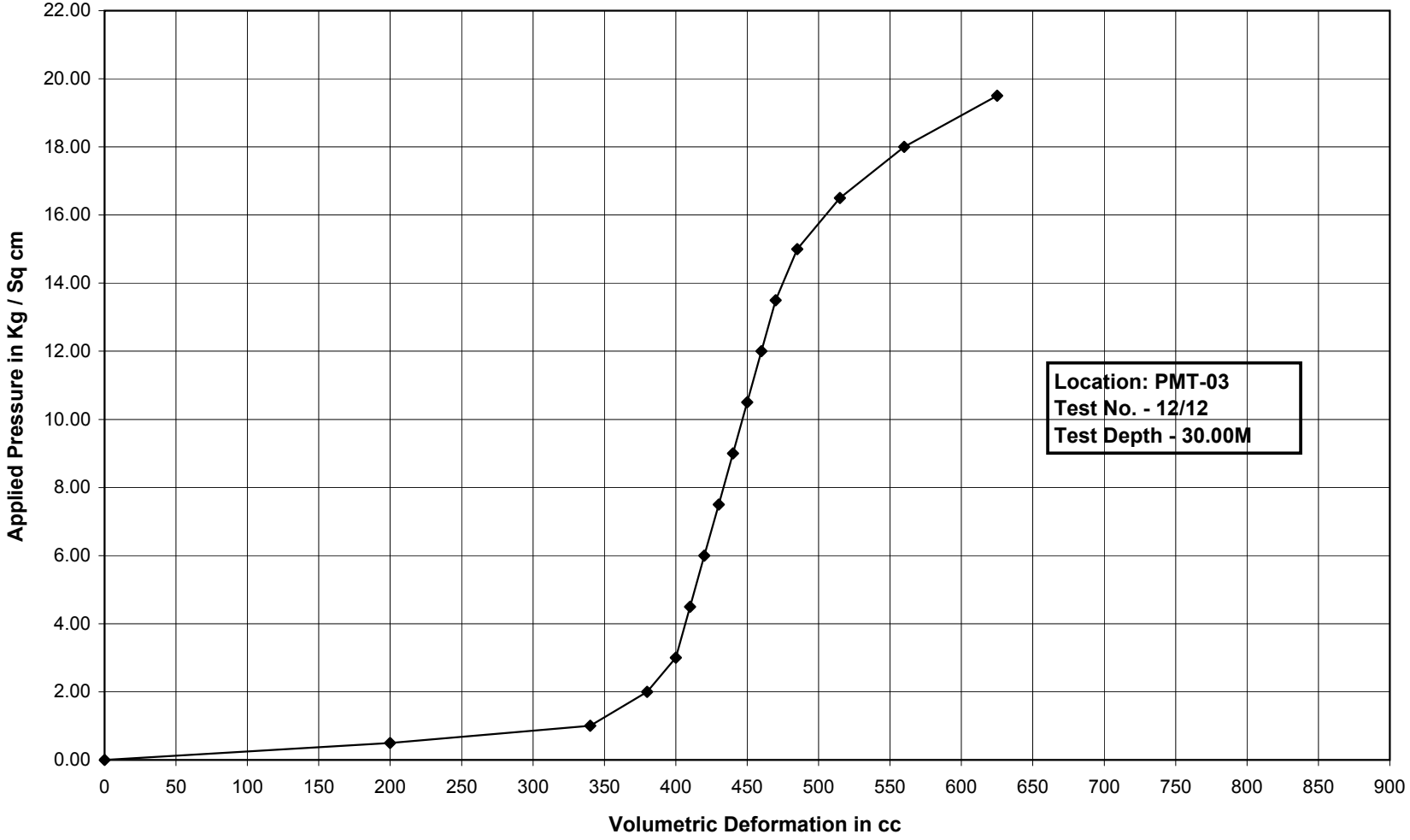


Fig. 49: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

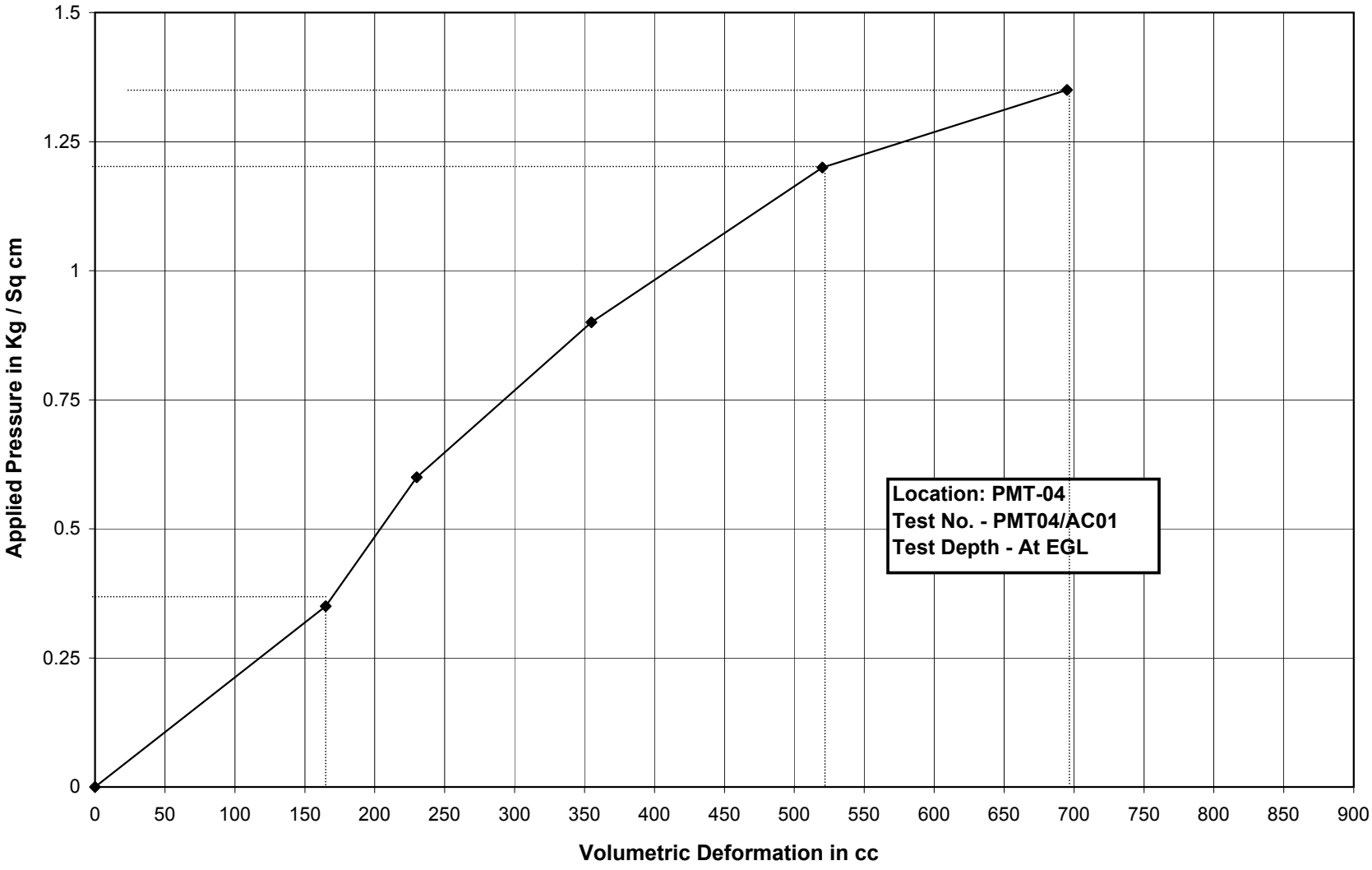


Fig. 50: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

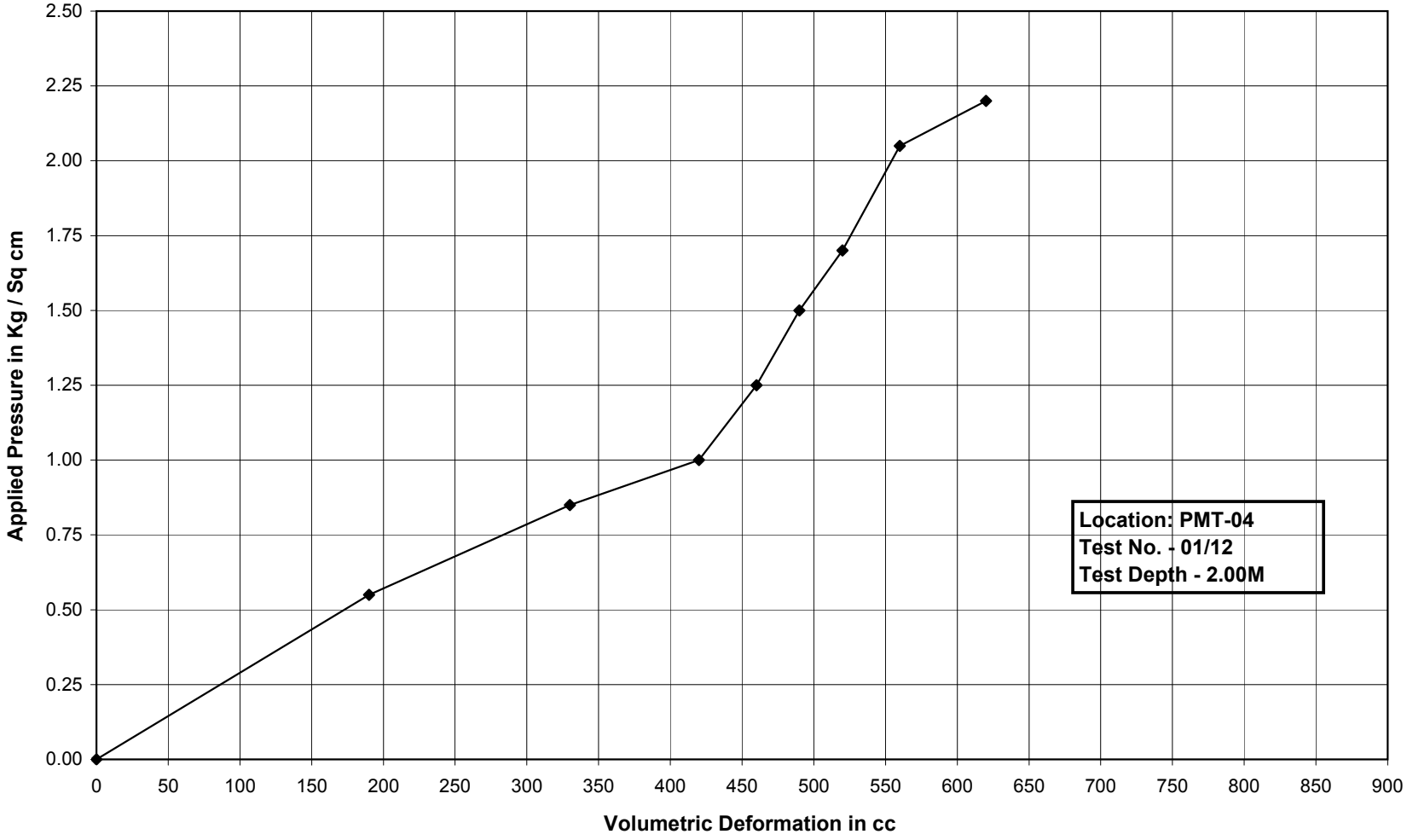


Fig. 51: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

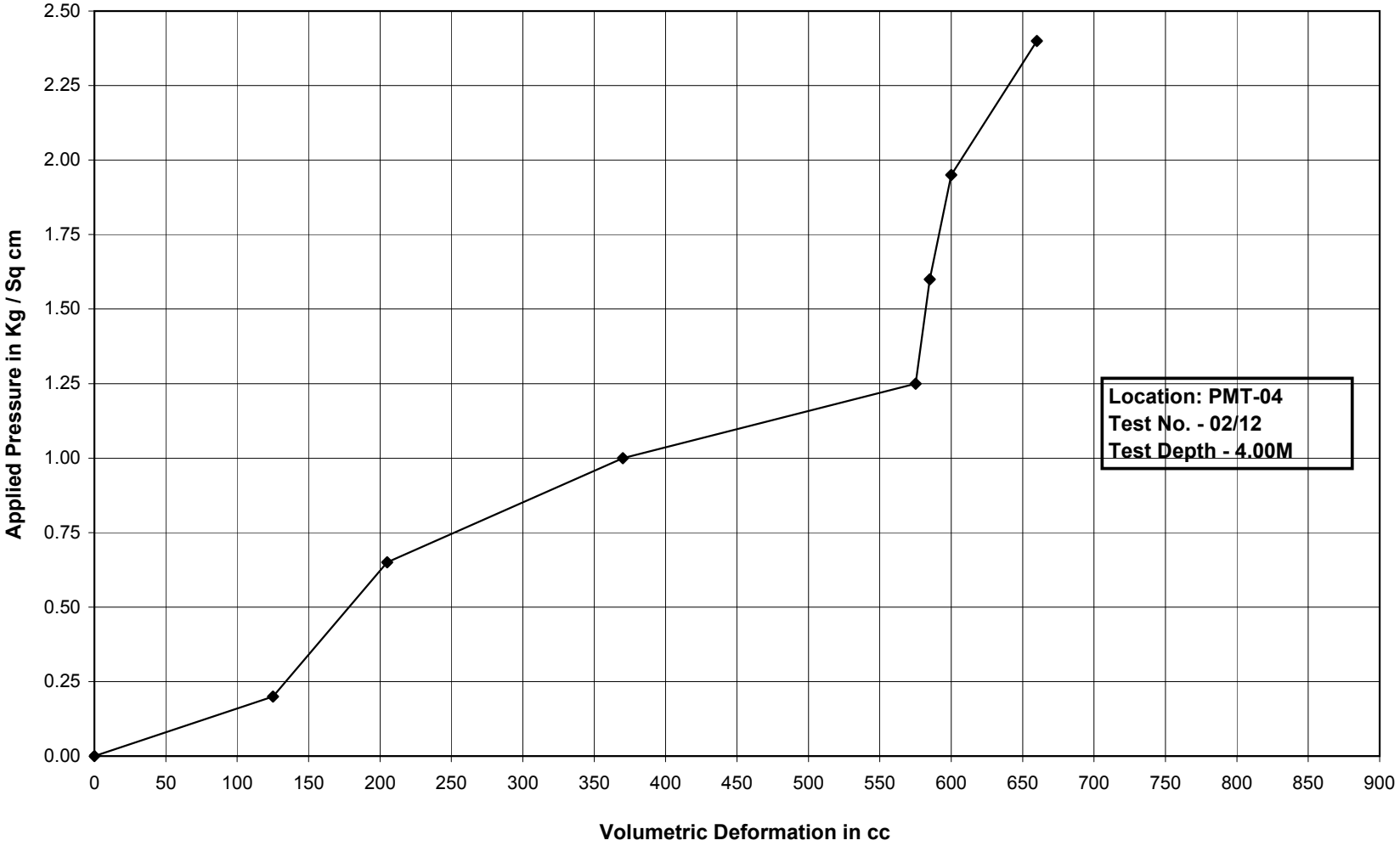


Fig. 52: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

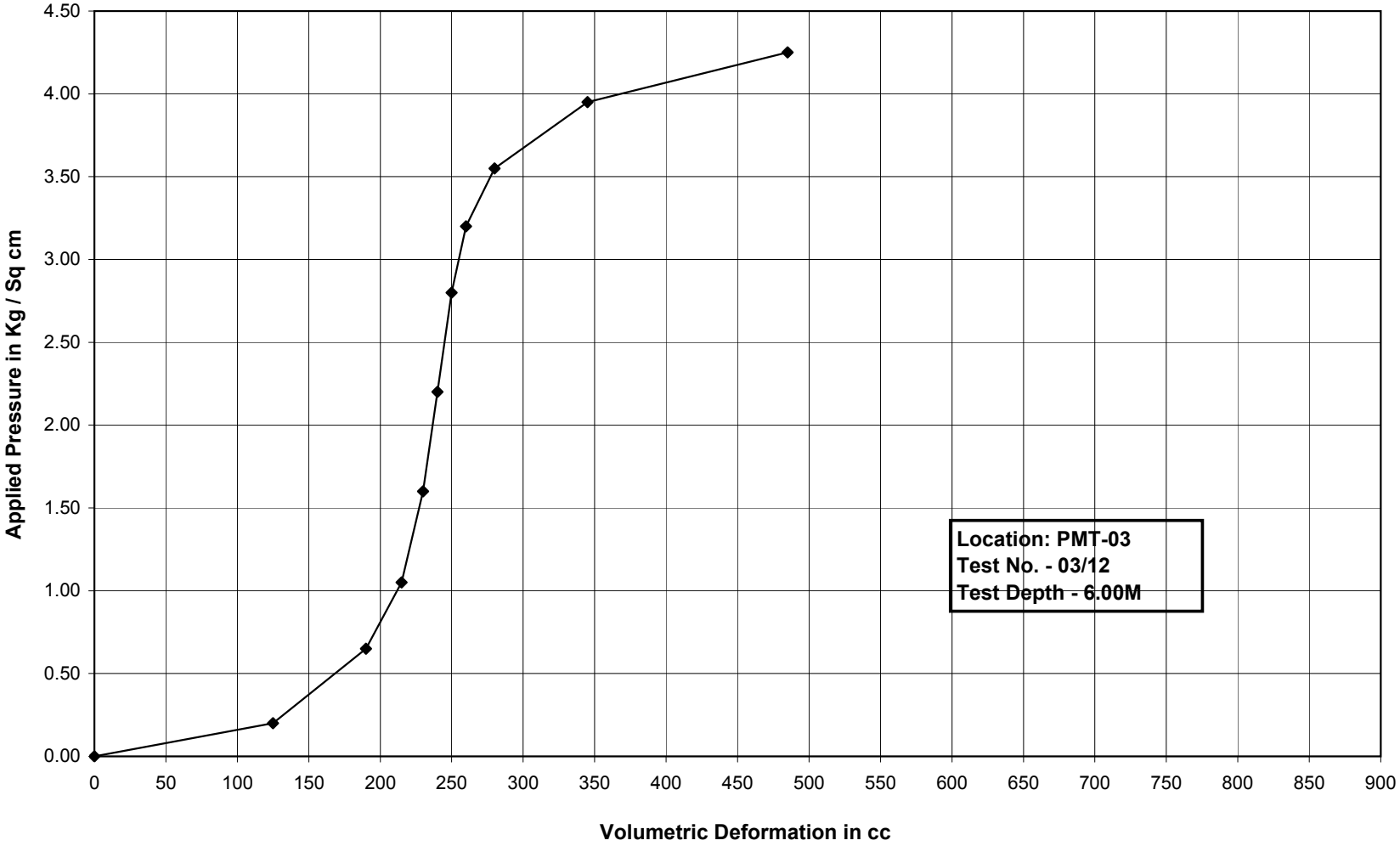


Fig. 53: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

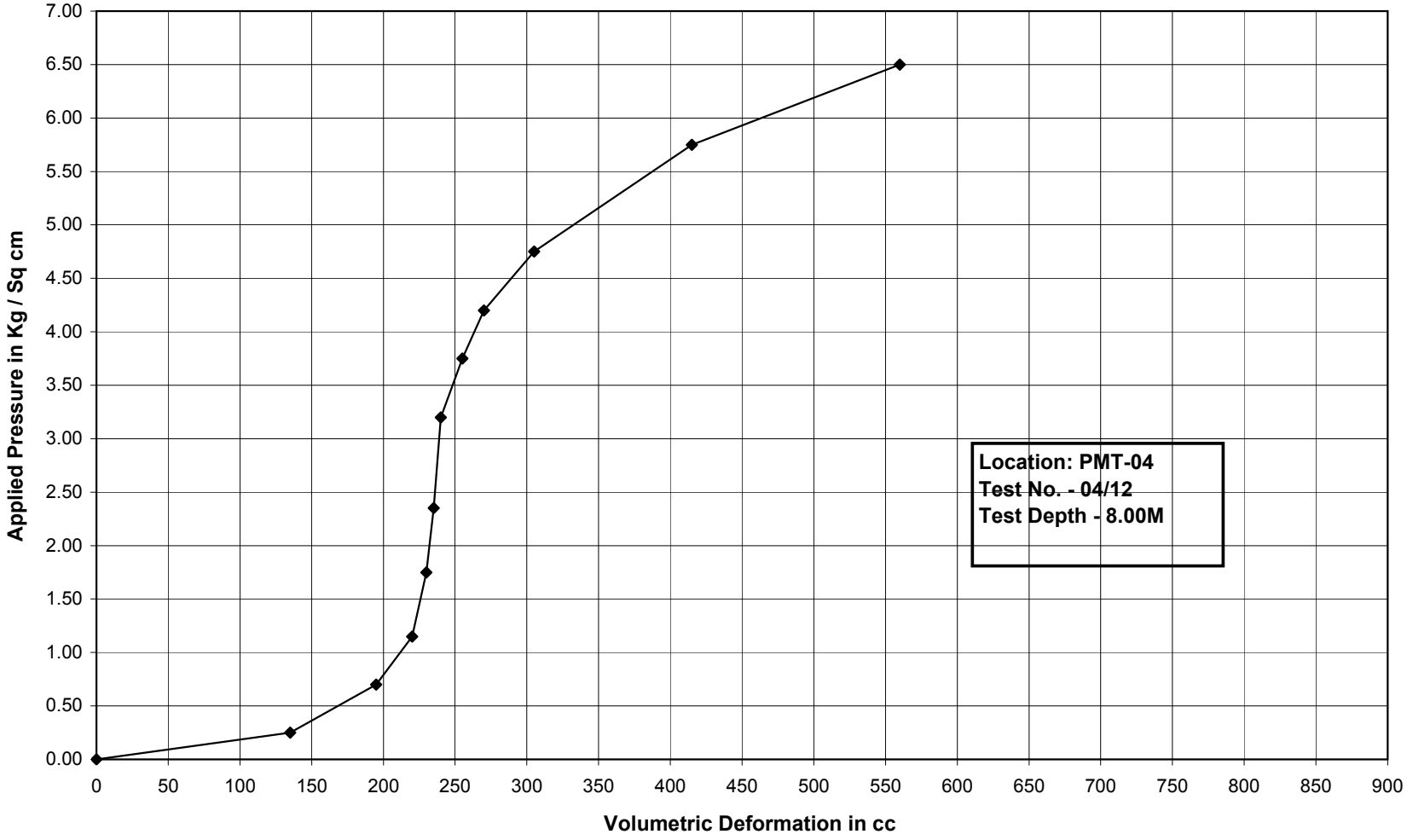


Fig. 54: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

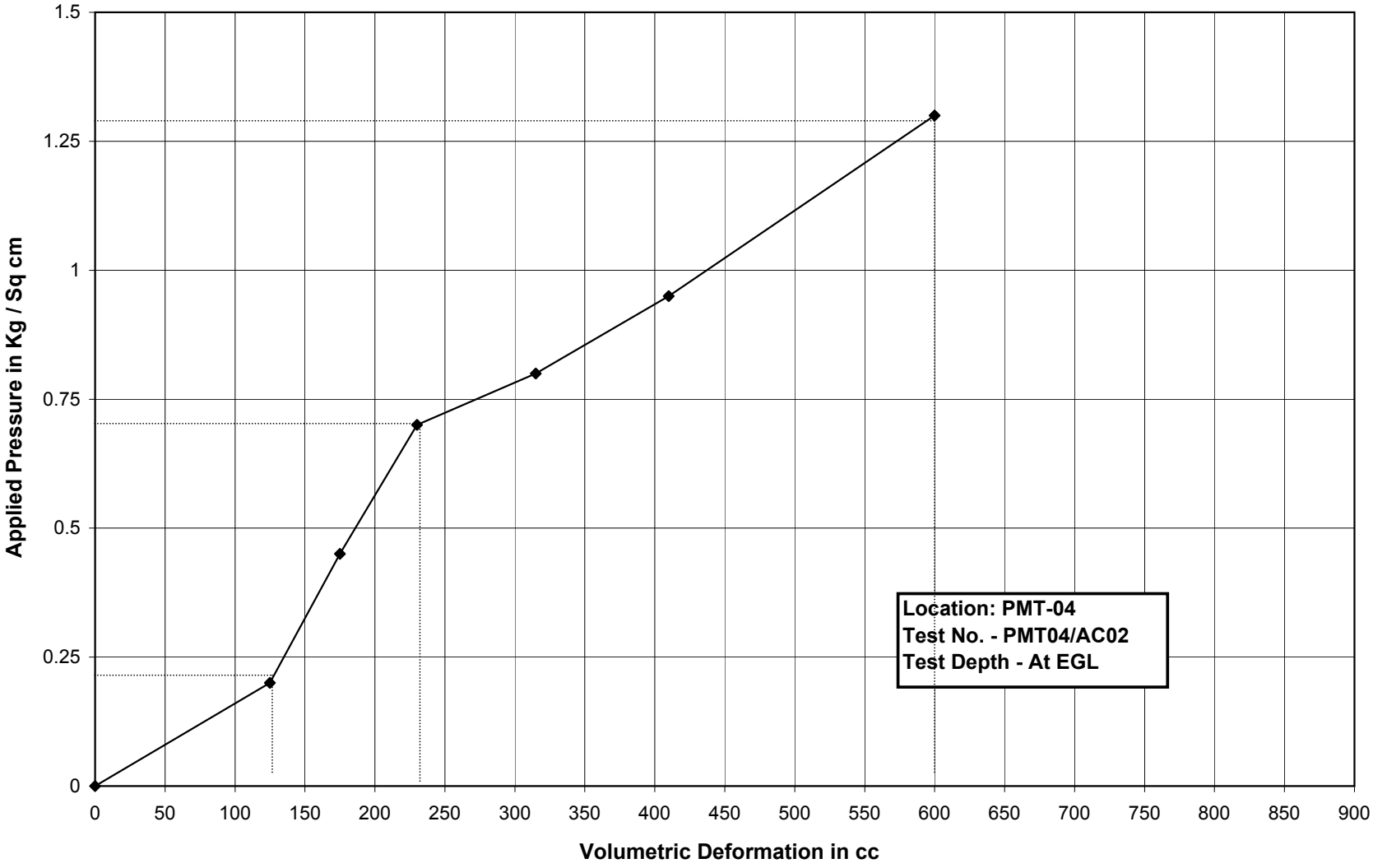


Fig. 55: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

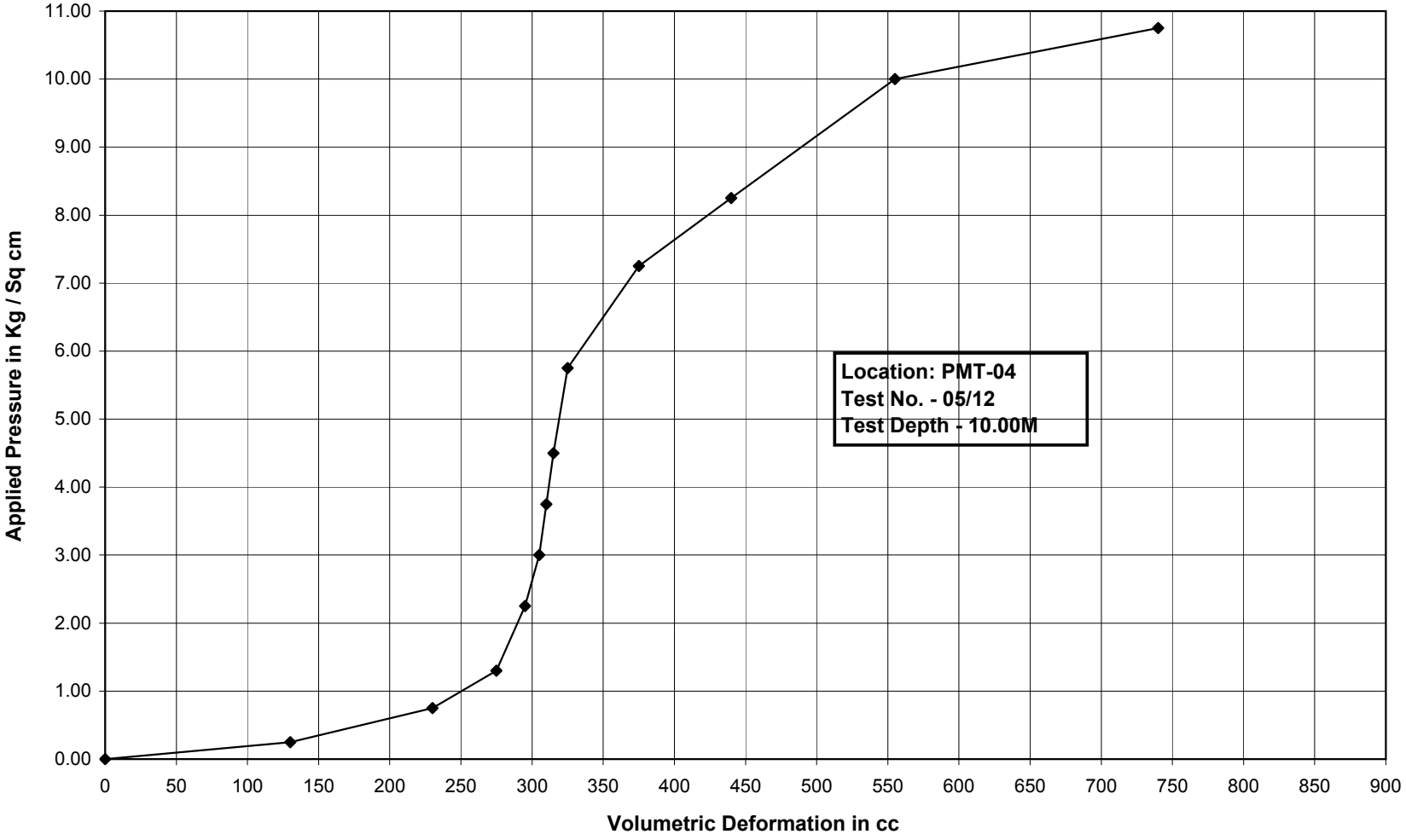


Fig. 56: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

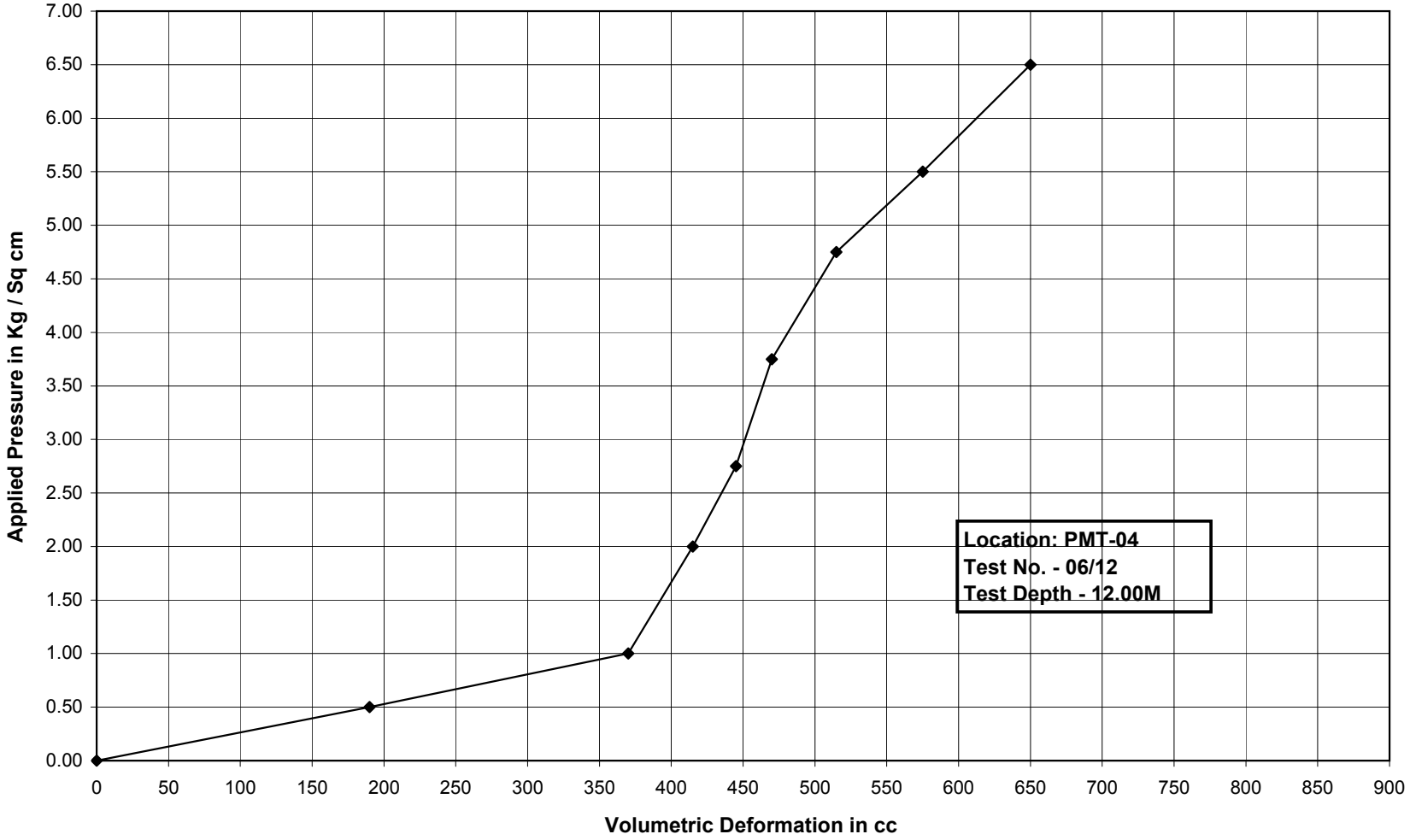


Fig. 57: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

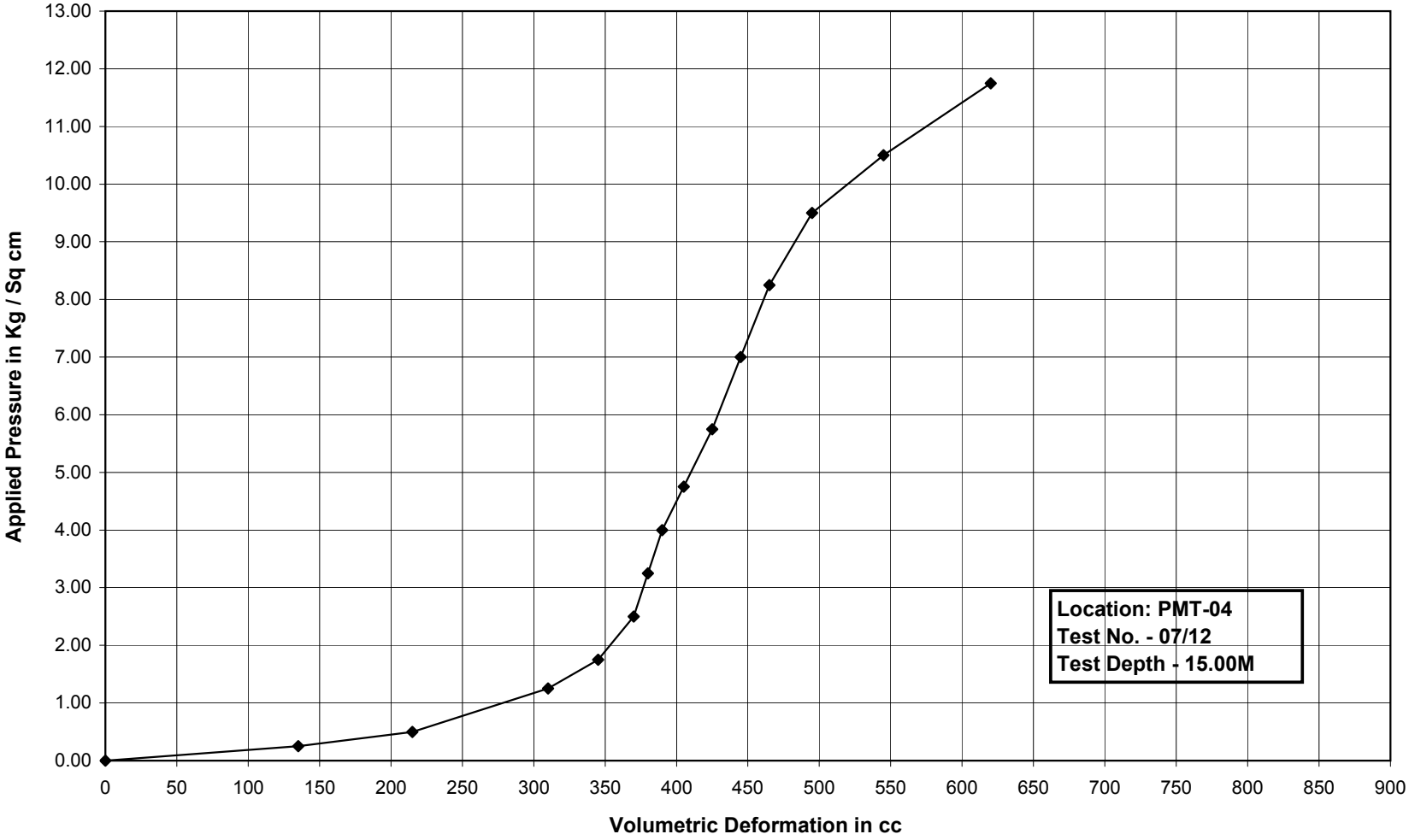


Fig. 58: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

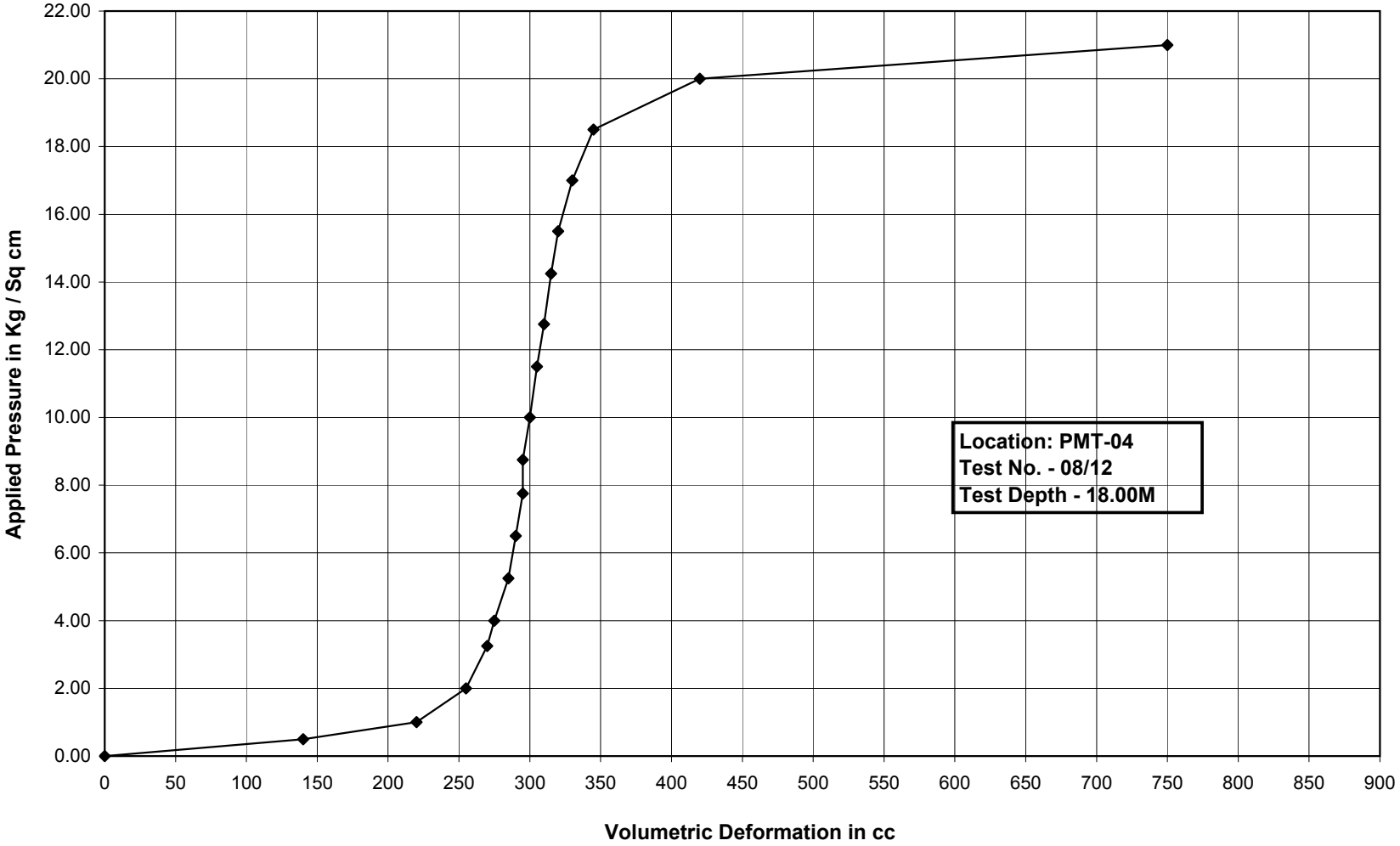


Fig. 59: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

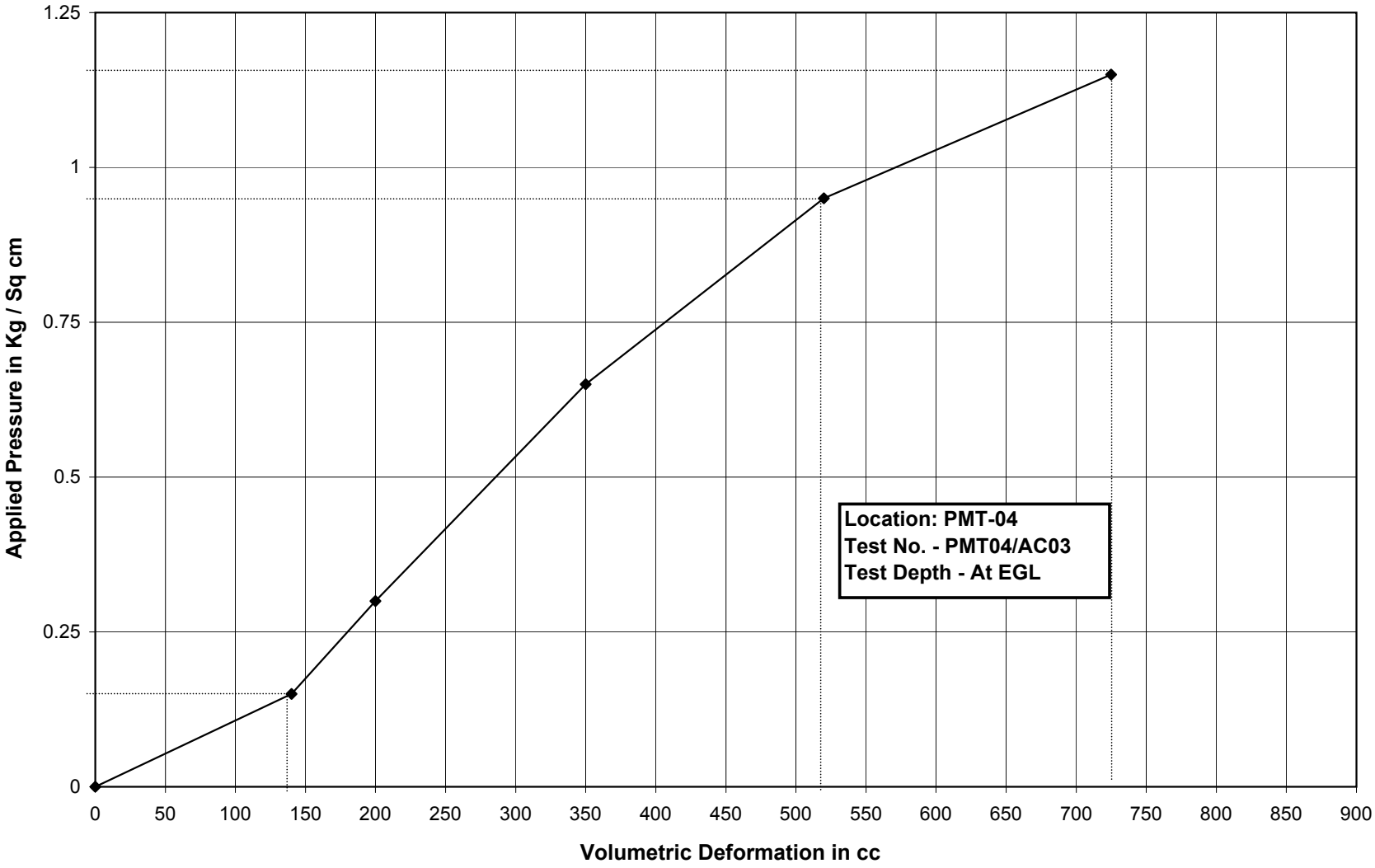


Fig. 60: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

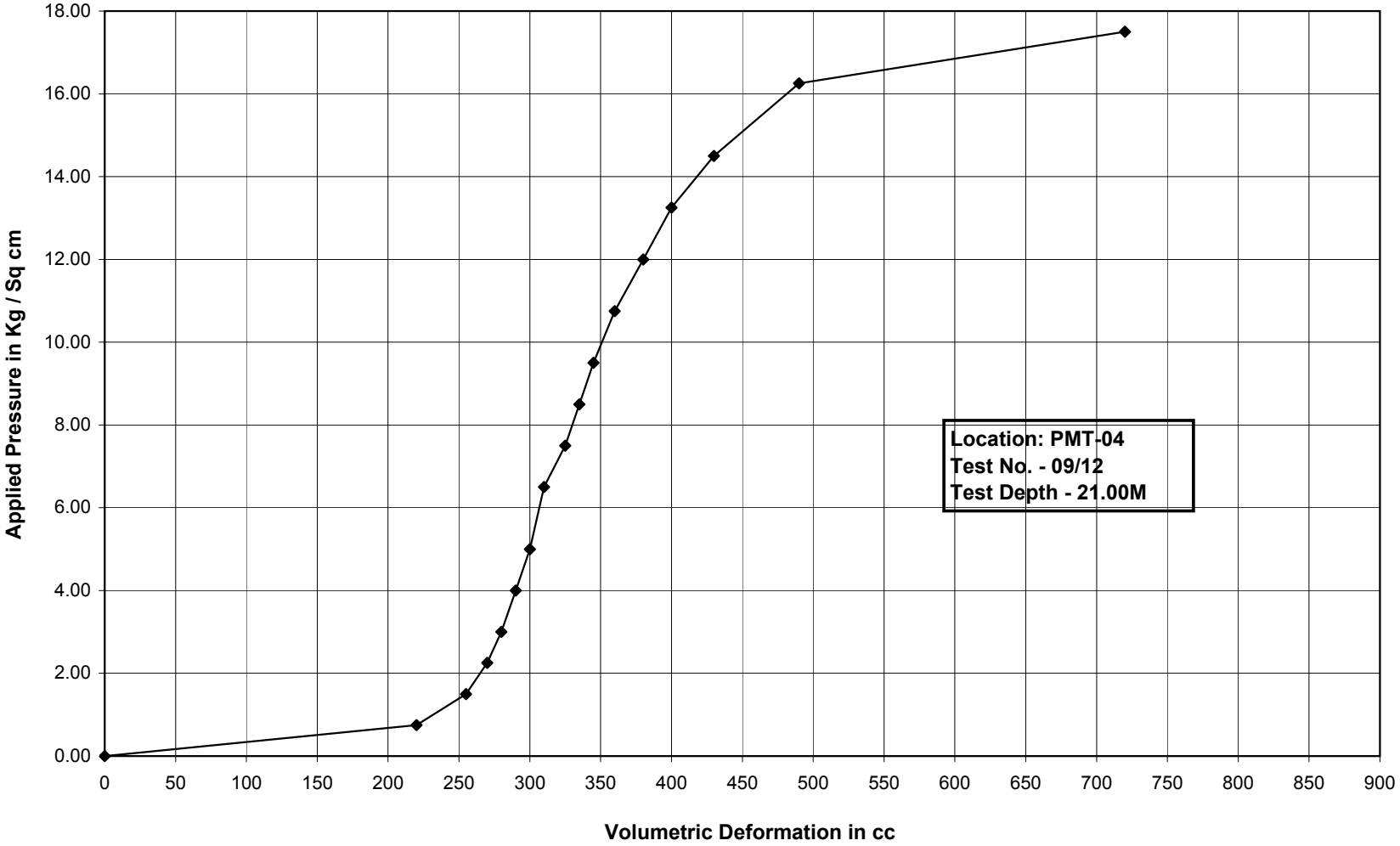


Fig. 61: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

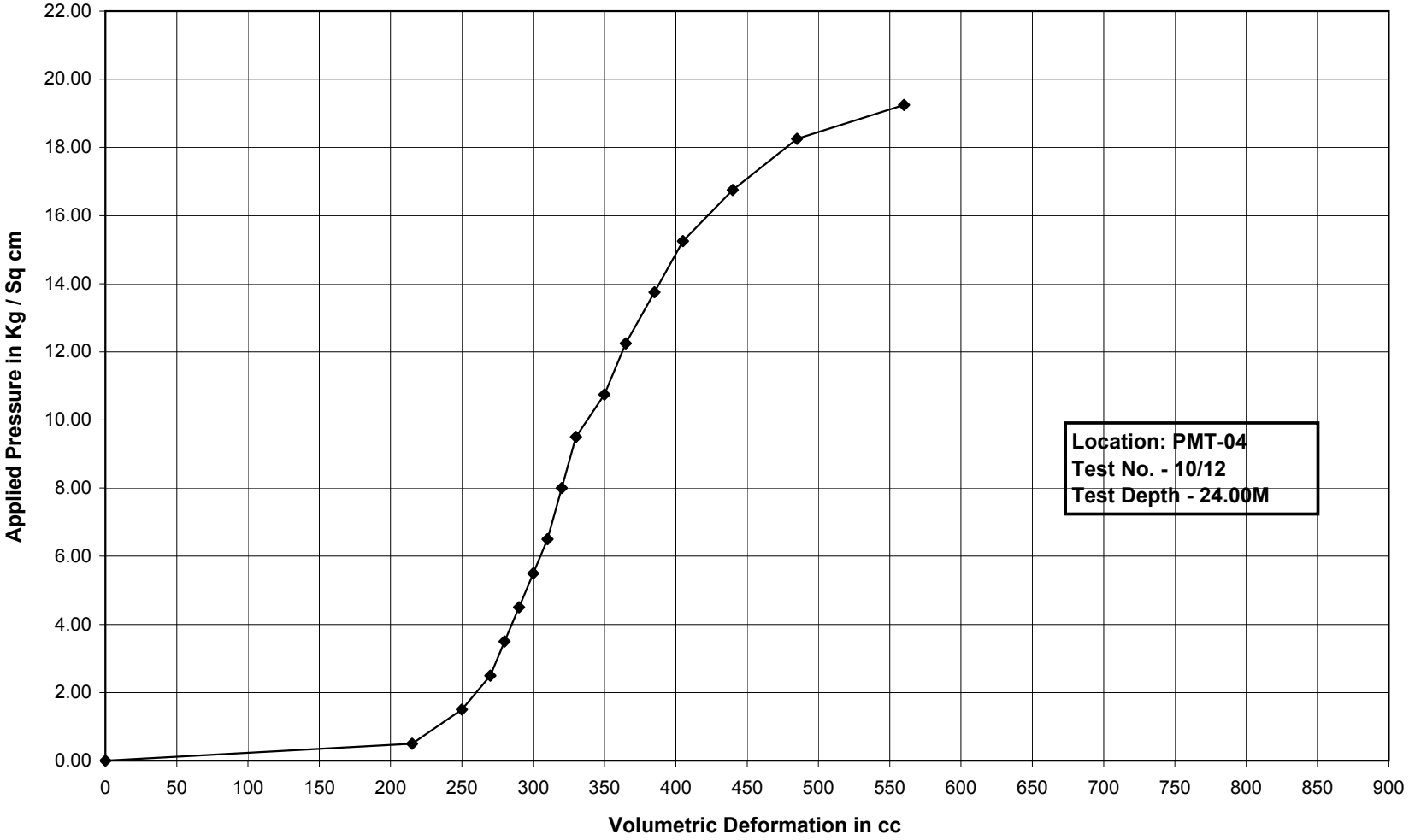


Fig. 62: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

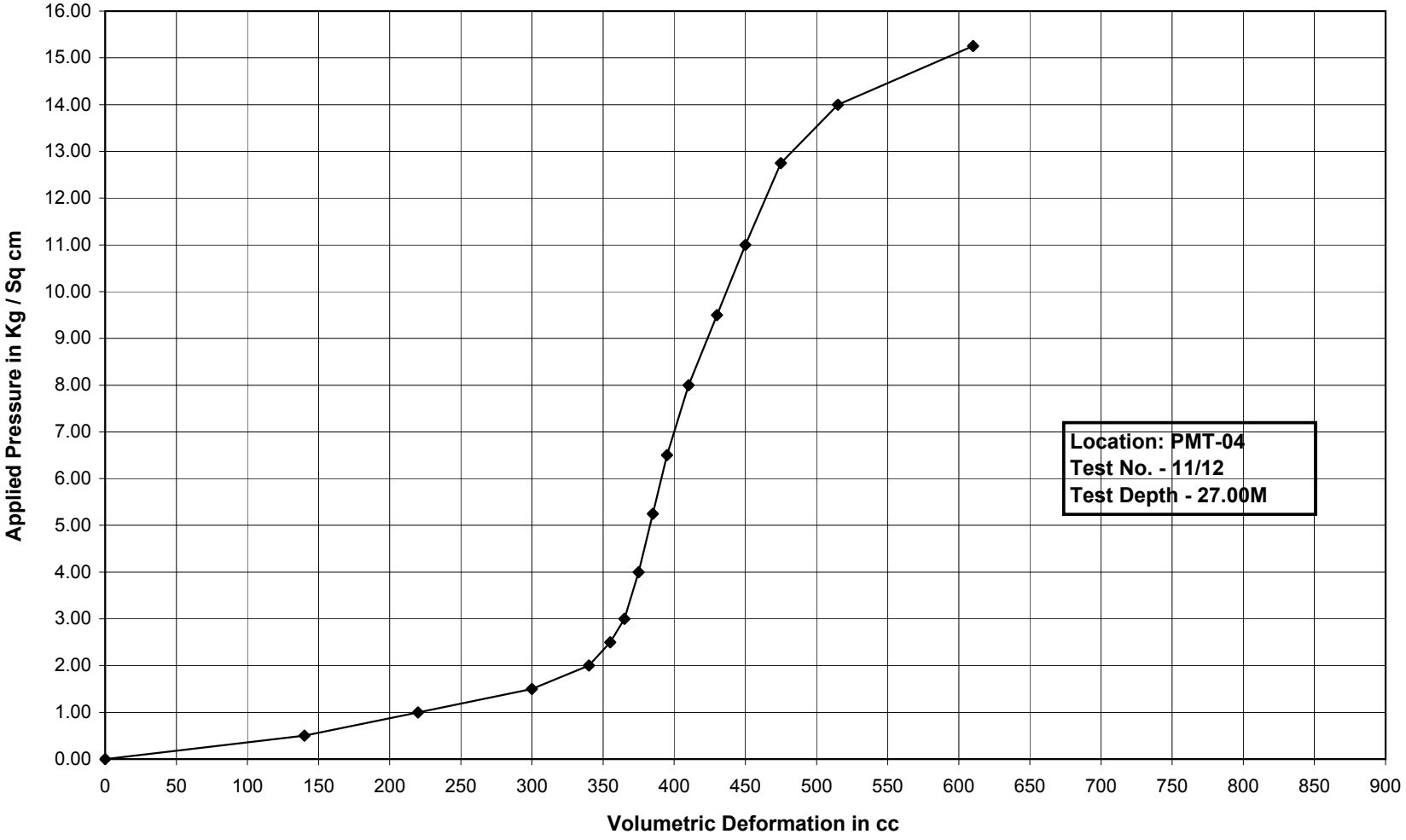


Fig. 63: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

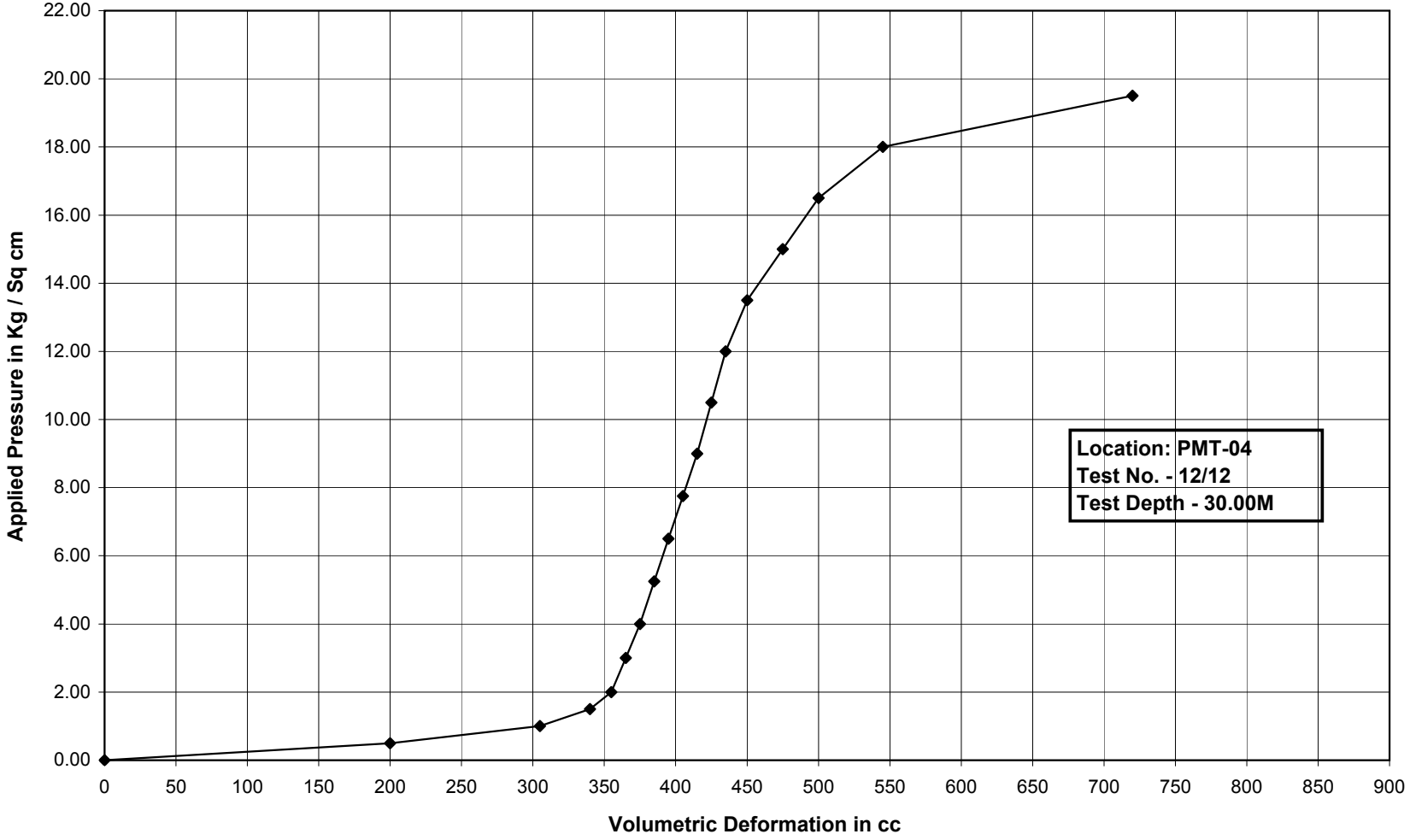


Fig. 64: APPLIED PRESSURE Vs. VOLUMETRIC DEFORMATION CURVE

10. BLOCK VIBRATION TESTS

BLOCK VIBRATION REPORT
FOR 1 x 800MW WANAKBORI TPS
AT GUJARAT.

1. INTRODUCTION

The **Gujarat State Electricity Corporation Limited** has proposed the expansion of Wanakbari Thermal Power Station, Gujarat. It has been proposed to install 1 x 800MW Unit in this phase & the job was awarded to **M/s. Bharat Heavy Electricals Limited**. For designing of Foundation Structures coming under this project, it was necessary to conduct a Detailed Geotechnical Investigation Work and **M/s Bharat Heavy Electricals Limited**, in turn awarded the job to **M/s. C. E. Testing Company Pvt. Ltd., Kolkata**.

As per the scope of work, 2 nos. Block Vibration Tests were conducted.

2. SITE CONDITION:

The soil at the test level is grayish brown, sandy silt. Only two (2) nos. BVT were carried out to determine the dynamic properties of the layer for the construction of machine foundations. The RL & depth of test is given below in a tabular form.

BVT No.	Co-ordinate (M)			Depth (M)
	E	N	R.L	
1	651.000	149.000	63.925	4.00
2	655.000	78.000	63.753	4.00

3. PURPOSE OF TEST:

The dynamic tests were performed for studying the behavior of sub-soil under vibration and for determining the various dynamic properties of soil as obtained by exciting a concrete block mechanically. The tests were performed according to I.S. 5249.

4. EQUIPMENTS USED:

Description of various equipment which were used during the tests are given below:

1. Oscillator:

Mechanical Oscillator type SEA-350 (A) was used. Maximum force that can be generated by this oscillator is 1200 Kg, and maximum frequency is 60 c.p.s. Eccentricity range is 0° - 140°. The oscillator was mounted on the base plate, which was in turn fitted with the block by holding down bolts. The oscillator can be fitted

with the base plate both for vertical vibration and horizontal vibration. The eccentricity is adjusted by adjustor circle on oscillator. One complete clockwise rotation increases the eccentricity by 4°. The tachometer is fixed internally in the equipment having two visible terminals, which were connected to the phase meter. The oscillator, which is filled with standard engine oil SEA-40, is connected by V-belt with the electric D.C. motor.

2. D.C. Motor:

Variable Speed Motor Type SEA-351 (A) was used. This 3 H.P. single phase D.C. Motor was fitted on the frame by the side of the oscillator. Supply from main was given through speed control unit, which controls the speed of the motor. The motor was connected to the oscillator by a V-belt.

3. Speed Control Unit:

Speed Control Unit Type SEA-352(A) was used. The maximum voltage for the armature is 250 V and maximum current is 12 Amp. For the fields, the maximum voltage is 28 V and maximum current is 8 Amp. The main function of the speed control unit is to control the speed of the motor as required. Higher speed of the motor gives higher frequency of the oscillator. The main knob of the speed control unit is turned in the anticlockwise direction till the minimum speed indicator light glows with a 'click' sound and then the knob is turned in the clockwise direction for increasing the speed as required. Maximum indicator light indicates the overloading of the motor.

4. Three-in-one Phase Meter:

Phase Meter Type SEA-550 was used for recording the frequency and amplitude. The instrument is powered by two 9 Volt batteries provided in the cabinet body of the units. For vertical vibration test, one acceleration pick up was fitted on top of the block and was connected to the remaining input of the meter. By turning the switch to "AMPLITUDE", the amplitude of the block is recorded. The second knob is meant for choosing properly the multiplier for recording higher amplitudes.

5. Acceleration Pick up:

The acceleration pick-ups are used to record the amplitude of vibration during vertical and horizontal block resonance test.

5. DESCRIPTION OF TESTS PERFORMED:

Forced vibration test was performed on a concrete block of size 1.50M x 0.75M x 0.70M (height) as per IS-5249. The detailed description of the test is given below:

Vertical Vibration Test: The acceleration pick up is fixed on the top of the concrete block such that it senses vertical motion of the block. The mechanical oscillator is mounted on the block such that it generates purely vertical sinusoidal vibrations and line of action of the vibrating force passes through the center of gravity of the block. After choosing a suitable value of angle of setting of eccentric masses, the oscillator is made to run at a constant frequency. With the help of the speed control unit, the speed of the motor is regulated and the frequency of the oscillator is increased in steps of small values upto the resonant frequency and two or three more readings of amplitude are taken beyond the resonant frequency. The same procedure is repeated for various values of angle of setting of eccentric masses. At any eccentricity and frequency, the dynamic force should not exceed 20 percent of the total mass of the block and motor-oscillator assembly. The frequency and amplitude are recorded through meter. □

6. CALCULATION:

6.1. COEFFICIENT OF □LASTIC UNIFORM COMPRESSION, C_u

The coefficient of elastic uniform compression, C_u, is calculated from the natural frequency as follows.

$$C_u = 4.\pi^2.f_{nz}^2.M/A$$

Where, f_{nz} = Natural frequency as obtained from forced vibration tests.

M = Mass of concrete block with Oscillator etc.

A = Base area of block.

Now we have, A = 150 X 75 = 11250 cm^2.

Weight of block = 1.50 X 0.75 X 0.70 X 2400 = 1890 kg

Weight of motor + Oscillator = 169 kg.

Total weight = 2059 kg.

M = 2059 / 981 = 2.10 kg.Sec^2/cm, M/A = 1.86 x 10^{-4} kg sec^2cm^{-3}

The natural frequencies are presented in Column-3 of Table-1 for vertical vibration for each level of Dynamic force. For example **for BVT-1, eccentricity = 8°,** f_{nz} = 480 rpm = 480/60 = 8 c.p.s.

$C_u = [4 \times \pi^2 \times 1.86 \times 10^{-4}] f_{nz}^2 = 4 \times \pi^2 \times 1.86 \times 10^{-4} \times 8^2$

= 0.47 kg/cucm

6.2. DAMPING CONSTANTS:

The damping constants, ξ is given as ξ **= ([f_2 . f_1] / [2.f_{nx}])**

Where, f_1 and f_2 are the frequencies at which the amplitude is 0.707 times the amplitude at natural frequency.

Considering Vertical Vibration test: **For BVT-01 & 8° eccentric angle**:

f_{nx} = 480 rpm, f_1 = 411 rpm, f_2 = 545 rpm from graph.

Therefore ξ = (545 – 411) / (2 x 480) = 0.140

Table- 1 : Summarised Results for Damping Constant

BVT No.	Type of Test	Eccentric angle (degree)	Natural frequency, f_{nx} (rpm)	Damping constant (ξ)	Avg. ξ
01	Vertical	4°	500	0.250	0.201
		8°	480	0.140	
		12°	571	0.256	
		16°	554	0.160	
02	Vertical	4°	637	0.304	0.183
		8°	754	0.143	
		12°	710	0.187	
		16°	818	0.097	

6.3. DYNAMIC SHEAR AND YOUNG'S MODULUS:

DYNAMIC YOUNG'S MODULUS: -

The co-efficient of elastic uniform compression, C_u is related to dynamic Young's Modulus, E_d as $C_u = 1.09\ E_d/[(1 - \mu^2)\ \sqrt{A}]$, Therefore $E_d = [\sqrt{A}\ C_u\ (1 - \mu^2)]/1.09$

Using μ = 0.30 and A = 150 x 75 = 11250 sqcm.

Substituting the values, E_d is given as $88.55C_u$.

For C_u = 0.47 kg/cucm, E_d = **41.74 kg/sqcm**

THE SHEAR MODULUS, G: -

Shear modulus is related to Young's Modulus by

$E_d = 2G\ (1 + \mu) = 2.60\ G$

Therefore, $G = E_d/2.60$ giving **16.05 kg/sqcm**.

Table:- 2: Summarised results for 1.50M x 0.75M foundation size.

Test No	Eccentricity	Co-efficient of Uniform compression C_u (kg/cucm)	Dynamic Young's Modulus (kg/sqcm)	Shear Modulus kg/sqcm (G)	Damping constant (ξ)
BVT-01	4°	0.51	45.29	17.42	0.250
	8°	0.47	41.74	16.05	0.140
	12°	0.67	59.07	22.72	0.256
	16°	0.63	55.6	21.39	0.160
	Average	**0.57**	**50.43**	**19.40**	**0.202**
BVT-02	4°	0.83	73.51	28.27	0.304
	8°	1.16	103.00	39.61	0.143
	12°	1.03	91.33	35.13	0.187
	16°	1.37	121.22	46.62	0.097
	Average	**1.10**	**97.27**	**37.41**	**0.183**

6.4. CORRECTIONS FOR AREA & OVERBURDEN PRESSURE ON VALUES OF C_u & C_τ

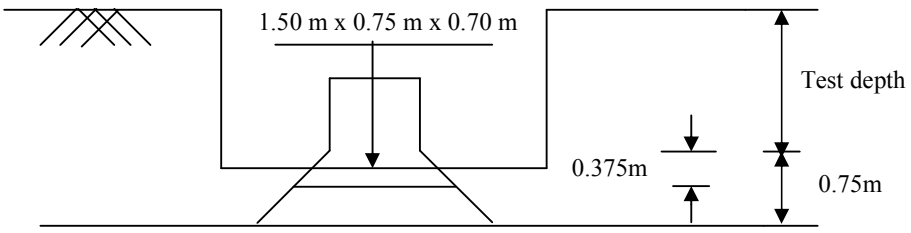
We know that, $C_u \propto 1/\sqrt{A}$ and $C_u \propto \sqrt{P_v}$

So, we can write, $C_u \propto \sqrt{(P_v/A)}$

Hence we can write, $(C_u)_{block} / (C_u)_{foundation} = [\sqrt{(P_v/A)}]_{block} / [\sqrt{(P_v/A)}]_{foundation}$

$$(C_u)_{foundation} = (C_u)_{block} \times [\sqrt{(A/P_v)}]_{block} \times [\sqrt{(P_v/A)}]_{foundation}$$

It is standard practice to deduce the values for 10sqm foundation with vertical stress of 10t/sqm.



6.5. CALCULATION OF $(C_u)_{Foundation}$ & $(E_d)_{Foundation}$

Weight of block = 2.059 t

Load at the base of foundation = 2.059/(1.5 x 0.75) = 1.83 t/sqm

Zone of influence = B = 0.75m below the block.

Hence pressure intensity at B/2 = (1.83x1.50x0.75) / ((1.50+0.375)x(0.75 + 0.375))

= 0.976 t/sqm

Overburden of 0.375m (submerged) soil = 0.338 t/sqm

Hence total Pressure = (0.976 + 0.338) = 1.314 t/sqm

Area of block = 1.5 x 0.75 = 1.125 sqm

Hence $\sqrt{(A/P_v)_{block}} = \sqrt{(1.125/1.314)} = 0.925$

Let us consider one actual footing of base area = 10 sqm = 3.162m x 3.162m

Vertical stress at centre of influence zone = 10 t/sqm (assumed)

Hence $\sqrt{(P_v/A)_{foundation}} = \sqrt{(10/10)} = 1$

Therefore, $(C_u)_{foundation} = (C_u)_{block} \times 1 \times 0.925 = 0.925 \times (C_u)_{block}$

The Young's modulus will vary as $E \propto \sqrt{P_v}$

Hence $E_{foundation} = E_{block} \times \sqrt{(10/1.30)} = 2.759 \times E_{block}$

The shear modulus will follow the same rule.

On the basis of the above, in Table – 3, the dynamic properties for 10 sqm foundation with vertical pressure intensity of 10 t/sqm is presented.

TABLE - 3: RECOMMENDED VALUES OF DYNAMIC PROPERTIES:-

Foundation size = 10 sqm, P_v = 10 t/sqm

Test No	Eccentricity	Corrected C_u (kg/cucm)	Modulus of Elasticity (Kg/sqcm) (E)	Corrected Shear Modulus (kg/sqcm) (G)	Damping constant (ξ)
BVT-01	4°	0.472	125.00	48.06	0.250
	8°	0.435	115.20	44.30	0.140
	12°	0.620	163.00	62.68	0.256
	16°	0.583	153.40	59.01	0.160
	Average	**0.527**	**139.15**	**53.51**	**0.202**
BVT-02	4°	0.768	202.80	78.01	0.304
	8°	1.073	284.20	109.30	0.143
	12°	0.953	252.00	96.92	0.187
	16°	1.267	334.50	128.60	0.097
	Average	**1.015**	**268.38**	**103.21**	**0.183**

Note: Following relations are to be used to calculate the coefficient of non uniform compression & shear.

Coefficient of elastic uniform shear, $C_\tau = 0.50C_u$

Co-efficient of elastic non-uniform compression = $3.46C_\tau$

Coefficient of elastic non-uniform shear = $1.50C_\tau$

7. CONCLUDING REMARKS:

1. Two (2) nos. Routine Block Vibration Tests has been conducted on 1.50m x 0.75m x 0.70m block.
2. The observed natural frequencies for the test are already given in the preceding clause.
3. The computed C_u values for the test are already given. However, this is further presented below.

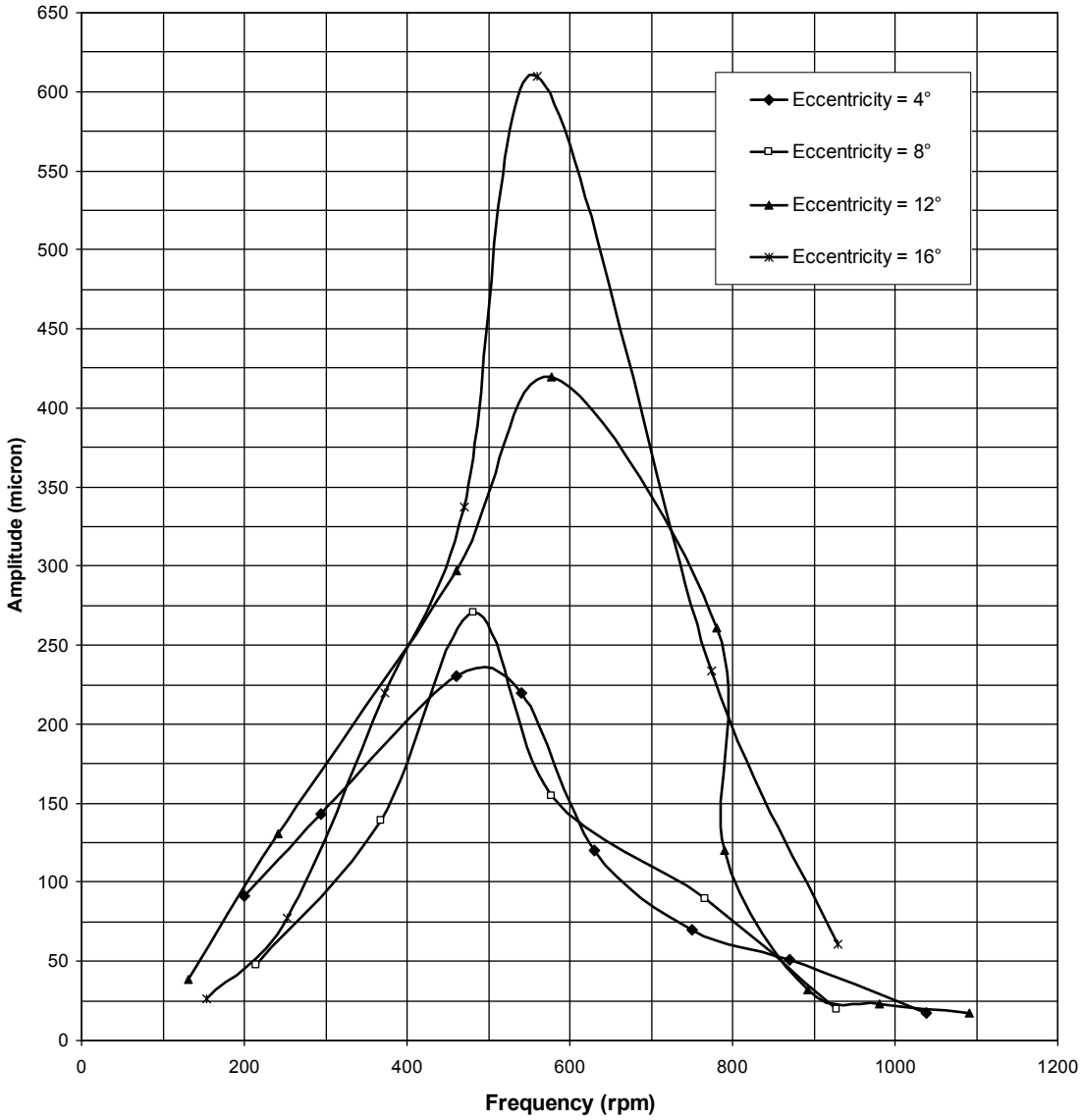
Test No	Eccentricity	Co-efficient of Uniform compression C_u (kg/cucm)	Dynamic Young's Modulus (kg/sqcm)	Shear Modulus kg/sqcm (G)	Damping constant (ξ)
BVT-01	4°	0.51	45.29	17.42	0.250
	8°	0.47	41.74	16.05	0.140
	12°	0.67	59.07	22.72	0.256
	16°	0.63	55.6	21.39	0.160
	Average	**0.57**	**50.43**	**19.40**	**0.202**
BVT-02	4°	0.83	73.51	28.27	0.304
	8°	1.16	103.00	39.61	0.143
	12°	1.03	91.33	35.13	0.187
	16°	1.37	121.22	46.62	0.097
	Average	**1.10**	**97.27**	**37.41**	**0.183**

4. On the basis of experimental test results, dynamic values are recommended for a **10sqm footing** with an average vertical pressure intensity of **10t/sqm** are calculated and supplied in the previous clause. However, the corrected values are presented below.

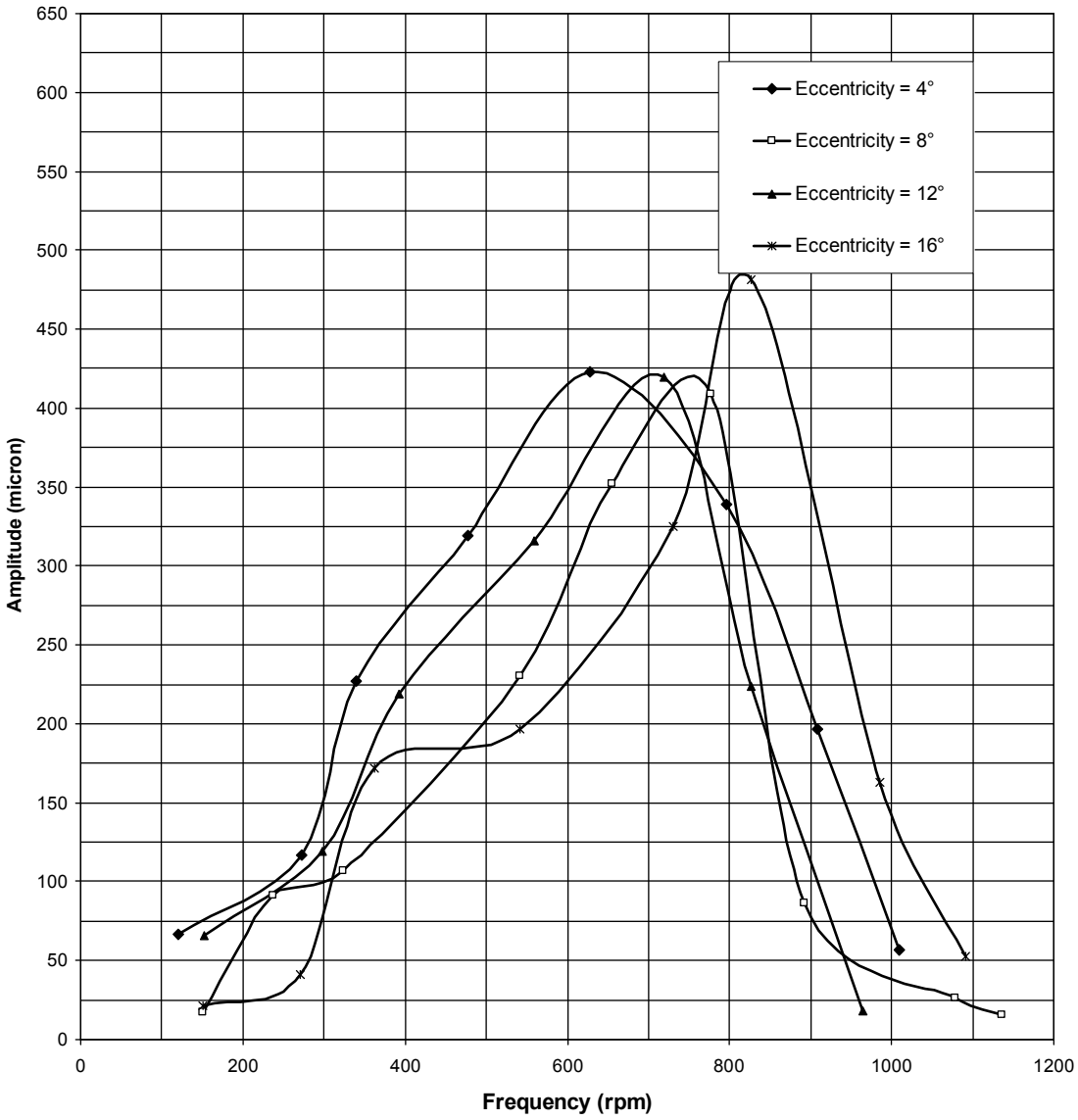
Test No	Eccentricity	Corrected C_u (kg/cucm)	Modulus of Elasticity (Kg/sqcm) (E)	Corrected Shear Modulus (kg/sqcm) (G)	Damping constant (ξ)
BVT-01	4°	0.472	125.00	48.06	0.250
	8°	0.435	115.20	44.30	0.140
	12°	0.620	163.00	62.68	0.256
	16°	0.583	153.40	59.01	0.160
	Average	**0.527**	**139.15**	**53.51**	**0.202**
BVT-02	4°	0.768	202.80	78.01	0.304
	8°	1.073	284.20	109.30	0.143
	12°	0.953	252.00	96.92	0.187
	16°	1.267	334.50	128.60	0.097
	Average	**1.015**	**268.38**	**103.21**	**0.183**

5. For different foundation size & vertical stress, the recommended dynamic properties should be computed by using the principles illustrated.

Vertical Block Vibration Test graphs for BVT-01



Vertical Block Vibration Test graphs for BVT-02



11. GEOLOGY

G E O L O G Y

Introduction

The 'BHEL' has proposed to construct 1 x 800MW Thermal Power Station at Wanakbori, Cheddar district of Gujarat. It is extension project of the existing Power Plant and located adjacent to it. The nearest town Godhra is located about 25km SE and Anand about 60km NE from the site respectively. The State capital Ahmadabad is situated about 100km at SW from the the site and is well connected through National Highway NH-59. NH-8 running almost NS direction cross close proximity to the site. Anand and Vadodara are nearest broad gauge railway stations of Western Railway. International Airport is available at Ahmadabad. Geographically the study area located at on the mainland close to the eastern boundary of the State and on the western part of the Peninsular India. Eastern boundary of the state has contacts with Rajasthan; Madhya Pradesh and Maharastra states of India and at the western and southern part, there is vast Arabian sea. Part of the north boundary of the state has contact with Rajasthan and partly with Pakisthan. The study area lies on the north bank of the NE – SW flowing Mahi river which ultimately discharged into the Arabian Sea in the Gulf of Cambay / Gulf of Khambhat. The river is the main drainage of the region. Morphologically it is plain land covered with alluvium soil, as a result the alluvial stretches is fertile for agriculture. Geologically the area of interest is characterised by the Quaternary alluvial sediments of Holocene / recent period. The depth of standing ground water levels varies from about 12m to 35m below the existing ground level. The maximum and minimum temperatures recorded during summer and winter varies from 43°-27°c and 29°-14°c respectively. The monsoon lasting from June to September and heavy rain fall recorded at southern part and is decreasing northward.

Geomorphology

Geo morphologically, the entire Gujarat can be divided into three distinct division,

I) Gujarat Mainland
II) Saurashtra – Kathiawar Peninsula and
III) Kutch Peninsula.

Gujarat Mainland:

The Gujarat Mainland is a vast alluvium / fluvial deposits extent northward upto the north boundary of the state and beyond the boundary within the Rajasthan whereas southern extension of the deposit continues upto the southern border where it terminated against Deccan Trap. The eastern limit of the basin deposits are marked by Aravalli, Vindhyan, Satpura and Sahyadri hill ranges and western extension is partly bordered by Saurashtra – kathiawar Peninsula at the southwestern portion and Kutch Peninsular at the north western portion. The sedimentary basin is fed by southwesterly to westerly flowing several major rivers like Tapi, Normoda, Mahi Sabarmati etc and ultimately draining into Gulf of Cambay. The basin is originated from high estuarine tract between Narmada and Tapi rivers, and extend about 400km northward. The Maximum width of the basin is about 120km.

Drainage Pattern and Sediment Distribution

The Gujarat Mainland at the western coast is traversed by several rivers flowing from north east to south west and ultimately discharged into Gulf of Cambay of Arabian Sea. The area of interest is located on the Tapi river bank, one of the major river flowing almost central portion of the mainland. All the rivers of the land originated from the high land of the western Peninsula. Most of the rivers are fed by rain water. In their course through the hills / high land area they have good gradient and carry much coarse materials including pebbles and boulders, and also torn off from the beds and banks. It carries enormous quantities of fine sand and silt derived from the hills as well as from the higher peninsular up-lands. Much of the coarse sediments are deposited near its debaucher into the plains.

Geology

The topography of the area is controlled by formation rocks. Eastern part of the south mainland is bordered by alluvium tract has a typical Deccan trap scenery upto Narmada valley. North and north eastern corner of the basin is occupied by quartzite, phyllites and schists. The area of interest is located right bank of the Mahi river close to Anand and Godhra (mentioned).

Deccan traps cover large area along the eastern margin extending from southern tips of Narmada, further northwards there are scattered patches cropping out from alluvial tracts at

different places and has been recorded upto Insurance in Ahmadabad. The Traps comprises lava flows of amygdaloidal trap; porphyritic type and basaltic etc.
The Tertiaries rocks occupying in between mouths of Tapi and Narmada river, forming a fringes along the edge of Deccan traps. The basal bed of Nummulitic limestone and ferruginous clay belongs to Eocene, while overlying rocks of Khand formation (yellow limestone), ferruginous sandstone, and agate bearing conglomerate are upper Gaj of Miocene age.

The Tertiary rocks are covered with Holocene to Recent sediments across the basin. It included fluvial deposits along the river valleys. The marine deposits at the gulf and deltaic sediments at the mouth of rivers. The sands are composed of quartz, fragments of feldspar, mica and heavy minerals. Layers within the alluvial soils vary in color and are composed of sand, dark clay, clayey silt / silty clay to sand particles. Layers are more sandy along river and stream courses but silty and clayey in the flood plains.

Local Geology:

The enormous thickness of soil encountered over the study area is dominantly characterized by yellowish brown to brownish grey silty sand with clay stringers sandwich between clayey silt / silty clay layers of variable thickness. The huge yellowish grey / brownish grey silty sand to sand follows the above and continues upto depth of investigation. From the disposition (see soil profiles), and nature of soil are similar to alluvial sediments occurs on more or less flat mainland and is dominantly sandy in nature. Almost the entire area is covered by Holocene / Recent alluvium, deposited by Mahi river. The alluvium is made up of mainly sand with rare clay and boulders / gravel zones within sand at depth. Sandy areas are found along the river bank of the alluvial deposits.
The area of interested 'Wanakbori' is located at the middle of mainland on the right bank of Mahi river close proximity to nearest Godhra and Anand towns in the Gujarat State. The Mahi river in the eastern high land flows to gulf of Cambay at the west and ultimately connect the Arabian Sea. To understand the subsurface soil distribution pattern and nature altogether 68nos. of boring had been done at different locations. Maximum and minimum depth of investigation restrict between 40m and 30m respectively. It has been observed from the soil profiles when correlated with each other along the preferred directions the upper portion is covered with loose sand of over bank deposit of the recent origin. The clayey silt / silty clay occasionally inter layered with fine to medium sand layers / stringers indicating deposited on the flood plain of

holocene to recent periods. At depth the soil is sandy in nature and at places contains gravels / pebbles indicating channel sand deposits. The river bank sand at places inter layers with clayey silt / silty clay. The alluvial deposits recorded from several boring reveals that the recent alluvial soils are represented by silty sand to fine to medium sand with mica of river bank deposits at the top. The sand may contains kankars at the upper reaches. Overall consistency of subsoil gradually improved with depth.

Seismicity

The Zero peak horizontal ground acceleration (EPGA) is of the order of 0.04 for safe shut down condition and for operating basis average earthquake acceleration spectra is 0.16 (Seismic Zone Factor, Z). The information is intended to bring out the fact that the site shall be considered to lies on moderately damage risk zone. Hence, suitable seismic coefficient commensurate to Seismic Zone-III and Important Factor (I=1.5) shall be adopted in the design of the structures.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 16/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.24

Co-ordinates E=668.000 N=151.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
		Disturbed (DS)	24
Vane (V)		Water Sample (WS)	0

Commencement Date : 19/11/14
Completion Date : 23/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.86 m.
Water Struck At :
Standing Water Level : 11.85 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
			DS-12	21.50
		76		
		11 23 53	SPT-13	22.00-22.45
			DS-13	23.00
		>100		
		26 57	SPT-14	23.50-23.73
		8.0 cm Pentn.		
			DS-14	24.50
		>100		
		29 52	SPT-15	25.00-25.21
		6.0 cm Pentn.		
			DS-15	26.00
		>100		
		36 65	SPT-16	26.50-26.72
		7.0 cm Pentn.		
			DS-16	27.50
		>100		
		40 60	SPT-17	28.00-28.20
		5.0 cm Pentn.		
			DS-17	29.00
		>100		
		39 62	SPT-18	29.50-29.71
		6.0 cm Pentn.		
			DS-18	30.50
		>100		
		35 45 50	SPT-19	31.00-31.35
		5.0 cm Pentn.		
			DS-19	32.00
		>100		
		37 48 50	SPT-20	32.50-32.87
		7.0 cm Pentn.		
			DS-20	33.50
		>100		
		40 52 50	SPT-21	34.00-34.36
		6.0 cm Pentn.		
			DS-21	35.00
		>100		
		50 52	SPT-22	35.50-35.73
		8.0 cm Pentn.		
			DS-22	36.50
		>100		
		56 50	SPT-23	37.00-37.21
		6.0 cm Pentn.		
			DS-23	38.00
		>100		
		60 58	SPT-24	38.50-38.74
		9.0 cm Pentn.		
			DS-24	39.50
		>100		
		57 59	SPT-25	40.00-40.22
		7.0 cm Pentn.		

21.00m

Very dense, brownish grey, silty sand with high % of gravels.

40.22m

N.B. - '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.25

Co-ordinates E=638.000 N=150.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	23
		Water Sample (WS)	0

Commencement Date : 24/11/14
Completion Date : 29/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.39 m.
Water Struck At :
Standing Water Level : 11.8 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	SAMPLES Depth (m)
0.00m							
Stiff, light yellowish brown, sandy silt with traces of clay.		4	6	7	13	DS-1	0.50
						SPT-1	1.00-1.45
						UDS-1	2.00-2.45
		4	5	5	10	SPT-2	3.00-3.45
4.00m						UDS-2	4.00-4.45
Medium dense, deep grey, silty sand / sandy silt.		4	6	7	13	SPT-3	5.00-5.45
						DS-2	6.00
6.50m						UDS-3	6.50-6.95
						DS-3	7.50
Dense, brownish grey, sandy silt / silty sand. Obs. gravels.		11	22	23	45	SPT-4	8.00-8.45
						DS-4	9.00
					37	*UDS-4	9.50-9.67
		10	16	21		SPT-5	9.75-10.20
10.50m							
						DS-5	11.00
		10	24	37	61	SPT-6	11.50-11.95
						DS-6	12.50
Hard, yellowish brown, clayey silt. Obs. gravels & sand mixture.		9	21	27	48	SPT-7	13.00-13.45
						DS-7	14.00
		16	43	43	86	SPT-8	14.50-14.95
						DS-8	15.50
16.20m		15	26	30	56	SPT-9	16.00-16.45
						DS-9	17.00
		25	30	37	67	SPT-10	17.50-17.95
Very dense, yellowish grey, silty sand with high % of gravels & pebbles.						DS-10	18.50
		20	35	40	75	SPT-11	19.00-19.45
						DS-11	20.00
20.50m							

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.25

Co-ordinates E=638.000 N=150.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	23
		Water Sample (WS)	0

Commencement Date : 24/11/14
Completion Date : 29/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.39 m.
Water Struck At :
Standing Water Level : 11.8 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
20.50m				
		16 50 56 ≥100	SPT-12	20.50-20.95
			DS-12	21.50
		≥100		
		18 58 50	SPT-13	22.00-22.37
		7.0 cm Pentn.		
			DS-13	23.00
		56		
		27 21 35	SPT-14	23.50-23.95
			DS-14	24.50
		≥100		
		38 67	SPT-15	25.00-25.28
		13.0 cm Pentn.		
			DS-15	26.00
		≥100		
		42 55	SPT-16	26.50-26.77
		12.0 cm Pentn.		
			DS-16	27.50
		≥100		
		46 60	SPT-17	28.00-28.25
		10.0 cm Pentn.		
			DS-17	29.00
		≥100		
Very dense, yellowish grey, silty sand with high % of gravels & pebbles.		58 65	SPT-18	30.00-30.23
		8.0 cm Pentn.		
			DS-18	31.00
		≥100		
		52 60	SPT-19	31.50-31.74
		9.0 cm Pentn.		
			DS-19	32.50
		≥100		
		56 62	SPT-20	33.00-33.22
		7.0 cm Pentn.		
			DS-20	34.00
		≥100		
		58 55	SPT-21	34.50-34.69
		4.0 cm Pentn.		
			DS-21	35.50
		≥100		
		60 50	SPT-22	36.00-36.18
		3.0 cm Pentn.		
			DS-22	37.00
		≥100		
		59 56	SPT-23	37.50-37.70
		5.0 cm Pentn.		
			DS-23	38.50
		≥100		
		65 59	SPT-24	39.00-39.17
		2.0 cm Pentn.		
		≥100		
40.19m		62 52	SPT-25	40.00-40.19
		4.0 cm Pentn.		

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 17/12/2014** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.26

Co-ordinates E=617.000 N=127.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	21
Vane (V)		Disturbed (DS)	21
		Water Sample (WS)	0

Commencement Date : 30/11/14
Completion Date : 03/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 65.80 m.
Water Struck At :
Standing Water Level : 13.5 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)				SAMPLES	
						Ref. No	Depth (m)
0.00m							
		2	2	3	5	DS-1	0.50
						SPT-1	1.00-1.45
						UDS-1	2.00-2.45
Loose to medium dense, reddish brown, fine silty sand.		4	5	6	11	SPT-2	3.00-3.45
						UDS-2	4.00-4.45
		5	6	8	14	SPT-3	5.00-5.45
5.50m							
						DS-2	6.00
						UDS-3	6.50-6.95
Very stiff, deep grey, silty clay / clayey silt.						DS-3	7.50
		5	9	11	20	SPT-4	8.00-8.45
						DS-4	9.00
9.50m							
						UDS-4	9.50-9.95
Dense, greyish brown, silty sand with mica.						DS-5	10.50
		12	20	23	43	SPT-5	11.00-11.45
12.00m						DS-6	12.00
						*UDS-5	12.50-12.67
		10	22	27	49	SPT-6	12.75-13.20
						DS-7	14.00
Hard, greyish brown, clayey silt / silty clay.		25	39	48	87	SPT-7	14.50-14.95
						DS-8	15.50
		23	37	45	82	SPT-8	16.00-16.45
						DS-9	17.00
		9	15	27	42	SPT-9	17.50-17.95
18.00m							

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.26

Co-ordinates E=617.000 N=127.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	21
		Disturbed (DS)	21
Vane (V)		Water Sample (WS)	0

Commencement Date : 30/11/14
Completion Date : 03/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 65.80 m.
Water Struck At :
Standing Water Level : 13.5 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
18.00m. Hard, greyish brown, clayey silt / silty clay.			DS-10	18.50
19.00m.		10 15 25 (40)	SPT-10	19.00-19.45
			DS-11	20.00
		28 45 50 (≥100) 4.0 cm Pentn.	SPT-11	20.50-20.84
Very dense, yellowish brown, silty sand with high % of gravels & pebbles.			DS-12	21.50
		45 50 (≥100) 10.0 cm Pentn.	SPT-12	22.00-22.25
			DS-13	23.00
		48 52 50 (≥100) 5.0 cm Pentn.	SPT-13	23.50-23.85
			DS-14	24.50
25.00m.		7 12 23 (35)	SPT-14	25.00-25.45
			DS-15	26.00
Hard, deep grey, silty clay.		10 16 24 (40)	SPT-15	26.50-26.95
			DS-16	27.00
		11 15 26 (41)	SPT-16	27.50-27.95
28.00m.			DS-17	28.50
		29 47 50 (≥100) 4.0 cm Pentn.	SPT-17	29.00-29.34
			DS-18	30.00
		48 58 (≥100) 11.0 cm Pentn.	SPT-18	30.50-30.76
Very dense, brownish grey, silty sand with high % of gravels.			DS-19	31.50
		42 54 (≥100) 9.0 cm Pentn.	SPT-19	32.00-32.24
			DS-20	33.00
		44 52 (≥100) 7.0 cm Pentn.	SPT-20	33.50-33.72
			DS-21	34.50
35.20m.		53 58 (≥100) 5.0 cm Pentn.	SPT-21	35.00-35.20

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 07/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.27

Co-ordinates E=593.000 N=161.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	22	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	22
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 11/12/14
Completion Date : 13/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 66.624 m.
Water Struck At :
Standing Water Level : 14.6 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of deep grey, ash.			DS-1	0.50
0.50m.		7 12 18 (30)	SPT-1	1.00-1.45
			UDS-1	2.00-2.45
Dense to medium dense, yellowish brown, silty fine sand / sandy silt.		9 13 19 (32)	SPT-2	3.00-3.45
			UDS-2	4.00-4.45
		4 6 7 (13)	SPT-3	5.00-5.45
			DS-2	6.00
6.50m.			UDS-3	6.50-6.95
Very stiff, brownish grey, silty clay / clayey silt.			DS-3	7.50
		7 8 12 (20)	SPT-4	8.00-8.45
9.00m.			DS-4	9.00
			*UDS-4	9.50-9.65
		13 25 28 (53)	SPT-5	9.80-10.25
			DS-5	11.00
Very dense, bronwish grey, silty sand.		15 27 29 (56)	SPT-6	11.50-11.95
			DS-6	12.50
		17 28 31 (59)	SPT-7	13.00-13.45
14.00m.			DS-7	14.00
		21 32 35 (67)	SPT-8	14.50-14.95
Hard, greyish brown, clayey silt. Obs. gravels / kankars & mica.			DS-8	15.50
		27 43 48 (91)	SPT-9	16.00-16.45
16.50m.			DS-9	17.00
Very dense, greyish brown, clayey sandy silt with kankars & mica.		30 54 52 (>100) 10.0 cm Pentn.	SPT-10	17.50-17.90
18.00m.				

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 07/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.27

Co-ordinates E=593.000 N=161.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	22	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	22
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 11/12/14
Completion Date : 13/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 66.624 m.
Water Struck At :
Standing Water Level : 14.6 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
18.00m.				
Very dense, greyish brown, clayey sandy silt with kankars & mica.		34 62 ≥100 9.0 cm Pentn.	DS-10	18.50
			SPT-11	19.00-19.24
20.00m.			DS-11	20.00
		54 52 ≥100 11.0 cm Pentn.	SPT-12	20.50-20.76
			DS-12	21.50
		49 57 ≥100 10.0 cm Pentn.	SPT-13	22.00-22.25
			DS-13	23.00
		53 60 ≥100 7.0 cm Pentn.	SPT-14	23.50-23.72
			DS-14	24.50
		48 63 ≥100 12.0 cm Pentn.	SPT-15	25.00-25.27
			DS-15	26.00
		54 60 ≥100 9.0 cm Pentn.	SPT-16	26.50-26.74
Very dense, brownish grey, silty sand with high % of gravels.			DS-16	27.50
		57 54 ≥100 7.0 cm Pentn.	SPT-17	28.00-28.22
			DS-17	29.00
		49 62 ≥100 10.0 cm Pentn.	SPT-18	29.50-29.75
			DS-18	30.50
		58 52 ≥100 8.0 cm Pentn.	SPT-19	31.00-31.23
			DS-19	32.00
		60 54 ≥100 9.0 cm Pentn.	SPT-20	32.50-32.74
			DS-20	33.50
		58 55 ≥100 6.0 cm Pentn.	SPT-21	34.00-34.21
		62 54 ≥100 5.0 cm Pentn.	SPT-22	35.00-35.20
35.20m.				

N.B. - '*' means sample could not be recovered.

BH-27/Sheet-2

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.				CETEST
Job No : 3369	Created by : Chandrani	Created on : 19/01/2015	Sheet No:	

BORE LOG DATA SHEET

BORE HOLE NO.28

Co-ordinates E=570.000 N=138.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	20	Undisturbed (UDS)	6
Cone (Pc)		Penetrometer (SPT)	20
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 07/12/14
Completion Date : 09/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 65.611 m.
Water Struck At :
Standing Water Level : 13.2 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	SAMPLES Depth (m)
0.00m							
Filled up soil consists of light grey, silty sand with ash.		12	21	28	49	DS-1	0.50
						SPT-1	1.00-1.45
1.50m						UDS-1	2.00-2.45
Loose, yellowish brown, silty sand with traces of clay binder.		3	3	4	7	SPT-2	3.00-3.45
						UDS-2	4.00-4.45
4.50m							
Stiff, deep grey, clayey silt.		4	5	8	13	SPT-3	5.00-5.45
						DS-2	6.00
						UDS-3	6.50-6.95
7.50m						DS-3	7.50
Dense, brownish grey, sandy silt / silty sand.		5	7	8	15	SPT-4	8.00-8.45
						DS-4	9.00
						UDS-4	9.50-9.80
						DS-5	10.50
		9	10	17	27	SPT-5	11.00-11.45
						DS-6	12.00
						*UDS-5	12.50-12.95
		11	16	12	28	SPT-6	13.05-13.50
						DS-7	14.00
14.50m							
Hard, greyish brown, clayey silt. Obs. mica & concreation of silt.		10	18	22	40	SPT-7	14.50-14.95
						DS-8	15.50
						UDS-6	16.00-16.30
						DS-9	17.00
17.50m					>100		
Very dense, brownish grey, silty sand with high % of gravels. 18.00m		25	73	10.0 cm Pentn.		SPT-8	17.50-17.75

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 19/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.28

Co-ordinates E=570.000 N=138.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	20	Undisturbed (UDS)	6
Cone (Pc)		Penetrometer (SPT)	20
		Disturbed (DS)	20
Vane (V)		Water Sample (WS)	0

Commencement Date : 07/12/14
Completion Date : 09/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 65.611 m.
Water Struck At :
Standing Water Level : 13.2 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
18.00m.				
		≥100	DS-10	18.50
		42 57 8.0 cm Pentn.	SPT-9	19.00-19.23
		≥100	DS-11	20.00
		53 62 4.0 cm Pentn.	SPT-10	20.50-20.69
		≥100	DS-12	21.50
		48 58 9.0 cm Pentn.	SPT-11	22.00-22.24
		≥100	DS-13	23.00
		52 60 7.0 cm Pentn.	SPT-12	23.50-23.72
		≥100	DS-14	24.50
		49 57 9.0 cm Pentn.	SPT-13	25.00-25.24
Very dense, brownish grey, silty sand with high % of gravels.		≥100	DS-15	26.00
		53 64 5.0 cm Pentn.	SPT-14	26.50-26.70
		≥100	DS-16	27.50
		57 62 12.0 cm Pentn.	SPT-15	28.00-28.27
		≥100	DS-17	29.00
		48 54 13.0 cm Pentn.	SPT-16	29.50-29.78
		≥100	DS-18	30.50
		52 58 8.0 cm Pentn.	SPT-17	31.00-31.23
		≥100	DS-19	32.00
		58 60 5.0 cm Pentn.	SPT-18	32.50-32.70
		≥100	DS-20	33.50
		62 55 6.0 cm Pentn.	SPT-19	34.00-34.21
		≥100		
35.18m.		60 72 3.0 cm Pentn.	SPT-20	35.00-35.18

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 10/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.29

Co-ordinates E=499.000 N=159.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	21
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 04/12/14
Completion Date : 06/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 67.752 m.
Water Struck At :
Standing Water Level : 15.1 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	SAMPLES Depth (m)
0.00m							
					5	DS-1	0.50
		2	2	3		SPT-1	1.00-1.45
						UDS-1	2.00-2.45
Loose to medium dense, yellowish brown, silty sand with traces of mica.					10		
		3	4	6		SPT-2	3.00-3.45
						UDS-2	4.00-4.45
					27		
		5	13	14		SPT-3	5.00-5.45
						DS-2	6.00
6.50m						UDS-3	6.50-6.95
						DS-3	7.50
					37		
		7	15	22		SPT-4	8.00-8.45
Hard, greyish brown, clayey sandy silt. Obs. kankars.						DS-4	9.00
						UDS-4	9.50-9.95
10.50m						DS-5	10.50
					62		
		12	29	33		SPT-5	11.00-11.45
						DS-6	12.00
					60	*UDS-5	12.50-12.66
Dense to very dense, yellowish grey, sandy silt / silty sand. Obs. mica & kankars.		15	24	36		SPT-6	12.80-13.25
						DS-7	14.00
					46		
		12	14	32		SPT-7	14.50-14.95
						DS-8	15.50
16.00m					47		
		11	17	30		SPT-8	16.00-16.45
Hard, brownish grey, silty clay / clayey silt. Obs. mica & sand mixture.						DS-9	17.00
					52		
		14	20	32		SPT-9	17.50-17.95
18.00m							

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | Created by : Chandrani | Created on : 10/12/2014 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.29

Co-ordinates E=499.000 N=159.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	21
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 04/12/14
Completion Date : 06/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 67.752 m.
Water Struck At :
Standing Water Level : 15.1 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
18.00m.				
Hard, brownish grey, silty clay / clayey silt. Obs. mica & sand mixture.		10 15 24 — 39	DS-10	18.50
			SPT-10	19.00-19.45
20.00m.			DS-11	20.00
		17 32 40 — 72	SPT-11	20.50-20.95
			DS-12	21.50
		34 49 52 — ≥100 (7.0 cm Pentn.)	SPT-12	22.00-22.37
			DS-13	23.00
		30 57 54 — ≥100 (5.0 cm Pentn.)	SPT-13	23.50-23.85
			DS-14	24.50
		40 54 58 — ≥100 (4.0 cm Pentn.)	SPT-14	25.00-25.34
			DS-15	26.00
		52 55 — ≥100 (10.0 cm Pentn.)	SPT-15	26.50-26.75
Very dense, brownish grey, silty sand with gravels & pebbles.			DS-16	27.50
		48 57 — ≥100 (8.0 cm Pentn.)	SPT-16	28.00-28.23
			DS-17	29.00
		53 54 — ≥100 (9.0 cm Pentn.)	SPT-17	29.50-29.74
			DS-18	30.50
		58 62 — ≥100 (12.0 cm Pentn.)	SPT-18	31.00-31.27
			DS-19	32.00
		47 53 — ≥100 (8.0 cm Pentn.)	SPT-19	32.50-32.73
			DS-20	33.50
		52 58 — ≥100 (5.0 cm Pentn.)	SPT-20	34.00-34.20
35.19m.		60 54 — ≥100 (4.0 cm Pentn.)	SPT-21	35.00-35.19

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 15/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.30

Co-ordinates E=313.000 N=150.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	24
		Disturbed (DS)	24
Vane (V)		Water Sample (WS)	0

Commencement Date : 29/12/14
Completion Date : 01/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 78.844 m.
Water Struck At :
Standing Water Level : 25.1 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of brownish grey, sandy silt with coal dust & gravels.		10 19 21 — 40	DS-1	0.50
			SPT-1	1.00-1.45
			*UDS-1	2.00-2.15
3.00m.		3 4 8 — 12	SPT-2	3.00-3.45
Medium dense, brownish grey, silty sand sand with traces of clay binders.			UDS-2	4.00-4.45
		5 7 11 — 18	SPT-3	5.00-5.45
			DS-2	6.00
			UDS-3	6.50-6.95
			DS-3	7.50
		7 10 13 — 23	SPT-4	8.00-8.45
			DS-4	9.00
			UDS-4	9.50-9.95
10.00m.			DS-5	10.50
		9 17 29 — 46	SPT-5	11.00-11.45
			DS-6	12.00
			*UDS-5	12.50-12.63
Hard, brownish grey, clayey silt with traces of sand mixture. Obs. gravels.		22 36 43 — 79	SPT-6	12.63-13.08
			DS-7	13.50
		28 32 46 — 78	SPT-7	14.00-14.45
			DS-8	15.00
		23 41 48 — 89	SPT-8	15.50-15.95
16.50m.			DS-9	16.50
		32 46 52 — ≥100 (11.0 cm Pentn.)	SPT-9	17.00-17.41
Very dense, brownish grey, clayey sandy silt.			DS-10	18.00
		38 42 55 — ≥100 (8.0 cm Pentn.)	SPT-10	18.50-18.88
			DS-11	19.50
20.00m.				
Very dense, brownish grey, silty sand.		29 48 56 — ≥100 (7.0 cm Pentn.)	SPT-11	20.00-20.37
20.75m.				

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
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BORE LOG DATA SHEET

BORE HOLE NO.30

Co-ordinates E=313.000 N=150.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	24
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 29/12/14
Completion Date : 01/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 78.844 m.
Water Struck At :
Standing Water Level : 25.1 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
			DS-12	21.00
		≥100	SPT-12	21.50-21.89
		33 47 53 (9.0 cm Pentn.)	DS-13	22.50
		≥100	SPT-13	23.00-23.26
		31 54 (11.0 cm Pentn.)	DS-14	24.00
		≥100	SPT-14	24.50-24.73
		36 52 (8.0 cm Pentn.)	DS-15	25.50
		≥100	SPT-15	26.00-26.25
		30 59 (10.0 cm Pentn.)	DS-16	27.00
		≥100	SPT-16	27.50-27.73
		35 54 (8.0 cm Pentn.)	DS-17	28.50
		≥100	SPT-17	29.00-29.37
		39 49 52 (7.0 cm Pentn.)	DS-18	30.00
		≥100	SPT-18	30.50-30.76
		36 59 (11.0 cm Pentn.)	DS-19	31.50
		≥100	SPT-19	32.00-32.28
		40 67 (13.0 cm Pentn.)	DS-20	33.00
		≥100	SPT-20	33.50-33.90
		33 40 57 (10.0 cm Pentn.)	DS-21	34.50
		≥100	SPT-21	35.00-35.38
		38 45 55 (8.0 cm Pentn.)	DS-22	36.00
		≥100	SPT-22	36.50-36.73
		42 58 (8.0 cm Pentn.)	DS-23	37.50
		≥100	SPT-23	38.00-38.22
		46 56 (7.0 cm Pentn.)	DS-24	39.00
		≥100	SPT-24	40.00-40.22
		57 52 (7.0 cm Pentn.)		
20.75m				
Very dense, brownish grey, silty sand.				
28.50m				
Very dense, brownish grey, clayey sandy silt.				
32.00m				
Very dense, brownish grey, silty sand with gravels.				
40.22m				

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 15/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.31

Co-ordinates E=296.000 N=89.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 26/12/14
Completion Date : 29/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 79.905 m.
Water Struck At :
Standing Water Level : 26.0 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	Depth (m)
0.00m. Filled up soil consists of light grey / brownish grey, sandy silt with ash & gravels.						DS-1	0.50
1.00m.		7	13	19	32	SPT-1	1.00-1.45
Blackish grey, coal with gravels.						*UDS-1	2.00-2.13
		8	11	17	28	SPT-2	2.13-2.58
3.00m.		6	8	9	17	SPT-3	3.00-3.45
Medium dense, yellowish brown, sandy silt.						UDS-2	4.00-4.45
		6	12	17	29	SPT-4	5.00-5.45
6.00m.						DS-2	6.00
						UDS-3	6.50-6.95
						DS-3	7.50
Hard, yellowish brown, clayey silt with sand mixture.		9	16	21	37	SPT-5	8.00-8.45
						DS-4	9.00
						UDS-4	9.50-9.95
10.50m.						DS-5	10.50
Very dense, brownish grey, sandy silt with concreation of silt.		15	35	44	79	SPT-6	11.00-11.45
12.00m.						DS-6	12.00
		12	29	38	67	SPT-7	12.50-12.95
						DS-7	13.50
		20	39	49	88	SPT-8	14.00-14.45
						DS-8	15.00
Very dense, brownish grey, sandy silt.		22	41	52	93	SPT-9	15.50-15.95
						DS-9	16.50
		24	50	63	>100	SPT-10	17.00-17.41
				11.0 cm Pentn.			
						DS-10	18.00
		28	50	50	>100	SPT-11	18.50-18.89
19.00m.				9.0 cm Pentn.			
						DS-11	19.50
Very dense, deep grey, silty sand with mica.		19	50	50	>100	SPT-12	20.00-20.37
20.75m.				7.0 cm Pentn.			

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
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BORE LOG DATA SHEET

BORE HOLE NO.31

Co-ordinates E=296.000 N=89.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 26/12/14
Completion Date : 29/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 79.905 m.
Water Struck At :
Standing Water Level : 26.0 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
			DS-12	21.00
		≥100		
		30 42 59	SPT-13	21.50-21.95
			DS-13	22.50
		92		
		15 38 54	SPT-14	23.00-23.45
			DS-14	24.00
		≥100		
		42 58 60	SPT-15	24.50-24.89
		9.0 cm Pentn.		
			DS-15	25.50
		≥100		
		32 46 51	SPT-16	26.00-26.39
		9.0 cm Pentn.		
			DS-16	27.00
		≥100		
		29 43 50	SPT-17	27.50-27.87
		7.0 cm Pentn.		
			DS-17	28.50
		≥100		
		35 45 52	SPT-18	29.00-29.37
		7.0 cm Pentn.		
			DS-18	30.00
		≥100		
		43 52 50	SPT-19	30.50-30.84
		4.0 cm Pentn.		
			DS-19	31.50
		≥100		
		56 60	SPT-20	32.00-32.27
		12.0 cm Pentn.		
			DS-20	33.00
		≥100		
		48 50	SPT-21	33.50-33.74
		9.0 cm Pentn.		
			DS-21	34.50
		≥100		
		45 58	SPT-22	35.00-35.28
		13.0 cm Pentn.		
			DS-22	36.00
		≥100		
		49 56	SPT-23	36.50-36.73
		8.0 cm Pentn.		
			DS-23	37.50
		≥100		
		44 55	SPT-24	38.00-38.25
		10.0 cm Pentn.		
			DS-24	39.00
		≥100		
		48 53	SPT-25	40.00-40.22
		7.0 cm Pentn.		

20.75m

Very dense, deep grey, silty sand with mica.

27.50m

Very dense, brownish grey, silty sand. Obs. concreation of silt.

33.00m

Very dense, brownish grey, sandy silt / silty sand. Obs. mica.

40.22m

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
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BORE LOG DATA SHEET

BORE HOLE NO.32

Co-ordinates E=271.000 N=38.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	24
		Disturbed (DS)	24
Vane (V)		Water Sample (WS)	0

Commencement Date : 24/12/14
Completion Date : 27/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 79.915 m.
Water Struck At :
Standing Water Level : 26.1 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of brownish grey, sandy silt.			DS-1	0.50
1.00m. Filled up soil consists of dense, deep grey, sandy silt with ash & gravels.		7 19 23 (42)	SPT-1	1.00-1.45
			UDS-1	2.00-2.45
2.50m. Medium dense, brownish grey, silty sand with traces of mica.		3 4 7 (11)	SPT-2	3.00-3.45
			UDS-2	4.00-4.45
		5 7 9 (16)	SPT-3	5.00-5.45
6.00m. Medium dense, yellowish brown, silty sand with traces of mica. Obs. concreation of silt.			DS-2	6.00
			UDS-3	6.50-6.95
			DS-3	7.50
		10 12 13 (25)	SPT-4	8.00-8.45
			DS-4	9.00
9.50m. Very stiff, brownish grey, clayey silt.			UDS-4	9.50-9.95
			DS-5	10.50
		7 11 13 (24)	SPT-5	11.00-11.45
11.50m. Hard, brownish grey, clayey silt with sand mixture.			DS-6	12.00
			*UDS-5	12.50-12.65
		14 26 32 (58)	SPT-6	12.80-13.25
			DS-7	13.55
		20 34 38 (72)	SPT-7	14.00-14.45
			DS-8	15.00
		28 42 54 (>100) 10.0 cm Pentn.	SPT-8	15.50-15.90
			DS-9	16.50
		30 48 52 (>100) 7.0 cm Pentn.	SPT-9	17.00-17.37
18.00m. Very dense, brownish grey, clayey sandy silt.			DS-10	18.00
		26 46 57 (>100) 9.0 cm Pentn.	SPT-10	18.50-18.89
			DS-11	19.50
		21 43 53 (>100) 10.0 cm Pentn.	SPT-11	20.00-20.40
20.75m.				

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
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BORE LOG DATA SHEET

BORE HOLE NO.32

Co-ordinates E=271.000 N=38.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	24
		Disturbed (DS)	24
Vane (V)		Water Sample (WS)	0

Commencement Date : 24/12/14
Completion Date : 27/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 79.915 m.
Water Struck At :
Standing Water Level : 26.1 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
20.75m. Very dense, brownish grey, clayey sandy silt.		≥100 23 48 56 7.0 cm Pentn.	DS-12	21.00
			SPT-12	21.50-21.87
22.50m. Very dense, brownish grey, silty sand.		≥100 46 50 5.0 cm Pentn.	DS-13	22.50
			SPT-13	23.00-23.20
24.00m. Very dense, brownish grey, silty sand with concreation of silt.		≥100 28 42 56 8.0 cm Pentn.	DS-14	24.00
			SPT-14	24.50-24.88
26.00m. Very dense, brownish grey, silty sand with traces of kankars & clay binders.		≥100 38 55 9.0 cm Pentn.	DS-15	25.50
			SPT-15	26.00-26.24
		≥100 30 50 10.0 cm Pentn.	DS-16	27.00
			SPT-16	27.50-27.675
29.00m. Very dense, brownish grey, silty sand with traces of kankars & clay binders.		≥100 24 43 52 12.0 cm Pentn.	DS-17	28.50
			SPT-17	29.00-29.42
		≥100 27 46 50 7.0 cm Pentn.	DS-18	30.00
			SPT-18	30.50-30.87
31.50m. Very dense, brownish grey, silty sand / sandy silt.		≥100 33 44 52 9.0 cm Pentn.	DS-19	31.50
			SPT-19	32.00-32.39
		≥100 42 54 13.0 cm Pentn.	DS-20	33.00
			SPT-20	33.50-33.78
		≥100 38 53 9.0 cm Pentn.	DS-21	34.50
			SPT-21	35.00-35.24
		≥100 45 50 8.0 cm Pentn.	DS-22	36.00
			SPT-22	36.50-36.73
		≥100 41 52 7.0 cm Pentn.	DS-23	37.50
			SPT-23	38.00-38.22
			DS-24	39.00
40.24m.		≥100 45 50 9.0 cm Pentn.	SPT-24	40.00-40.24

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

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BORE LOG DATA SHEET

BORE HOLE NO.33

Co-ordinates E=386.000 N=132.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	24
		Disturbed (DS)	24
Vane (V)		Water Sample (WS)	0

Commencement Date : 28/12/14
Completion Date : 31/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 76.477 m.
Water Struck At :
Standing Water Level : 23.75 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of brownish grey / deep grey, sandy silt with ash & gravels.			DS-1	0.50
1.00m. Filled up soil consists of blackish grey, coal dust & gravels.		4 0 0 0 9/4 5	SPT-1	1.00-1.45
2.00m. Medium dense, yellowish brown, silty sand with traces of mica. Obs. reddish brown patches.			UDS-1	2.00-2.45
		5 7 10 17	SPT-2	3.00-3.45
4.00m. Medium dense, yellowish brown, silty sand with traces of mica.			UDS-2	4.00-4.45
		8 13 15 28	SPT-3	5.00-5.45
			DS-2	6.00
			UDS-3	6.50-6.95
7.50m. Dense, brownish grey, clayey sandy silt with concreation of silt.			DS-3	7.50
		9 14 18 32	SPT-4	8.00-8.45
9.00m. Hard, brownish grey, clayey silt with concreation of silt & traces of sand mixture.			DS-4	9.00
			UDS-4	9.50-9.80
			DS-5	10.50
		44 54 ≥100 10.0 cm Pentn.	SPT-5	11.00-11.25
			DS-6	12.00
		37 42 52 ≥100 9.0 cm Pentn.	SPT-6	12.50-12.89
			DS-7	13.50
		18 54 ≥100 11.0 cm Pentn.	SPT-7	14.00-14.26
			DS-8	15.00
		50 50 ≥100 9.0 cm Pentn.	SPT-8	15.50-15.74
			DS-9	16.50
		47 54 ≥100 7.0 cm Pentn.	SPT-9	17.00-17.22
18.00m. Very dense, brownish grey, silty sand / sandy silt.			DS-10	18.00
		60 50 ≥100 5.0 cm Pentn.	SPT-10	18.50-18.70
			DS-11	19.50
		49 54 ≥100 8.0 cm Pentn.	SPT-11	20.00-20.23
20.75m.				

BH-33/Sheet-1

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
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BORE LOG DATA SHEET

BORE HOLE NO.33

Co-ordinates E=386.000 N=132.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	24
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 28/12/14
Completion Date : 31/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 76.477 m.
Water Struck At :
Standing Water Level : 23.75 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
20.75m. Very dense, brownish grey, silty sand / sandy silty.		24 37 42 = 79	DS-12	21.00
21.50m.			SPT-12	21.50-21.95
Hard, brownish grey, clayey silt with traces of sand mixture. Obs. mica & gravels.		23 39 45 = 84	DS-13	22.50
			SPT-13	23.00-23.45
24.00m.			DS-14	24.00
Very dense, brownish grey, silty sand.		20 48 55 = >100 10.0 cm Pentn.	SPT-14	24.50-24.90
		37 44 54 = >100 5.0 cm Pentn.	DS-15	25.50
			SPT-15	26.00-26.35
27.00m.			DS-16	27.00
Very dense, brownish grey, silty sand with concreation of silt & gravels.		48 52 = >100 10.0 cm Pentn.	SPT-16	27.50-27.75
			DS-17	28.50
29.00m.		43 54 = >100 8.0 cm Pentn.	SPT-17	29.00-29.23
			DS-18	30.00
		30 47 54 = >100 5.0 cm Pentn.	SPT-18	30.50-30.85
			DS-19	31.50
		44 54 = >100 9.0 cm Pentn.	SPT-19	32.00-32.24
			DS-20	33.00
		53 50 = >100 7.0 cm Pentn.	SPT-20	33.50-33.72
Very dense, brownish grey, silty sand with high % of gravels & pebbles.			DS-21	34.50
		49 54 = >100 8.0 cm Pentn.	SPT-21	35.00-35.23
			DS-22	36.00
		60 52 = >100 9.0 cm Pentn.	SPT-22	36.50-36.74
			DS-23	37.50
		54 50 = >100 7.0 cm Pentn.	SPT-23	38.00-38.22
			DS-24	39.00
40.23m.		52 54 = >100 8.0 cm Pentn.	SPT-24	40.00-40.23

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

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BORE LOG DATA SHEET

BORE HOLE NO.34

Co-ordinates E=430.000 N=90.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	6
Cone (Pc)		Penetrometer (SPT)	24
		Disturbed (DS)	24
Vane (V)		Water Sample (WS)	0

Commencement Date : 28/12/14
Completion Date : 01/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 79.385 m.
Water Struck At :
Standing Water Level : 25.45 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	Depth (m)
0.00m							
Filled up soil consists of brownish grey, sandy silt with ash & gravels.						DS-1	0.50
1.00m		4	5	6	11	SPT-1	1.00-1.45
						UDS-1	2.00-2.45
		3	5	5	10	SPT-2	3.00-3.45
						UDS-2	4.00-4.45
Medium dense, greyish brown, silty sand with traces of mica. Obs. coal dust patches.		5	8	9	17	SPT-3	5.00-5.45
						DS-2	6.00
						UDS-3	6.50-6.95
						DS-3	7.50
8.00m		8	10	11	21	SPT-4	8.00-8.45
						DS-4	9.00
Medium dense, brownish grey, silty sand with clay binders.						UDS-4	9.50-9.95
						DS-5	10.50
11.00m		17	20	28	48	SPT-5	11.00-11.45
						DS-6	12.00
						*UDS-5	12.50-12.65
		12	17	21	38	SPT-6	12.65-13.10
						DS-7	13.50
		15	25	29	54	SPT-7	14.00-14.45
Hard, brownish grey, clayey silt with gravels.						DS-8	15.00
		14	32	35	67	SPT-8	15.50-15.95
						DS-9	16.50
		16	38	40	78	SPT-9	17.00-17.45
18.00m						DS-10	18.00
		48	54		≥100	SPT-10	18.50-18.72
				7.0 cm Pentn.			
Hard, brownish grey, clayey silt with traces of sand mixture.						DS-11	19.50
		24	40	52	≥100	SPT-11	20.00-20.38
20.75m				8.0 cm Pentn.			

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
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BORE LOG DATA SHEET

BORE HOLE NO.34

Co-ordinates E=430.000 N=90.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	6
Cone (Pc)		Penetrometer (SPT)	24
		Disturbed (DS)	24
Vane (V)		Water Sample (WS)	0

Commencement Date : 28/12/14
Completion Date : 01/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 79.385 m.
Water Struck At :
Standing Water Level : 25.45 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
20.75m.			DS-12	21.00
		30 45 54 ≥100	SPT-12	21.50-21.86
		6.0 cm Pentn.	DS-13	22.50
Hard, brownish grey, clayey silt with traces of sand mixture.		21 47 57 ≥100	SPT-13	23.00-23.45
			DS-14	24.00
		32 45 52 ≥100	SPT-14	24.50-24.89
		9.0 cm Pentn.	DS-15	25.50
25.50m.		13 16 18 34	SPT-15	26.00-26.45
			DS-16	27.00
Desne brownish grey, silty sand.		14 19 27 46	SPT-16	27.50-27.95
			DS-17	28.50
29.00m.		17 24 35 59	*UDS-6	29.00-29.15
Very dense, brownish grey, silty sand with gravels.			SPT-17	29.30-29.75
30.50m.			DS-18	30.50
Hard, brownish grey, clayey silt with traces of sand mixture.		19 34 43 77	SPT-18	31.00-31.45
32.00m.			DS-19	32.00
		38 49 54 ≥100	SPT-19	32.50-32.84
		4.0 cm Pentn.	DS-20	33.50
		34 47 52 ≥100	SPT-20	34.00-34.36
		6.0 cm Pentn.	DS-21	35.00
		45 54 ≥100	SPT-21	35.50-35.75
Very dense, brownish grey, silty sand with gravels & pebbles.		10.0 cm Pentn.	DS-22	36.50
		47 58 ≥100	SPT-22	37.00-37.22
		7.0 cm Pentn.	DS-23	38.00
		56 50 ≥100	SPT-23	38.50-38.74
		9.0 cm Pentn.	DS-24	39.50
		60 52 ≥100	SPT-24	40.00-40.23
40.23m.		8.0 cm Pentn.		

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 15/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.35

Co-ordinates E=483.000 N=55.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	21
Vane (V)		Disturbed (DS)	21
		Water Sample (WS)	0

Commencement Date : 11/12/14
Completion Date : 13/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 68.012 m.
Water Struck At :
Standing Water Level : 15.2 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Filled up soil consists of light grey, sandy silt with ash. 0.50m			DS-1	0.50
		1 1 2 (3)	SPT-1	1.00-1.45
			UDS-1	2.00-2.45
Very loose to medium dense, yellowish brown, silty sand with traces of mica.		2 2 1 (3)	SPT-2	3.00-3.45
			UDS-2	4.00-4.45
		5 6 9 (15)	SPT-3	5.00-5.45
6.00m			DS-2	6.00
			UDS-3	6.50-6.95
			DS-3	7.50
		13 40 48 (88)	SPT-4	8.00-8.45
Hard, yellowish brown, clayey silt with traces of sand mixture.			DS-4	9.00
			UDS-4	9.50-9.80
			DS-5	10.50
		12 63 (>100) 12.0 cm Pentn.	SPT-5	11.00-11.27
11.50m			DS-6	12.00
		11 38 52 (90)	SPT-6	12.00-12.45
			DS-7	13.50
Very dense, brownish grey, silty sand. Obs. gravels.		12 42 44 (86)	SPT-7	14.00-14.45
			DS-8	15.00
		11 33 45 (78)	SPT-8	15.50-15.95
16.50m			DS-9	16.50
Very dense, greyish brown, sandy silt with traces of clay. Obs. concreation of silt.		16 32 45 (77)	SPT-9	17.00-17.45
18.00m			DS-10	18.00

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 15/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.35

Co-ordinates E=483.000 N=55.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	21
		Disturbed (DS)	21
Vane (V)		Water Sample (WS)	0

Commencement Date : 11/12/14
Completion Date : 13/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 68.012 m.
Water Struck At :
Standing Water Level : 15.2 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
18.00m				
Very dense, greyish brown, sandy silt with traces of clay. Obs. concreation of silt.		20 42 49 (91)	SPT-10	18.50-18.95
			DS-11	19.50
		26 38 38 (76)	SPT-11	20.00-20.45
21.00m			DS-12	21.00
		38 52 2 (>100) 13.0 cm Pentn.	SPT-12	22.00-22.28
			DS-13	23.00
		43 60 (>100) 7.0 cm Pentn.	SPT-13	23.50-23.72
			DS-14	24.50
		50 50 (>100) 2.0 cm Pentn.	SPT-14	25.00-25.17
			DS-15	26.00
		50 50 (>100) 6.0 cm Pentn.	SPT-15	26.50-26.71
			DS-16	27.50
Very dense, yellowish brown, silty sand with high % of gravels.		50 50 (>100) 9.0 cm Pentn.	SPT-16	28.00-28.24
			DS-17	29.00
		50 50 (>100) 3.0 cm Pentn.	SPT-17	29.50-29.68
			DS-18	30.50
		50 50 (>100) 8.0 cm Pentn.	SPT-18	31.00-31.23
			DS-19	31.50
		63 50 (>100) 5.0 cm Pentn.	SPT-19	32.00-32.20
			DS-20	33.00
		54 52 (>100) 9.0 cm Pentn.	SPT-20	33.50-33.74
			DS-21	34.50
35.19m		61 50 (>100) 4.0 cm Pentn.	SPT-21	35.00-35.19

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 07/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.36

Co-ordinates E=522.000 N=72.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	18	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	18
Vane (V)		Disturbed (DS)	17
		Water Sample (WS)	0

Commencement Date : 15/12/14
Completion Date : 17/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 66.246 m.
Water Struck At :
Standing Water Level : 13.3 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of sandy silt with ash. 0.50m.			DS-1	0.50
		3 3 4 (7)	SPT-1	1.00-1.45
			UDS-1	2.00-2.45
		5 6 7 (13)	SPT-2	3.00-3.45
			UDS-2	4.00-4.45
Loose to medium dense, greyish brown, silty sand with traces of mica & clay binders.		7 5 9 (14)	SPT-3	5.00-5.45
			DS-2	6.00
			UDS-3	6.50-6.95
			DS-3	7.50
		9 11 18 (29)	SPT-4	8.00-8.45
			DS-4	9.00
			UDS-4	9.50-9.95
			DS-5	10.50
11.00m.		13 41 45 (86)	SPT-5	11.00-11.45
			DS-6	12.00
Hard, brownish grey, clayey silt with sand mixture.		12 29 47 (76)	SPT-6	12.50-12.95
			DS-7	13.50
		14 27 48 (75)	SPT-7	14.00-14.45
15.00m.			DS-8	15.00
Very dense, brownish grey, clayey silty sand. 15.50m.				

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 07/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.36

Co-ordinates E=522.000 N=72.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	18	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	18
		Disturbed (DS)	17
Vane (V)		Water Sample (WS)	0

Commencement Date : 15/12/14
Completion Date : 17/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 66.246 m.
Water Struck At :
Standing Water Level : 13.3 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
15.50m				
Very dense, brownish grey, clayey silty sand.		18 32 57 — 89	SPT-8	15.50-15.95
			DS-9	16.50
		20 27 38 — 65	SPT-9	17.00-17.45
			DS-10	18.00
		21 29 40 — 69	SPT-10	18.50-18.95
19.00m				
			DS-11	19.50
		12 26 42 — 68	SPT-11	20.00-20.45
			DS-12	21.00
		35 45 49 — 94	SPT-12	21.50-21.95
Very dense, brownish grey, silty sand with gravels. A pocket of clayey silt with sand mixture was observed around SPT-15.			DS-13	22.50
		43 62 — 6.0 cm Pentn. — ≥100	SPT-13	23.00-23.21
			DS-14	24.00
		53 56 — 3.0 cm Pentn. — ≥100	SPT-14	24.50-24.68
			DS-15	25.50
		55 62 — 7.0 cm Pentn. — ≥100	SPT-15	26.00-26.22
26.50m				
			DS-16	27.00
		29 52 50 — 8.0 cm Pentn. — ≥100	SPT-16	27.50-27.88
Very dense, greyish brown, silty sand with traces of clay. Obs. concreation of silt & mica.			DS-17	28.50
		43 61 — 13.0 cm Pentn. — ≥100	SPT-17	29.00-29.28
		34 60 — 11.0 cm Pentn. — ≥100	SPT-18	30.00-30.26
30.26m				

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 17/12/2014** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.37

Co-ordinates E=609.000 N=93.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	24
		Disturbed (DS)	24
Vane (V)		Water Sample (WS)	0

Commencement Date : 02/12/14
Completion Date : 04/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.026 m.
Water Struck At :
Standing Water Level : 11.4 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of brownish grey, silty fine sand. Obs. gravels. 0.50m.			DS-1	0.50
		6 7 7 (14)	SPT-1	1.00-1.45
			UDS-1	2.00-2.45
Medium dense, yellowish brown, silty sand / sandy silt.		4 6 9 (15)	SPT-2	3.00-3.45
			*UDS-2	4.00-4.45
		5 6 5 (11)	SPT-3	4.80-5.25
5.50m.			DS-2	6.00
			UDS-3	6.50-6.95
Medium dense, yellowish brown, silty fine sand with pieces of clay mixture.			DS-3	7.50
		9 10 10 (20)	SPT-4	8.00-8.45
9.00m.			DS-4	9.00
Medium dense, yellowish brown, silty sand.			UDS-4	9.50-9.95
			DS-5	10.50
11.00m.		11 14 16 (30)	SPT-5	11.00-11.45
			DS-6	12.00
			*UDS-5	12.50-12.68
Hard, greyish brown, silty clay / clayey silt.		8 17 26 (43)	SPT-6	12.75-13.20
			DS-7	14.00
		12 20 28 (48)	SPT-7	14.50-14.95
			DS-8	15.50
16.00m.		30 45 55 (100)	SPT-8	16.00-16.45
			DS-9	17.00
		27 47 58 (>100) 13.0 cm Pentn.	SPT-9	17.50-17.93
Very dense, brownish grey, silty sand.			DS-10	18.50
		29 54 50 (>100) 5.0 cm Pentn.	SPT-10	19.00-19.35
			DS-11	20.00
21.00m.		21 43 52 (>100) 10.0 cm Pentn.	SPT-11	20.50-20.90

BH-37/Sheet-1

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.37

Co-ordinates E=609.000 N=93.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	24
		Disturbed (DS)	24
Vane (V)		Water Sample (WS)	0

Commencement Date : 02/12/14
Completion Date : 04/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.026 m.
Water Struck At :
Standing Water Level : 11.4 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
21.00m				
Very dense, brownish grey, silty sand.		32 45 50 (9.0 cm) ≥100 Pentn.	DS-12	21.50
			SPT-12	22.00-22.39
			DS-13	23.00
23.50m		35 43 50 (7.0 cm) ≥100 Pentn.	SPT-13	23.50-23.87
			DS-14	24.50
		34 47 50 (4.0 cm) ≥100 Pentn.	SPT-14	25.00-25.34
			DS-15	26.00
		12 20 32 52	SPT-15	26.50-26.95
Hard, greyish brown, silty clay / clayey silt.			DS-16	27.50
		14 25 34 59	SPT-16	28.00-28.45
			DS-17	29.00
		17 30 43 73	SPT-17	29.50-29.95
			DS-18	30.50
		20 35 42 77	SPT-18	31.00-31.45
32.00m			DS-19	32.00
Very dense, greyish brown, clayey silty fine sand. Obs. mica.		23 38 44 82	SPT-19	32.50-32.95
33.50m			DS-20	33.50
Very dense, brownish grey, silty sand with gravels. Obs. clay binder.		48 54 (7.0 cm) ≥100 Pentn.	SPT-20	34.00-34.22
35.00m			DS-21	35.00
		57 50 (5.0 cm) ≥100 Pentn.	SPT-21	35.50-35.70
			DS-22	36.50
Very dense, brownish grey to light grey, compacted coarse sand. Obs. gravels.		65 50 (3.0 cm) ≥100 Pentn.	SPT-22	37.00-37.18
			DS-23	38.00
		63 50 (4.0 cm) ≥100 Pentn.	SPT-23	38.50-38.69
			DS-24	39.50
40.17m		70 54 (2.0 cm) ≥100 Pentn.	SPT-24	40.00-40.17

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.38

Co-ordinates E=645.000 N=94.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	22	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	22
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 03/12/14
Completion Date : 06/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.681 m.
Water Struck At :
Standing Water Level : 11.3 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	Depth (m)
0.00m.							
Filled up soil consists of deep grey, ash. Obs. stone pieces.						DS-1	0.50
0.50m.		5	5	6	11	SPT-1	1.00-1.45
						UDS-1	2.00-2.45
Medium dense, yellowish brown, silty sand.		3	5	6	11	SPT-2	3.00-3.45
						UDS-2	4.00-4.45
		4	6	7	13	SPT-3	5.00-5.45
6.00m.						DS-2	6.00
Brownish grey, clayey silt with traces of sand mixture.						UDS-3	6.50-6.95
7.50m.						DS-3	7.50
		10	18	25	43	SPT-4	8.00-8.45
						DS-4	9.00
						*UDS-4	9.50-9.67
		12	20	28	48	SPT-5	9.80-10.25
Desne, brownish grey, silty sand. Obs. gravels & pebbles.						DS-5	11.00
		8	21	24	45	SPT-6	11.50-11.95
						DS-6	12.50
13.00m.		10	16	22	38	SPT-7	13.00-13.45
						DS-7	14.00
		12	23	34	57	SPT-8	14.50-14.95
Hard, greyish brown, clayey silt. Obs. kankars & mica.						DS-8	15.50
		14	17	19	36	SPT-9	16.00-16.45
						DS-9	17.00
						*UDS-5	17.50-17.65
18.00m.							

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.38

Co-ordinates E=645.000 N=94.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	22	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	22
		Disturbed (DS)	20
Vane (V)		Water Sample (WS)	0

Commencement Date : 03/12/14
Completion Date : 06/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.681 m.
Water Struck At :
Standing Water Level : 11.3 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
18.00m		11 15 24 39	SPT-10	17.80-18.25
			DS-10	18.50
		80		
		24 38 42	SPT-11	19.00-19.45
Hard, greyish brown, clayey silt. Obs. kankars & mica.			DS-11	20.00
		55		
		19 27 28	SPT-12	20.50-20.95
21.50m			DS-12	21.50
		84		
		21 37 47	SPT-13	22.00-22.45
Very dense, brownish grey, silty sand with high % of gravels.			DS-13	23.00
		>100		
		32 49 50 7.0 cm Pentn.	SPT-14	23.50-23.87
24.50m			DS-14	24.50
		73		
Hard, brownish grey, silty clay / clayey silt. Obs. gravels.		19 30 43	SPT-15	25.00-25.45
26.00m			DS-15	26.00
		>100		
		50 50 12.0 cm Pentn.	SPT-16	26.50-26.77
			DS-16	27.50
		>100		
		24 38 50 10.0 cm Pentn.	SPT-17	28.00-28.40
			DS-17	29.00
		>100		
Very dense, brownish grey, clayey silty fine sand / sandy silt. Obs. mica.		28 40 50 7.0 cm Pentn.	SPT-18	29.50-29.87
			DS-18	30.50
		68		
		17 25 43	SPT-19	31.00-31.45
			DS-19	32.00
		82		
		19 34 48	SPT-20	32.50-32.95
			DS-20	33.50
		97		
		23 43 54	SPT-21	34.00-34.45
34.50m				
Very dense, brownish grey, silty sand with gravels & pebbles.		>100		
35.18m		48 55 3.0 cm Pentn.	SPT-22	35.00-35.18

N.B. - '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 11/11/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.39

Co-ordinates E=680.000 N=92.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	23	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	23
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 24/10/14
Completion Date : 29/10/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.524 m.
Water Struck At :
Standing Water Level : 13.6 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists with grey, ash & stone pieces. 0.60m.			DS-1	0.50
Loose to medium dense, greyish brown, silty sand. A pocket of clayey silt with sand mixture was observed around UDS-01.		3 3 4 (7)	SPT-1	1.00-1.45
			UDS-1	2.00-2.45
3.40m.		3 5 7 (12)	SPT-2	3.00-3.45
			UDS-2	4.00-4.45
Very stiff to hard, brownish grey, clayey silt with sand mixture.		5 7 12 (19)	SPT-3	5.00-5.45
			DS-2	6.00
			UDS-3	6.50-6.95
			DS-3	7.50
8.80m.		8 16 20 (36)	SPT-4	8.00-8.45
			DS-4	9.00
		12 20 23 (43)	SPT-5	9.50-9.95
			DS-5	10.50
		8 19 26 (45)	SPT-6	11.00-11.45
Dense, brownish grey, silty sand.			DS-6	12.00
		9 13 21 (34)	SPT-7	12.50-12.95
			DS-7	13.00
		10 15 23 (38)	SPT-8	14.00-14.45
			DS-8	15.00
15.50m.		13 28 25 (53)	SPT-9	15.50-15.95
			DS-9	16.50
Hard, brownish grey, clayey silt with sand mixture.		15 20 26 (46)	SPT-10	17.00-17.45
17.90m.				

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 11/11/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.39

Co-ordinates E=680.000 N=92.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	23	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	23
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 24/10/14
Completion Date : 29/10/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.524 m.
Water Struck At :
Standing Water Level : 13.6 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
17.90m			DS-10	18.00
Hard, brownish grey, clayey silt with sand mixture.		19 22 30 — 52	SPT-11	18.50-18.95
19.90m		25 30 41 — 71	SPT-12	19.50-19.95
			DS-11	20.00
		24 32 42 — 74	SPT-13	21.00-21.45
			DS-12	22.00
		26 35 45 — 80	SPT-14	22.50-22.95
Very dense, brownish grey, silty sand with high % of gravels & pebbles. Obs. mica.			DS-13	23.50
		30 35 48 — 83	SPT-15	24.00-24.45
			DS-14	25.00
		22 42 53 — 95	SPT-16	25.50-25.95
			DS-15	26.50
		35 72 50 — ≥100 (8.0 cm Penetn.)	SPT-17	27.00-27.38
28.00m			DS-16	28.00
Very dense, brownish grey, clayey silty sand / sandy silt Obs. mica.		40 68 50 — ≥100 (10.0 cm Penetn.)	SPT-18	28.50-28.90
29.00m			DS-17	29.50
Very dense, brownish grey, silty sand. Obs. mica.		40 60 — ≥100 (13.0 cm Penetn.)	SPT-19	30.00-30.28
			DS-18	31.00
		45 56 — ≥100 (10.0 cm Penetn.)	SPT-20	31.50-31.75
32.00m			DS-19	32.50
		46 57 — ≥100 (5.0 cm Penetn.)	SPT-21	33.00-33.20
Very dense, light grey to brownish grey, silty sand / sandy silt. Obs. mica.			DS-20	34.00
		50 56 — ≥100 (5.0 cm Penetn.)	SPT-22	34.50-34.70
		15 33 47 — 80	SPT-23	35.00-35.45
35.45m				

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 17/12/2014** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.40

Co-ordinates E=609.000 N=58.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	6
Cone (Pc)		Penetrometer (SPT)	21
Vane (V)		Disturbed (DS)	21
		Water Sample (WS)	0

Commencement Date : 28/11/14
Completion Date : 01/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 66.376 m.
Water Struck At :
Standing Water Level : 11.6 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)				SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.							
Filled up soil consists of silty sand with ash.		2	2	2	4	DS-1	0.50
						SPT-1	1.00-1.45
2.00m.						UDS-1	2.00-2.45
Loose to medium dense, reddish brown, silty sand.		4	7	8	15	SPT-2	3.00-3.45
						UDS-2	4.00-4.45
		5	7	5	12	SPT-3	5.00-5.45
5.50m.						DS-2	6.00
						UDS-3	6.50-6.95
						DS-3	7.50
		8	9	8	17	SPT-4	8.00-8.45
Very stiff, greyish brown, clayey silt.						DS-4	9.00
						UDS-4	9.50-9.95
						DS-5	10.50
		11	13	13	26	SPT-5	11.00-11.45
						DS-6	12.00
12.50m.						UDS-5	12.50-12.95
Dense, yellowish grey, silty sand with traces of clay.						DS-7	13.50
		30	19	22	41	SPT-6	14.00-14.45
15.00m.						DS-8	15.00
						*UDS-6	15.50-15.64
		17	19	30	49	SPT-7	15.75-16.20
Hard, greyish brown, clayey silt. Obs. mica & fine sand.						DS-9	17.00
		21	26	39	65	SPT-8	17.50-17.95
						DS-10	18.50
19.00m.							

BH-40/Sheet-1

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.40

Co-ordinates E=609.000 N=58.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	6
Cone (Pc)		Penetrometer (SPT)	21
		Disturbed (DS)	21
Vane (V)		Water Sample (WS)	0

Commencement Date : 28/11/14
Completion Date : 01/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 66.376 m.
Water Struck At :
Standing Water Level : 11.6 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
19.00m.				
Very dense, brownish grey, silty sand. Obs. mica & gravels.		37 45 58 ≥100	SPT-9	19.00-19.45
			DS-11	20.00
		91		
		30 42 49	SPT-10	20.50-20.95
21.50m.			DS-12	21.50
		≥100		
		37 46 50	SPT-11	22.00-22.37
		7.0 cm Pentn.		
Hard, deep grey to brownish grey, clayey sandy silt. Obs. concreation of silt & mica.			DS-13	23.00
		≥100		
		25 38 62	SPT-12	23.50-23.84
		4.0 cm Pentn.		
			DS-14	24.50
		≥100		
		54 55	SPT-13	25.00-25.19
25.50m.		4.0 cm Pentn.		
Very dense, yellowish brown, sandy silt with traces of clay. Obs. concreation of silt & mica.			DS-15	26.00
		≥100		
		31 68	SPT-14	26.50-26.78
27.00m.		13.0 cm Pentn.		
			DS-16	27.50
		≥100		
		42 66	SPT-15	28.00-28.21
		6.0 cm Pentn.		
			DS-17	29.00
Hard, yellowish brown, clayey silt. Obs. concreation of silt & fine sand.		83		
		16 35 48	SPT-16	29.50-29.95
			DS-18	30.50
		≥100		
		22 38 60	SPT-17	31.00-31.35
		5.0 cm Pentn.		
32.00m.			DS-19	32.00
		≥100		
		28 54 50	SPT-18	32.50-32.83
		3.0 cm Pentn.		
			DS-20	33.50
		≥100		
		37 63	SPT-19	34.00-34.28
Very dense, brownish grey, silty sand with gravels pieces.		13.0 cm Pentn.		
		≥100		
		64 50	SPT-20	35.00-35.18
		3.0 cm Pentn.		
			DS-21	36.00
		≥100		
37.17m.		61 50	SPT-21	37.00-37.17
		2.0 cm Pentn.		

N.B. - '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 11/11/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.41

Co-ordinates E=646.000 N=59.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	22	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	22
Vane (V)		Disturbed (DS)	21
		Water Sample (WS)	0

Commencement Date : 04/11/14
Completion Date : 06/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.813 m.
Water Struck At :
Standing Water Level : 13.8 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	Depth (m)
0.00m.							
Filled up soil consists of yellowish grey, silty sand.						DS-1	0.50
1.00m.		8	11	17	28	SPT-1	1.00-1.45
Loose to medium dense, greyish brown, silty sand.						UDS-1	2.00-2.45
		3	4	5	9	SPT-2	3.00-3.45
3.50m.						UDS-2	4.00-4.45
		4	5	8	13	SPT-3	5.00-5.45
Stiff, brownish grey, clayey silt. Obs. sand mixture.						DS-2	6.00
						UDS-3	6.50-6.95
						DS-3	7.50
8.00m.		12	25	33	58	SPT-4	8.00-8.45
						DS-4	9.00
		17	30	33	63	SPT-5	9.50-9.95
						DS-5	10.50
		19	32	36	68	SPT-6	11.00-11.45
Very dense, brownish grey, sandy silt / silty sand. Obs. concreation of silt.						DS-6	12.00
		12	24	30	54	SPT-7	12.50-12.95
						DS-7	13.50
		15	26	32	58	SPT-8	14.00-14.45
						DS-8	15.00
15.50m.		9	18	23	41	SPT-9	15.50-15.95
						DS-9	16.50
Hard, greyish brown, clayey silt with sand mixture & mica.		10	19	26	45	SPT-10	17.00-17.45
17.90m.							

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
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BORE LOG DATA SHEET

BORE HOLE NO.41

Co-ordinates E=646.000 N=59.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	22	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	22
Vane (V)		Disturbed (DS)	21
		Water Sample (WS)	0

Commencement Date : 04/11/14
Completion Date : 06/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.813 m.
Water Struck At :
Standing Water Level : 13.8 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
			DS-10	18.00
Hard, greyish brown, clayey silt with sand mixture & mica.		13 21 29 50	SPT-11	18.50-18.95
			DS-11	19.50
17.90m				
		45 55 ≥100 10.0 cm Pentn.	SPT-12	20.00-20.25
			DS-12	21.00
		48 52 ≥100 5.0 cm Pentn.	SPT-13	21.50-21.70
Very dense, brownish grey, silty sand with gravels & pebbles.			DS-13	22.50
		65 35 ≥100 3.0 cm Pentn.	SPT-14	23.00-23.18
			DS-14	24.00
		100 ≥100 15.0 cm Pentn.	SPT-15	24.50-24.65
20.00m				
			DS-15	25.50
		15 31 60 91	SPT-16	26.00-26.45
			DS-16	27.00
		20 42 38 ≥100 10.0 cm Pentn.	SPT-17	27.50-27.90
			DS-17	28.50
		60 40 ≥100 5.0 cm Pentn.	SPT-18	29.00-29.20
			DS-18	30.00
Very dense, brownish grey, sandy silt / silty sand.		22 42 55 97	SPT-19	30.50-30.95
			DS-19	31.50
		30 52 28 ≥100 5.0 cm Pentn.	SPT-20	32.00-32.35
			DS-20	33.00
		40 60 ≥100 15.0 cm Pentn.	SPT-21	33.50-33.80
			DS-21	34.00
		30 46 34 ≥100 6.0 cm Pentn.	SPT-22	35.00-35.36
25.00m				
35.36m				

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | Created by : Chandrani | Created on : 11/11/2014 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.42

Co-ordinates E=683.000 N=62.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	23
		Water Sample (WS)	0

Commencement Date : 30/10/14
Completion Date : 02/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.616 m.
Water Struck At :
Standing Water Level : 13.55 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)				SAMPLES Ref. No	SAMPLES Depth (m)
0.00m							
Loose, greyish brown to brownish grey, silty sand with clay binders.		2	2	3	5	DS-1	0.50
						SPT-1	1.00-1.45
						UDS-1	2.00-2.45
		3	3	4	7	SPT-2	3.00-3.45
						UDS-2	4.00-4.45
4.00m		8	14	17	31	SPT-3	5.00-5.45
Hard, light blackish grey to brownish grey, silty clay / clayey silt. Obs. pocket of silty sand in UDS-03.						UDS-3	6.50-6.80
						DS-2	7.50
		10	16	24	40	SPT-4	8.00-8.45
						UDS-4	8.50-8.95
						DS-3	9.50
10.00m		8	14	29	43	SPT-5	10.00-10.45
						DS-4	11.00
		10	16	31	47	SPT-6	11.50-11.95
						DS-5	12.50
		12	16	29	45	SPT-7	13.00-13.45
Hard, brownish grey, clayey silt with sand with sand mixture & mica.						DS-6	14.00
		10	14	28	42	SPT-8	14.50-14.95
						DS-7	15.50
		18	24	29	53	SPT-9	16.00-16.45
						DS-8	17.00
		13	25	32	57	SPT-10	17.50-17.95
18.20m						DS-9	18.50
Very dense, brownish grey, silty sand with gravels pebbles & mica.		32	42	46	88	SPT-11	19.00-19.45
20.20m						DS-10	20.00

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 11/11/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.42

Co-ordinates E=683.000 N=62.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	23
		Water Sample (WS)	0

Commencement Date : 30/10/14
Completion Date : 02/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.616 m.
Water Struck At :
Standing Water Level : 13.55 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
			SPT-12	20.50-20.92
		30 46 50 ≥100 12.0 cm Pentn.	DS-11	21.50
			SPT-13	22.00-22.40
Very dense, brownish grey, silty sand with gravels pebbles & mica.		33 50 61 ≥100 10.0 cm Pentn.	DS-12	23.00
			SPT-14	23.50-23.85
		40 42 35 ≥100 5.0 cm Pentn.	DS-13	24.50
20.20m				
			SPT-15	25.00-25.45
		32 41 52 93	DS-14	26.00
25.00m				
			SPT-16	26.50-26.95
		23 32 36 68	DS-15	27.50
			SPT-17	28.00-28.45
		37 49 50 ≥100 11.0 cm Pentn.	DS-16	29.00
			SPT-18	29.50-29.75
		47 50 ≥100 2.5 cm Pentn.	DS-17	30.50
			SPT-19	31.00-31.25
		50 52 ≥100 10.0 cm Pentn.	DS-18	32.00
Very dense, brownish grey, silty sand / sandy silt. Obs. mica.			SPT-20	32.50-32.70
		53 50 ≥100 5.0 cm Pentn.	DS-19	33.50
			SPT-21	34.00-34.21
		55 50 ≥100 6.0 cm Pentn.	DS-20	35.00
			SPT-22	35.50-35.75
		58 60 ≥100 10.0 cm Pentn.	DS-21	36.50
			SPT-23	37.00-37.20
		80 50 ≥100 5.0 cm Pentn.	DS-22	38.00
			SPT-24	38.50-38.65
		100 ≥100 15.0 cm Pentn.	DS-23	39.00
			SPT-25	40.00-40.10
40.10m		150 ≥100 10.0 cm Pentn.		

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 11/11/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.43

Co-ordinates E=773.000 N=39.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	19	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	19
Vane (V)		Disturbed (DS)	18
		Water Sample (WS)	0

Commencement Date : 21/10/14
Completion Date : 27/10/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.524 m.
Water Struck At :
Standing Water Level : 13.5 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	Depth (m)
0.00m. Filled up soil consists with ash, brick etc.							
0.70m.						DS-1	0.50
		4	6	9	15	SPT-1	1.00-1.45
						UDS-1	2.00-2.45
Very stiff to hard, brownish grey, clayey silt. Obs. sand mixture & mica.		3	8	9	17	SPT-2	3.00-3.45
						UDS-2	4.00-4.45
		11	14	17	31	SPT-3	5.00-5.45
5.60m.						DS-2	6.00
						UDS-3	6.50-6.95
						DS-3	7.50
Dense, brownish grey, silty sand.		12	17	21	38	SPT-4	8.00-8.45
						DS-4	9.00
		10	20	22	42	SPT-5	9.50-9.95
						DS-5	10.50
11.00m.		12	20	33	53	SPT-6	11.00-11.45
Very dense, brownish grey, silty sand with high % of gravels. Obs. mica.						DS-6	12.00
		23	22	36	58	SPT-7	12.50-12.95
13.20m.						DS-7	13.50
Dense, brownish grey, silty sand with high % of gravels & mica. Obs. clay pocket around SPT-12.		8	15	19	34	SPT-8	14.00-14.45
						DS-8	15.00
15.50m.							

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 11/11/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.43

Co-ordinates E=773.000 N=39.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	19	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	19
Vane (V)		Disturbed (DS)	18
		Water Sample (WS)	0

Commencement Date : 21/10/14
Completion Date : 27/10/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.524 m.
Water Struck At :
Standing Water Level : 13.5 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	SAMPLES Depth (m)
15.50m.							
		10	16	20	36	SPT-9	15.50-15.95
						DS-9	16.50
		11	17	22	39	SPT-10	17.00-17.45
						DS-10	18.00
		13	20	23	43	SPT-11	18.50-18.95
						DS-11	19.50
		8	12	17	29	SPT-12	20.00-20.45
Dense, brownish grey, silty sand with high % of gravels & mica. Obs. clay pocket around SPT-12.						DS-12	21.00
		12	19	22	41	SPT-13	21.50-21.95
						DS-13	22.50
		14	21	24	45	SPT-14	23.00-23.45
						DS-14	24.00
		15	20	26	46	SPT-15	24.50-24.95
						DS-15	25.50
		12	22	28	50	SPT-16	26.00-26.45
27.00m.						DS-16	27.00
		14	24	35	59	SPT-17	27.50-27.95
						DS-17	28.30
Very dense, brownish grey, silty sand with high % of gravels. Obs. mica.		20	28	52	80	SPT-18	28.50-28.95
						DS-18	29.50
		25	40	54	94	SPT-19	30.00-30.45
30.45m.							

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 13/11/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.44

Co-ordinates E=646.000 N=25.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	20	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	20
Vane (V)		Disturbed (DS)	21
		Water Sample (WS)	0

Commencement Date : 07/11/14
Completion Date : 11/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.034 m.
Water Struck At :
Standing Water Level : 13.45 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of light grey, silty sand with ash.			DS-1	0.50
0.50m.		21		
		13 13 8	SPT-1	1.00-1.45
			UDS-1	2.00-2.45
		10		
Loose to medium dense, greyish brown, silty sand with traces of clay binders & mica.		4 4 6	SPT-2	3.00-3.45
			UDS-2	4.00-4.45
		9		
		5 5 4	SPT-3	5.00-5.45
6.00m.			DS-2	6.00
			UDS-3	6.50-6.90
Very stiff, greyish brown, clayey silt with traces of fine sand.			DS-3	7.50
		28		
		11 13 15	SPT-4	8.00-8.45
9.00m.			DS-4	9.00
Brownish grey, silty sand with mica.			UDS-4	9.50-9.95
10.50m.			DS-5	10.50
		45		
		13 18 27	SPT-5	11.00-11.45
			DS-6	12.50
			UDS-5	13.00-13.30
Hard, greyish brown, clayey silt with fine sand. Obs. mica.			DS-7	14.00
		81		
		16 33 48	SPT-6	14.50-14.95
			DS-8	15.50
		94		
		24 37 57	SPT-7	16.00-16.45
			DS-9	17.00
		>100		
17.90m.		22 39 50 4.0 cm Penth.	SPT-8	17.50-17.84

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Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 13/11/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.44

Co-ordinates E=646.000 N=25.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	20	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	20
Vane (V)		Disturbed (DS)	21
		Water Sample (WS)	0

Commencement Date : 07/11/14
Completion Date : 11/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.034 m.
Water Struck At :
Standing Water Level : 13.45 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
17.90m				
Hard, greyish brown, clayey silt with fine sand. Obs. mica.		18 26 58 — 84	DS-10	18.50
			SPT-9	19.00-19.45
20.00m			DS-11	20.00
Dense, silty sand. Obs. gravels & pebbles.		12 16 26 — 42	SPT-10	20.50-20.95
			DS-12	21.50
		11 17 28 — 45	SPT-11	22.00-22.45
23.00m			DS-13	23.00
Hard, brownish grey, clayey silt. Obs. mica.		14 19 32 — 51	SPT-12	23.50-23.95
			DS-14	24.50
		13 20 34 — 54	SPT-13	25.00-25.45
			DS-15	26.00
		16 22 36 — 58	SPT-14	26.50-26.95
			DS-16	27.50
		19 24 36 — 60	SPT-15	28.00-28.45
			DS-17	29.00
		25 32 49 — 81	SPT-16	29.50-29.95
30.00m			DS-18	30.50
Very dense, brownish grey, silty sand with high % of gravels & pebbles.		29 67 — >100 — 10.0 cm Pentn.	SPT-17	31.00-31.25
			DS-19	32.00
		64 36 — >100 — 7.0 cm Pentn.	SPT-18	32.50-32.72
			DS-20	33.20
		73 27 — >100 — 2.0 cm Pentn.	SPT-19	33.50-33.67
			DS-21	34.50
35.21m		58 42 — >100 — 6.0 cm Pentn.	SPT-20	35.00-35.21

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.45

Co-ordinates E=633.000 N=(-)11.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	24
		Disturbed (DS)	23
Vane (V)		Water Sample (WS)	0

Commencement Date : 13/11/14
Completion Date : 16/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 65.039 m.
Water Struck At :
Standing Water Level : 13.45 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.							
Filled up soil consists of silty sand with ash.		2	2	4	6	DS-1	0.50
						SPT-1	1.00-1.45
1.90m.						UDS-1	2.00-2.45
Loose, yellowish brown, sandy silt / silty sand.		5	4	5	9	SPT-2	3.00-3.45
4.00m.						UDS-2	4.00-4.45
Very stiff, deep grey, silty clay / clayey silt. Obs. mica, fine sand.		6	9	10	19	SPT-3	5.00-5.45
						DS-2	6.00
6.30m.						UDS-3	6.50-6.95
						DS-3	7.50
Hard, yellowish brown, clayey silt with fine sand. Obs. concreation of silt.		15	26	23	49	SPT-4	8.00-8.45
						DS-4	9.00
					52	*UDS-4	9.50-9.65
		17	24	28		SPT-5	9.75-10.20
10.50m.						DS-5	10.50
		24	40	58	98	SPT-6	11.00-11.45
Very dense, brownish grey, silty sand.						DS-6	12.00
		19	28	36	64	SPT-7	12.50-12.95
13.50m.						DS-7	13.50
		16	22	31	53	SPT-8	14.00-14.45
						DS-8	15.00
		13	24	30	54	SPT-9	15.50-15.95
Hard, brownish grey, clayey silt. Obs. concreation of silt.						DS-9	16.50
		12	17	29	46	SPT-10	17.00-17.45
						DS-10	18.00
		15	33	30	63	SPT-11	18.50-18.95
19.00m.							

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.45

Co-ordinates E=633.000 N=(-)11.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	24
		Disturbed (DS)	23
Vane (V)		Water Sample (WS)	0

Commencement Date : 13/11/14
Completion Date : 16/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 65.039 m.
Water Struck At :
Standing Water Level : 13.45 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
19.00m.				
Hard, brownish grey, clayey silt. Obs. concreation of silt.		24 33 43 (76)	DS-11	19.50
			SPT-12	20.00-20.45
			DS-12	21.00
		26 37 53 (90)	SPT-13	21.50-21.95
22.00m.			DS-13	22.50
Hard, brownish grey, clayey silt with fine sand. Obs. mica & concreation of silt.		36 52 12 (>100) 2.0 cm Pentn.	SPT-14	23.00-23.32
			DS-14	24.00
		26 42 32 (>100) 8.0 cm Pentn.	SPT-15	24.50-24.88
			DS-15	25.50
		39 62 (>100) 13.0 cm Pentn.	SPT-16	26.00-26.28
27.00m.			DS-16	27.00
Very dense, brownish grey, silty sand with high % of gravels pieces.		56 44 (>100) 8.0 cm Pentn.	SPT-17	27.50-27.73
			DS-17	28.20
		61 50 (>100) 6.0 cm Pentn.	SPT-18	29.00-29.21
			DS-18	30.00
		46 54 (>100) 4.0 cm Pentn.	SPT-19	30.50-30.69
			DS-19	31.00
		34 66 (>100) 9.0 cm Pentn.	SPT-20	31.50-31.74
			DS-20	32.50
		53 47 (>100) 12.0 cm Pentn.	SPT-21	33.00-33.27
			DS-21	34.00
		59 41 (>100) 3.0 cm Pentn.	SPT-22	34.50-34.68
			DS-22	35.00
		37 58 15 (>100) 2.0 cm Pentn.	SPT-23	35.50-35.82
			DS-23	36.50
37.28m.		43 57 (>100) 13.0 cm Pentn.	SPT-24	37.00-37.28

N.B. - '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | Created by : Chandrani | Created on : 15/01/2015 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.46

Co-ordinates E=687.000 N=(-)34.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	24
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 14/11/14
Completion Date : 11/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.447 m.
Water Struck At :
Standing Water Level : 13.35 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of light grey, silty sand with ash.			DS-1	0.50
0.80m.		2 4 5 — 9	SPT-1	1.00-1.45
			UDS-1	2.00-2.45
Stiff to hard, deep grey, clayey silt with traces of sand. Obs. concreation of silt.		8 10 13 — 23	SPT-2	3.00-3.45
			UDS-2	4.00-4.45
		12 18 21 — 39	SPT-3	5.00-5.45
5.50m.			DS-2	6.00
			*UDS-3	6.50-6.65
		22 28 33 — 61	SPT-4	6.75-7.20
			DS-3	8.00
		19 34 39 — 73	SPT-5	8.50-8.95
			DS-4	9.50
		28 35 58 — >100 (7.0 cm Pentn.)	SPT-6	10.00-10.37
			DS-5	11.00
Very dense, brownish grey, silty sand with gravels & pebbles.		22 46 52 — >100 (3.0 cm Pentn.)	SPT-7	11.50-11.83
			DS-6	12.20
		26 40 34 — >100 (14.0 cm Pentn.)	SPT-8	12.50-12.79
			DS-7	13.00
		18 51 52 — >100 (8.0 cm Pentn.)	SPT-9	13.50-13.88
			DS-8	14.20
		21 33 58 — >100 (11.0 cm Pentn.)	SPT-10	15.00-15.41
			DS-9	16.00
		20 36 61 — 97	SPT-11	16.50-16.95
			DS-10	17.50
18.00m.				

BH-46/Sheet-1

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | Created by : Chandrani | Created on : 15/01/2015 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.46

Co-ordinates E=687.000 N=(-)34.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	24
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 14/11/14
Completion Date : 11/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.447 m.
Water Struck At :
Standing Water Level : 13.35 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
18.00m Very dense, brownish grey, silty sand with gravels & pebbles.		10 32 54 — 86	SPT-12	18.00-18.45
19.00m			DS-11	19.00
Hard, brownish grey, clayey silt. Obs. concreation of silt.		16 28 34 — 62	SPT-13	19.50-19.95
			DS-12	20.50
		13 31 47 — 78	SPT-14	21.00-21.45
22.00m			DS-13	22.00
Desne to very dense, brownish grey, silty sand / sandy silt with traces of clay. Obs. gravels.		10 22 27 — 49	SPT-15	22.50-22.95
			DS-14	23.50
		17 21 33 — 54	SPT-16	24.00-24.45
			DS-15	25.00
25.50m		41 30 31 — >100 (13.0 cm Penth.)	SPT-17	25.50-25.78
			DS-16	26.50
		43 60 — >100 (10.0 cm Penth.)	SPT-18	27.00-27.25
			DS-17	28.00
		52 54 — >100 (8.0 cm Pentn.)	SPT-19	28.50-28.73
			DS-18	29.50
Very dense, brownish grey, silty sand with high % of gravels & pebbles.		57 52 — >100 (9.0 cm Pentn.)	SPT-20	30.00-30.24
			DS-19	31.00
		60 50 — >100 (7.0 cm Pentn.)	SPT-21	31.50-31.72
			DS-20	32.50
		54 52 — >100 (10.0 cm Penth.)	SPT-22	33.00-33.25
		62 50 — >100 (5.0 cm Pentn.)	SPT-23	34.00-34.20
35.18m		69 59 — >100 (3.0 cm Pentn.)	SPT-24	35.00-35.18

N.B. - '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.47

Co-ordinates E=606.000 N=(-)34.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	21
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 17/11/14
Completion Date : 19/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.284 m.
Water Struck At :
Standing Water Level : 12.6 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.							
Medium, yellowish brown, clayey silt with fine sand.		2	3	3	6	DS-1	0.50
						SPT-1	1.00-1.45
1.50m.							
						UDS-1	2.00-2.45
		3	4	6	10	SPT-2	3.00-3.45
Stiff, deep grey, silty clay.						UDS-2	4.00-4.45
		3	5	8	13	SPT-3	5.00-5.45
6.00m.						DS-2	6.00
						UDS-3	6.50-6.95
Very stiff, brownish grey, clayey silt with fine sand. Obs. mica.						DS-3	7.50
		8	10	9	19	SPT-4	8.00-8.45
						DS-4	9.00
9.50m.						UDS-4	9.50-9.95
Dense, brownish grey, silty sand.						DS-5	10.50
		11	22	27	49	SPT-5	11.00-11.45
12.00m.						DS-6	12.00
						*UDS-5	12.50-12.67
		10	13	21	34	SPT-6	12.75-13.20
						DS-7	14.00
Hard, brownish grey, clayey silt with fine sand mixture. Obs. mica.		10	12	15	27	SPT-7	14.50-14.95
						DS-8	15.50
		16	17	20	37	SPT-8	16.00-16.45
						DS-9	17.00
		18	20	22	42	SPT-9	17.50-17.95
18.00m.							

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.47

Co-ordinates E=606.000 N=(-)34.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	21
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 17/11/14
Completion Date : 19/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.284 m.
Water Struck At :
Standing Water Level : 12.6 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
18.00m.				
Hard, brownish grey, clayey silt with fine sand mixture. Obs. mica.		19 25 29 — 54	DS-10	18.50
			SPT-10	19.00-19.45
			DS-11	20.00
20.50m.		22 50 50 — 100	SPT-11	20.50-20.95
			DS-12	21.50
		30 48 50 — 98	SPT-12	22.00-22.45
			DS-13	23.00
		40 50 — 10.0 cm Pentn. — ≥100	SPT-13	23.50-23.75
			DS-14	24.50
		15 50 — 10.0 cm Pentn. — ≥100	SPT-14	25.00-25.25
			DS-15	26.00
		20 50 — 9.0 cm Pentn. — ≥100	SPT-15	26.50-26.74
			DS-16	27.50
Very dense, brownish grey, silty sand with gravels pieces.		48 60 — 6.0 cm Pentn. — ≥100	SPT-16	28.00-28.21
			DS-17	29.00
		60 55 — 4.0 cm Pentn. — ≥100	SPT-17	29.50-29.69
			DS-18	30.50
		58 50 — 5.0 cm Pentn. — ≥100	SPT-18	31.00-31.20
			DS-19	32.00
		62 55 — 3.0 cm Pentn. — ≥100	SPT-19	32.50-32.68
			DS-20	33.50
		65 57 — 4.0 cm Pentn. — ≥100	SPT-20	34.00-34.19
35.18m.		70 60 — 3.0 cm Pentn. — ≥100	*SPT-21	35.00-35.18

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 17/12/2014** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.48

Co-ordinates E=571.000 N=(-)12.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	20	Undisturbed (UDS)	6
Cone (Pc)		Penetrometer (SPT)	20
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 16/11/14
Completion Date : 19/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.129 m.
Water Struck At :
Standing Water Level : 14.0 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
			DS-1	0.50
		8		
		3 4 4	SPT-1	1.00-1.45
Filled up soil consists of yellowish brown to greyish brown, clayey silt with fine sand.			UDS-1	2.00-2.45
		6		
		3 2 4	SPT-2	3.00-3.45
			UDS-2	4.00-4.45
4.50m.				
		10		
Stiff, deep grey, silty clay.		6 5 5	SPT-3	5.00-5.45
6.00m.			DS-2	6.00
			UDS-3	6.50-6.95
Stiff, greyish brown, clayey silt with fine sand.			DS-3	7.50
		15		
		4 7 8	SPT-4	8.00-8.45
9.00m.			DS-4	9.00
			UDS-4	9.50-9.95
Medium dense, brownish grey, silty sand.			DS-5	10.50
		17		
		5 8 9	SPT-5	11.00-11.45
11.50m.			DS-6	12.00
			UDS-5	12.50-12.95
			DS-7	13.50
		37		
		6 13 24	SPT-6	14.00-14.45
Hard, brownish grey, clayey silt with fine sand. Obs. mica & concreation of silt.			DS-8	15.00
		46	*UDS-6	15.50-15.68
		9 19 27	SPT-7	15.80-16.25
			DS-9	17.00
		45		
		11 20 25	SPT-8	17.50-17.95
18.00m.				

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
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BORE LOG DATA SHEET

BORE HOLE NO.48

Co-ordinates E=571.000 N=(-)12.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	20	Undisturbed (UDS)	6
Cone (Pc)		Penetrometer (SPT)	20
		Disturbed (DS)	20
Vane (V)		Water Sample (WS)	0

Commencement Date : 16/11/14
Completion Date : 19/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.129 m.
Water Struck At :
Standing Water Level : 14.0 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
18.00m.				
Hard, brownish grey, clayey silt with fine sand. Obs. mica & concreation of silt.		10 22 29 — 51	DS-10	18.50
			SPT-9	19.00-19.45
20.50m.			DS-11	20.50
		28 43 50 — ≥100 (8.0 cm Pentn.)	SPT-10	21.00-21.38
			DS-12	22.00
		42 50 50 — 100	SPT-11	22.50-22.95
			DS-13	23.50
		45 49 52 — ≥100	SPT-12	24.00-24.45
			DS-14	25.00
		48 50 — ≥100 (7.0 cm Pentn.)	SPT-13	25.50-25.72
			DS-15	26.50
		59 50 — ≥100 (6.0 cm Pentn.)	SPT-14	27.00-27.21
Very dense, brownish grey, silty sand with gravels pieces.			DS-16	28.00
		47 50 — ≥100 (3.0 cm Pentn.)	SPT-15	28.50-28.68
			DS-17	29.50
		60 50 — ≥100 (5.0 cm Pentn.)	SPT-16	30.00-30.20
			DS-18	31.00
		68 50 — ≥100 (6.0 cm Pentn.)	SPT-17	31.50-31.71
			DS-19	32.50
		68 55 — ≥100 (4.0 cm Pentn.)	SPT-18	33.00-33.19
			DS-20	34.00
		72 60 — ≥100 (6.0 cm Pentn.)	SPT-19	34.50-34.71
35.18m.		75 50 — ≥100 (3.0 cm Pentn.)	SPT-20	35.00-35.18

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.49

Co-ordinates E=654.000 N=(-)67.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	22	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	22
Vane (V)		Disturbed (DS)	21
		Water Sample (WS)	0

Commencement Date : 15/11/14
Completion Date : 18/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 65.011 m.
Water Struck At :
Standing Water Level : 13.8 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of silty sand with ash.		4 7 9 (16)	DS-1	0.50
			SPT-1	1.00-1.45
1.60m.			UDS-1	2.00-2.45
		7 11 22 (33)	SPT-2	3.00-3.45
Very stiff / hard, deep grey, silty clay. A pocket of deep brown, silty sand was observed around UDS-03.			UDS-2	4.00-4.45
		22 10 18 (28)	SPT-3	5.00-5.45
			DS-2	6.00
			UDS-3	6.50-6.95
7.50m.			DS-3	7.50
		14 31 42 (73)	SPT-4	8.00-8.45
Hard, yellowish grey, clayey silt with white shade. Obs. fine sand & concreation of silt.			DS-4	9.00
			*UDS-4	9.50-9.65
		12 20 33 (53)	SPT-5	9.80-10.25
11.00m.			DS-5	11.00
		21 43 50/8.0 cm Pentn. (>100)	SPT-6	11.50-11.88
			DS-6	13.00
		24 50 50/2.0 cm Pentn. (>100)	SPT-7	13.50-13.82
			DS-7	14.50
Very dense, yellowish grey to brownish grey, silty sand with high % of gravels & pebbles.		38 50/8.0 cm Pentn. (>100)	SPT-8	15.00-15.23
			DS-8	16.00
		50 48/4.0 cm Pentn. (>100)	SPT-9	16.50-16.69
			DS-9	17.50
		41 50/11.0 cm Pentn. (>100)	SPT-10	18.00-18.26
19.00m.			DS-10	19.00

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.				CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:	

BORE LOG DATA SHEET

BORE HOLE NO.49

Co-ordinates E=654.000 N=(-)67.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	22	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	22
		Disturbed (DS)	21
Vane (V)		Water Sample (WS)	0

Commencement Date : 15/11/14
Completion Date : 18/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 65.011 m.
Water Struck At :
Standing Water Level : 13.8 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
19.00m.				
		32 23 27 (50)	SPT-11	19.50-19.95
			DS-11	20.50
		21 33 39 (72)	SPT-12	21.00-21.45
			DS-12	22.50
		27 48 50 (>100) 7.0 cm Pentn.	SPT-13	23.00-23.37
			DS-13	24.00
		36 50 (>100) 13.0 cm Pentn.	SPT-14	24.50-24.78
			DS-14	25.50
		48 50 (>100) 8.0 cm Pentn.	SPT-15	26.00-26.23
			DS-15	27.00
Very dense, yellowish grey to brownish grey, silty sand with high % of gravels & pebbles.		29 42 50 (>100) 3.0 cm Pentn.	SPT-16	27.50-27.83
			DS-16	28.50
		38 50 (>100) 12.0 cm Pentn.	SPT-17	29.00-29.27
			DS-17	30.00
		25 47 50 (>100) 5.0 cm Pentn.	SPT-18	30.50-30.85
			DS-18	31.50
		38 41 50 (>100) 1.0 cm Pentn.	SPT-19	32.00-32.31
			DS-19	33.00
		46 50 (>100) 11.0 cm Pentn.	SPT-20	33.50-33.76
			DS-20	34.50
		50 50 (>100) 9.0 cm Pentn.	SPT-21	35.00-35.24
			DS-21	36.00
37.22m.		50 50 (>100) 7.0 cm Pentn.	SPT-22	37.00-37.22

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 17/12/2014** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.50

Co-ordinates E=615.000 N=(-)102.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	21
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 23/11/14
Completion Date : 27/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.299 m.
Water Struck At :
Standing Water Level : 13.9 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Filled up soil consists of blackish grey, silty sand with gravels.			DS-1	0.50
1.00m		4		
Loose, deep grey, silty sand / sandy silt. Obs. mica.		1 2 2	SPT-1	1.00-1.45
2.00m			UDS-1	2.00-2.45
Loose, yellowish brown, silty sand. Obs. mica.		5		
		4 3 2	SPT-2	3.00-3.45
4.00m			UDS-2	4.00-4.45
		10		
		6 3 7	SPT-3	5.00-5.45
			DS-2	6.00
Stiff, brownish grey, clayey silt with sand mixture.			UDS-3	6.50-6.95
			DS-3	7.50
		15		
		8 5 10	SPT-4	8.00-8.45
9.00m			DS-4	9.00
			UDS-4	9.50-9.95
			DS-5	10.50
		57		
		15 27 30	SPT-5	11.00-11.45
			DS-6	12.00
Dense to very dense, brownish grey, silty sand. Obs. gravels.			*UDS-5	12.50-12.66
		54		
		18 24 30	SPT-6	12.80-13.25
			DS-7	14.00
		42		
		22 17 25	SPT-7	14.50-14.95
15.50m			DS-8	15.50
		31		
Dense, yellowish brown, sandy silt with traces of clay. Obs. mica.		13 12 19	SPT-8	16.00-16.45
17.00m			DS-9	17.00
		>100		
Very dense, yellowish grey, silty sand with gravels.		54 58 9.0 cm Pentn.	SPT-9	17.50-17.74
18.00m				

BH-50/Sheet-1

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.50

Co-ordinates E=615.000 N=(-)102.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	21
Vane (V)		Disturbed (DS)	20
		Water Sample (WS)	0

Commencement Date : 23/11/14
Completion Date : 27/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.299 m.
Water Struck At :
Standing Water Level : 13.9 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
18.00m				
			DS-10	18.50
		86		
		22 38 48	SPT-10	19.00-19.45
Very dense, yellowish grey, silty sand with gravels.			DS-11	20.00
		81		
		18 30 51	SPT-11	20.50-20.95
			DS-12	21.50
		>100		
22.00m		42 56 52	SPT-12	22.00-22.34
		4.0 cm Pentn.		
			DS-13	23.00
		>100		
Very dense, reddish brown, sandy silt / silty sand. Obs. mica & gravels.		59 62	SPT-13	24.00-24.27
		12.0 cm Pentn.		
			DS-14	25.00
		79		
		22 35 44	SPT-14	25.50-25.95
26.50m			DS-15	26.50
		94		
		23 38 56	SPT-15	27.00-27.45
			DS-16	28.00
		>100		
		49 58	SPT-16	28.50-28.74
		9.0 cm Pentn.		
			DS-17	29.50
		>100		
		52 55	SPT-17	30.00-30.22
		7.0 cm Pentn.		
Very dense, yellowish brown, silty sand, high % of gravels pieces.			DS-18	31.00
		>100		
		60 58	SPT-18	31.50-31.74
		9.0 cm Pentn.		
			DS-19	32.50
		>100		
		63 56	SPT-19	33.00-33.23
		8.0 cm Pentn.		
			DS-20	34.00
		>100		
		62 58	SPT-20	34.50-34.75
		10.0 cm Pentn.		
		>100		
35.19m		55 50	*SPT-21	35.00-35.19
		4.0 cm Pentn.		

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | Created by : Chandrani | Created on : 16/01/2015 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.51

Co-ordinates E=676.000 N=(-)102.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	21
		Disturbed (DS)	21
Vane (V)		Water Sample (WS)	0

Commencement Date : 22/12/14
Completion Date : 25/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 61.517 m.
Water Struck At :
Standing Water Level : 11.15 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.							
Filled up soil consists of black mill reject.						DS-1	0.50
		2	2	3	5	SPT-1	1.00-1.45
1.50m.						UDS-1	2.00-2.45
		5	6	8	14	SPT-2	3.00-3.45
						UDS-2	4.00-4.45
		3	4	7	11	SPT-3	5.00-5.45
Stiff, deep grey, silty clay / clayey silt with traces of sand mixture.						DS-2	6.00
						UDS-3	6.50-6.95
						DS-3	7.50
		3	5	7	12	SPT-4	8.00-8.45
						DS-4	9.00
9.50m.						*UDS-4	9.50-9.95
						DS-5	10.50
		10	19	32	51	SPT-5	11.00-11.45
						DS-6	12.00
		10	10	20	30	SPT-6	12.50-12.95
Dense to very dense, brownish grey, silty sand. Obs. gravels. Observed clay pocket around SPT-06.						DS-7	13.50
		12	17	22	39	SPT-7	14.00-14.45
						DS-8	15.00
		15	18	25	43	SPT-8	15.50-15.95
						DS-9	16.50
		20	25	35	60	SPT-9	17.00-17.45
18.00m.						DS-10	18.00

BH-51/Sheet-1

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 16/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.51

Co-ordinates E=676.000 N=(-)102.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	21	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	21
		Disturbed (DS)	21
Vane (V)		Water Sample (WS)	0

Commencement Date : 22/12/14
Completion Date : 25/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 61.517 m.
Water Struck At :
Standing Water Level : 11.15 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
18.00m.				
Dense to very dense, brownish grey, silty sand. Obs. gravels. Observed clay pocket around SPT-06.		10 25 36 = 61	SPT-10	18.50-18.95
			DS-11	19.50
		17 19 36 = 55	SPT-11	20.00-20.45
21.00m.			DS-12	21.00
		15 32 35 = 67	SPT-12	21.50-21.95
			DS-13	22.50
		10 21 40 = 61	SPT-13	23.00-23.45
			DS-14	24.00
		15 28 36 = 64	SPT-14	24.50-24.95
			DS-15	25.50
		22 32 42 = 74	SPT-15	26.00-26.45
			DS-16	27.00
Very dense, greyish brown, silty sand / sandy silt. Obs. pebbles.		36 45 58 = >100 5.0 cm Pentn.	SPT-16	27.50-27.85
			DS-17	28.50
		43 62 = >100 13.0 cm Pentn.	SPT-17	29.00-29.28
			DS-18	30.00
		52 50 = >100 8.0 cm Pentn.	SPT-18	30.50-30.73
			DS-19	31.50
		56 51 = >100 6.0 cm Pentn.	SPT-19	32.00-32.21
			DS-20	33.00
		62 52 = >100 4.0 cm Pentn.	SPT-20	33.50-33.69
			DS-21	34.50
35.20m.		58 50 = >100 5.0 cm Pentn.	SPT-21	35.00-35.20

N.B. - '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 17/12/2014** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.52

Co-ordinates E=656.000 N=(-)128.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 20/11/14
Completion Date : 22/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.97 m.
Water Struck At :
Standing Water Level : 14.4 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of silty sand with ash.			DS-1	0.50
1.00m.		2 3 5 (8)	SPT-1	1.00-1.45
			UDS-1	2.00-2.45
Loose to medium dense, yellowish brown, silty sand.		4 7 11 (18)	SPT-2	3.00-3.45
			UDS-2	4.00-4.45
		8 11 13 (24)	SPT-3	5.00-5.45
5.50m.			DS-2	6.00
			UDS-3	6.50-6.95
Hard, greyish brown, clayey silt with fine sand. Obs. kankars.			DS-3	7.50
		10 16 23 (39)	SPT-4	8.00-8.45
			DS-4	9.00
9.50m.			UDS-4	9.50-9.80
			DS-5	10.50
		18 36 50 6.0 cm Pentn. (>100)	SPT-5	11.00-11.36
			DS-6	12.00
		23 42 50 3.0 cm Pentn. (>100)	SPT-6	12.50-12.83
			DS-7	13.50
Dense to very dense, brownish grey, silty sand with gravels pieces.		12 17 24 (41)	SPT-7	14.00-14.45
			DS-8	15.00
		14 18 26 (44)	SPT-8	15.50-15.95
			DS-9	16.50
		10 18 23 (41)	SPT-9	17.00-17.45
			DS-10	18.00
		11 13 22 (35)	SPT-10	18.00-18.45
			DS-11	19.00
19.50m.		14 21 34 (55)	SPT-11	19.50-19.95
Hard, yellowish brown, silty clay / clayey silt with sand mixture. Obs. concreation of silt.			DS-12	20.50
21.00m.				

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 17/12/2014	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.52

Co-ordinates E=656.000 N=(-)128.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 20/11/14
Completion Date : 22/11/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.97 m.
Water Struck At :
Standing Water Level : 14.4 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
		23 36 42 — 78	SPT-12	21.00-21.45
			DS-13	22.00
		19 33 48 — 81	SPT-13	22.50-22.95
			DS-14	23.50
Hard, yellowish brown, silty clay / clayey silt with sand mixture. Obs. concreation of silt.		16 32 54 — 86	SPT-14	24.00-24.45
			DS-15	25.00
		18 35 53 — 88	SPT-15	25.50-25.95
			DS-16	26.50
		23 39 56 — 95	SPT-16	27.00-27.45
21.00m.			DS-17	28.00
		33 45 50 — ≥100	SPT-17	28.50-28.84
		4.0 cm Pentn.		
			DS-18	29.50
		42 60 — ≥100	SPT-18	30.00-30.22
		7.0 cm Pentn.		
			DS-19	31.00
		48 50 — ≥100	SPT-19	31.50-31.68
		3.0 cm Pentn.		
			DS-20	32.50
		54 50 — ≥100	SPT-20	33.00-33.27
		12.0 cm Pentn.		
Very dense, yellowish grey, silty sand with traces of gravels & mica.			DS-21	34.00
		61 50 — ≥100	SPT-21	34.50-34.73
		8.0 cm Pentn.		
			DS-22	35.50
		57 50 — ≥100	SPT-22	36.00-36.25
		10.0 cm Pentn.		
			DS-23	37.00
		65 50 — ≥100	SPT-23	37.50-37.71
		6.0 cm Pentn.		
			DS-24	38.50
		62 50 — ≥100	SPT-24	39.00-39.19
		4.0 cm Pentn.		
40.22m.		73 52 — ≥100	SPT-25	40.00-40.22
		7.0 cm Pentn.		

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 07/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.53

Co-ordinates E=628.000 N=(-)149.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	18	Undisturbed (UDS)	7
Cone (Pc)		Penetrometer (SPT)	18
Vane (V)		Disturbed (DS)	21
		Water Sample (WS)	0

Commencement Date : 15/12/14
Completion Date : 18/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 72.226 m.
Water Struck At :
Standing Water Level : 22.3 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Filled up soil consists of light grey, silty sand / sandy silt with ash.		2 2 3 (5)	DS-1	0.50
			SPT-1	1.00-1.45
			UDS-1	2.00-2.45
		2 3 3 (6)	SPT-2	3.00-3.45
3.50m				
Medium dense, yellowish brown, silty sand with traces of clay binder. Obs. concreation of silt & mica.			UDS-2	4.00-4.45
		5 9 11 (20)	SPT-3	5.00-5.45
			DS-2	6.00
			UDS-3	6.50-6.95
			DS-3	7.50
		8 8 9 (17)	SPT-4	8.00-8.45
9.00m			DS-4	9.00
Hard, brownish grey, clayey silt with sand mixture & mica.			UDS-4	9.50-9.95
			DS-5	10.50
		5 12 18 (30)	SPT-5	11.00-11.45
			DS-6	12.00
			UDS-5	12.50-12.95
13.50m			DS-7	13.50
Dense, yellowish brown, silty sand with traces of kankars. Obs. concreation of silt & mica.		5 12 18 (30)	SPT-6	14.00-14.45
			DS-8	15.00
			UDS-6	15.50-15.95
			DS-9	16.50
		7 13 21 (34)	SPT-7	17.00-17.45
18.00m			DS-10	18.00

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 07/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.53

Co-ordinates E=628.000 N=(-)149.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	18	Undisturbed (UDS)	7
Cone (Pc)		Penetrometer (SPT)	18
Vane (V)		Disturbed (DS)	21
		Water Sample (WS)	0

Commencement Date : 15/12/14
Completion Date : 18/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 72.226 m.
Water Struck At :
Standing Water Level : 22.3 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
18.00m.				
Dense, yellowish brown, silty sand with traces of kankars. Obs. concreation of silt & mica.		12 18 32 — 50	UDS-7	18.50-18.80
			DS-11	19.50
			SPT-8	20.00-20.45
21.00m.			DS-12	21.00
		20 34 38 — 72	SPT-9	21.50-21.95
			DS-13	22.50
		18 35 38 — 73	SPT-10	23.00-23.45
			DS-14	24.00
		32 46 55 — ≥100 (4.0 cm Pentn.)	SPT-11	24.50-24.84
			DS-15	25.50
		43 60 — ≥100 (12.0 cm Pentn.)	SPT-12	26.00-26.27
			DS-16	27.00
Very dense, brownish grey, silty sand with gravels.		52 50 — ≥100 (7.0 cm Pentn.)	SPT-13	27.50-27.72
			DS-17	28.50
		55 58 — ≥100 (9.0 cm Pentn.)	SPT-14	29.00-29.24
			DS-18	30.00
		61 50 — ≥100 (3.0 cm Pentn.)	SPT-15	30.50-30.68
			DS-19	31.50
		57 50 — ≥100 (5.0 cm Pentn.)	SPT-16	32.00-32.20
			DS-20	33.00
		63 53 — ≥100 (2.0 cm Pentn.)	SPT-17	33.50-33.67
			DS-21	34.50
35.19m.		67 50 — ≥100 (4.0 cm Pentn.)	SPT-18	35.00-35.19

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 16/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.54

Co-ordinates E=666.000 N=(-)149.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	18	Undisturbed (UDS)	7
Cone (Pc)		Penetrometer (SPT)	18
Vane (V)		Disturbed (DS)	21
		Water Sample (WS)	0

Commencement Date : 12/12/14
Completion Date : 13/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 72.476 m.
Water Struck At :
Standing Water Level : 22.6 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
			DS-1	0.50
		3		
		1 1 2	SPT-1	1.00-1.45
Filled up soil consists of yellowish brown, sandy silt with ash.			UDS-1	2.00-2.45
		6		
		2 3 3	SPT-2	3.00-3.45
			UDS-2	4.00-4.45
5.00m		17		
		8 7 10	SPT-3	5.00-5.45
Very stiff, brownish grey, clayey silt with sand mixture.			DS-2	6.00
			UDS-3	6.50-6.95
6.95m			DS-3	7.50
		23		
		8 10 13	SPT-4	8.00-8.45
			DS-4	9.00
Medium dense, yellowish brown, sandy silt.			UDS-4	9.50-9.95
			DS-5	10.50
		26		
		11 12 14	SPT-5	11.00-11.45
			DS-6	12.00
			UDS-5	12.50-12.95
13.00m			DS-7	13.50
		29		
Very stiff, blackish grey, silty clay / clayey silt.		8 11 18	SPT-6	14.00-14.45
			DS-8	15.00
15.00m			UDS-6	15.00-15.45
Medium dense, yellowish brown, silty sand.			DS-9	16.50
17.00m		44		
		11 17 27	SPT-7	17.00-17.45
Dense to very dense, brownish grey, silty sand. Obs. gravels.			DS-10	18.00
18.00m				

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 16/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.54

Co-ordinates E=666.000 N=(-)149.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	18	Undisturbed (UDS)	7
Cone (Pc)		Penetrometer (SPT)	18
Vane (V)		Disturbed (DS)	21
		Water Sample (WS)	0

Commencement Date : 12/12/14
Completion Date : 13/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 72.476 m.
Water Struck At :
Standing Water Level : 22.6 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	SAMPLES Depth (m)
18.00m							
						*UDS-7	18.50-18.69
						DS-11	19.50
					53		
		19	23	30		SPT-8	20.00-20.45
						DS-12	21.00
					56		
		21	24	32		SPT-9	21.50-21.95
						DS-13	22.50
Dense to very dense, brownish grey, silty sand. Obs. gravels.					60		
		23	25	35		SPT-10	23.00-23.45
						DS-14	24.00
					47		
		15	19	28		SPT-11	24.50-24.95
						DS-15	25.50
					61		
		19	28	33		SPT-12	26.00-26.45
						DS-16	27.00
27.50m					73		
		22	34	39		SPT-13	27.50-27.95
						DS-17	28.50
					55		
Hard, greyish brown, clayey silt with sand mixture.		12	24	31		SPT-14	29.00-29.45
						DS-18	30.00
					61		
		17	26	35		SPT-15	30.50-30.95
						DS-19	31.50
32.00m					65		
		12	28	37		SPT-16	32.00-32.45
						DS-20	33.00
					84		
Very dense, brownish grey, silty sand.		23	38	46		SPT-17	33.50-33.95
						DS-21	34.50
					85		
35.45m		13	37	48		SPT-18	35.00-35.45

N.B. - '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 07/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.55

Co-ordinates E=766.000 N=(-)194.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	17	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	17
Vane (V)		Disturbed (DS)	17
		Water Sample (WS)	0

Commencement Date : 19/12/14
Completion Date : 21/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 71.248 m.
Water Struck At :
Standing Water Level : 21.8 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	Depth (m)
0.00m.							
						DS-1	0.50
					6		
		2	3	3		SPT-1	1.00-1.45
Filled up soil consists of light grey, silty sand with ash.							
						UDS-1	2.00-2.45
					8		
		3	4	4		SPT-2	3.00-3.45
3.50m.							
						UDS-2	4.00-4.45
					11		
		5	4	7		SPT-3	5.00-5.45
						DS-2	6.00
Medium dense, yellowish brown, sandy silt. Obs. mica.						UDS-3	6.50-6.95
						DS-3	7.50
					11		
		4	4	7		SPT-4	8.00-8.45
						DS-4	9.00
						UDS-4	9.50-9.95
10.50m.						DS-5	10.50
					34		
		9	12	22		SPT-5	11.00-11.45
						DS-6	12.00
Hard, brownish grey, clayey silt with sand mixture.						UDS-5	12.50-12.95
						DS-7	13.50
					50		
		5	22	28		SPT-6	14.00-14.45
15.00m.						DS-8	15.00
Very dense, brownish grey, silty sand.							
15.50m.							

BH-55/Sheet-1

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 07/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.55

Co-ordinates E=766.000 N=(-)194.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	17	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	17
		Disturbed (DS)	17
Vane (V)		Water Sample (WS)	0

Commencement Date : 19/12/14
Completion Date : 21/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 71.248 m.
Water Struck At :
Standing Water Level : 21.8 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
15.50m.				
Very dense, brownish grey, silty sand.		7 20 35 55	SPT-7	15.50-15.95
			DS-9	16.50
		13 21 37 58	SPT-8	17.00-17.45
			DS-10	18.00
		15 25 45 70	SPT-9	18.50-18.95
19.50m.			DS-11	19.50
		28 55 50/9.0 cm Pentn.	SPT-10	20.00-20.39
			DS-12	21.00
		35 67 50/8.0 cm Pentn.	SPT-11	21.50-21.73
			DS-13	22.50
		42 61 50/5.0 cm Pentn.	SPT-12	23.00-23.20
			DS-14	24.00
Very dense, brownish grey, silty sand with high % of gravels.		48 55 50/9.0 cm Pentn.	SPT-13	24.50-24.74
			DS-15	25.50
		52 50 50/6.0 cm Pentn.	SPT-14	26.00-26.21
			DS-16	27.00
		56 50 50/3.0 cm Pentn.	SPT-15	27.50-27.68
			DS-17	28.50
		53 55 50/5.0 cm Pentn.	SPT-16	29.00-29.20
30.17m.		58 51 50/2.0 cm Pentn.	SPT-17	30.00-30.17

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 07/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.56

Co-ordinates E=517.000 N=(-)66.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	18	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	18
Vane (V)		Disturbed (DS)	17
		Water Sample (WS)	0

Commencement Date : 21/12/14
Completion Date : 23/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.518 m.
Water Struck At :
Standing Water Level : 11.8 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
			DS-1	0.50
		3 4 6 (10)	SPT-1	1.00-1.45
Medium dense, yellowish brown, silty sand / sandy silt.			UDS-1	2.00-2.45
		4 6 8 (14)	SPT-2	3.00-3.45
4.00m			UDS-2	4.00-4.45
		3 7 9 (16)	SPT-3	5.00-5.45
Medium dense, brownish grey, silty sand / sandy silt with traces of clay.			DS-2	6.00
			UDS-3	6.50-6.95
			DS-3	7.50
8.00m		11 14 20 (34)	SPT-4	8.00-8.45
			DS-4	9.00
Hard, brownish grey, clayey silt with sand mixture.			UDS-4	9.50-9.95
			DS-5	10.50
11.00m		13 27 32 (59)	SPT-5	11.00-11.45
			DS-6	12.00
		42 76 (>100) 13.0 cm Pentn.	SPT-6	12.50-12.78
Very dense, brownish grey, silty sand with gravels.			DS-7	13.50
		51 78 (>100) 11.0 cm Pentn.	SPT-7	14.00-14.26
			DS-8	15.00
15.50m				

BH-56/Sheet-1

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | Created by : Chandrani | Created on : 07/01/2015 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.56

Co-ordinates E=517.000 N=(-)66.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	18	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	18
Vane (V)		Disturbed (DS)	17
		Water Sample (WS)	0

Commencement Date : 21/12/14
Completion Date : 23/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 64.518 m.
Water Struck At :
Standing Water Level : 11.8 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
15.50m				
		54 75 ≥100 (10.0 cm Penth.)	SPT-8	15.50-15.75
			DS-9	16.50
		55 56 ≥100 (11.0 cm Penth.)	SPT-9	17.00-17.26
			DS-10	18.00
		52 59 ≥100 (8.0 cm Penth.)	SPT-10	18.50-18.73
			DS-11	19.50
		56 45 ≥100 (10.0 cm Penth.)	SPT-11	20.00-20.25
			DS-12	21.00
		40 64 ≥100 (11.0 cm Penth.)	SPT-12	21.50-21.76
			DS-13	22.50
Very dense, brownish grey, silty sand with gravels.		52 61 ≥100 (7.0 cm Penth.)	SPT-13	23.00-23.22
			DS-14	24.00
		48 53 ≥100 (6.0 cm Penth.)	SPT-14	24.50-24.71
			DS-15	25.50
		51 59 ≥100 (9.0 cm Penth.)	SPT-15	26.00-26.24
			DS-16	27.00
		55 64 ≥100 (7.0 cm Penth.)	SPT-16	27.50-27.72
			DS-17	28.50
		58 65 ≥100 (10.0 cm Penth.)	SPT-17	29.00-29.25
30.23m		60 62 ≥100 (8.0 cm Penth.)	SPT-18	30.00-30.23

BH-56/Sheet-2

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | Created by : Chandrani | Created on : 16/01/2015 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.57

Co-ordinates E=480.000 N=(-)81.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	18	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	18
Vane (V)		Disturbed (DS)	17
		Water Sample (WS)	0

Commencement Date : 24/12/14
Completion Date : 27/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 68.229 m.
Water Struck At :
Standing Water Level : 14.35 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m				
Medium dense, brownish grey, sandy silt.		5 6 7 (13)	DS-1	0.50
			SPT-1	1.00-1.45
1.50m			UDS-1	2.00-2.45
		5 6 8 (14)	SPT-2	3.00-3.45
Medium dense, yellowish brown, silty sand with traces of clay binders.			UDS-2	4.00-4.45
		3 6 13 (19)	SPT-3	5.00-5.45
			DS-2	6.00
			UDS-3	6.50-6.95
7.50m			DS-3	7.50
		4 8 11 (19)	SPT-4	8.00-8.45
			DS-4	9.00
Very stiff to hard, brownish grey, clayey silt.			UDS-4	9.50-9.95
			DS-5	10.50
		35 47 52 (99)	SPT-5	11.00-11.45
12.00m			DS-6	12.00
		38 48 52 (≥100) 8.0 cm Pentn.	SPT-6	12.50-12.88
Very dense, brownish grey, silty sand.			DS-7	13.50
14.00m		53 58 (≥100) 14.0 cm Pentn.	SPT-7	14.00-14.29
Very dense, brownish grey, silty sand with gravels.			DS-8	15.00
15.50m				

BH-57/Sheet-1

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 16/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.57

Co-ordinates E=480.000 N=(-)81.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	18	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	18
		Disturbed (DS)	17
Vane (V)		Water Sample (WS)	0

Commencement Date : 24/12/14
Completion Date : 27/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 68.229 m.
Water Struck At :
Standing Water Level : 14.35 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
15.50m.				
		55 59 ≥100 10.0 cm Pentn.	SPT-8	15.50-15.75
			DS-9	16.50
		54 65 ≥100 13.0 cm Pentn.	SPT-9	17.00-17.28
			DS-10	18.00
		40 52 54 ≥100 3.0 cm Pentn.	SPT-10	18.50-18.83
			DS-11	19.50
		42 59 ≥100 8.0 cm Pentn.	SPT-11	20.00-20.23
			DS-12	21.00
		40 52 58 ≥100 8.0 cm Pentn.	SPT-12	21.50-21.88
			DS-13	22.50
Very dense, brownish grey, silty sand with gravels.		46 58 ≥100 11.0 cm Pentn.	SPT-13	23.00-23.26
			DS-14	24.00
		43 59 ≥100 11.0 cm Pentn.	SPT-14	24.50-24.76
			DS-15	25.50
		45 56 ≥100 8.0 cm Pentn.	SPT-15	26.00-26.23
			DS-16	27.00
		52 50 ≥100 6.0 cm Pentn.	SPT-16	27.50-27.71
			DS-17	28.50
		58 51 ≥100 3.0 cm Pentn.	SPT-17	29.00-29.18
30.20m.		55 50 ≥100 5.0 cm Pentn.	SPT-18	30.00-30.20

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 16/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.58

Co-ordinates E=339.000 N=(-)45.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 24/12/14
Completion Date : 27/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 80.057 m.
Water Struck At :
Standing Water Level : 26.5 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of brownish grey to deep grey, sandy silt with ash & gravels. 1.00m.		14 15 12 (27)	DS-1	0.50
			SPT-1	1.00-1.45
			UDS-1	2.00-2.45
Medium dense, yellowish brown, silty sand with traces of mica & clay binders.		11 9 14 (23)	SPT-2	3.00-3.45
			UDS-2	4.00-4.45
5.50m.		8 7 7 (14)	SPT-3	5.00-5.45
			DS-2	6.00
			UDS-3	6.50-6.95
Very dense, yellowish brown, silty sand with traces of mica & clay binders.			DS-3	7.50
		18 24 30 (54)	SPT-4	8.00-8.45
9.00m.			DS-4	9.00
		30 43 52 (>100) 4.0 cm Pentn.	SPT-5	9.50-9.84
			DS-5	10.50
		34 60 (>100) 12.0 cm Pentn.	SPT-6	11.00-11.27
			DS-6	12.00
Hard, yellowish brown, clayey silt. Obs. mica.		45 54 (>100) 9.0 cm Pentn.	SPT-7	12.50-12.74
			DS-7	13.50
		48 63 (>100) 11.0 cm Pentn.	SPT-8	14.00-14.26
			DS-8	15.00
		54 52 (>100) 7.0 cm Pentn.	SPT-9	15.50-15.72
			DS-9	16.50
		47 54 (>100) 10.0 cm Pentn.	SPT-10	17.00-17.25
18.00m.			DS-10	18.00
Very dense, brownish grey, clayey sandy silt.		36 58 (>100) 9.0 cm Pentn.	SPT-11	18.50-18.74
			DS-11	19.50
20.20m.		48 52 (>100) 5.0 cm Pentn.	SPT-12	20.00-20.20
Very dense, brownish grey, silty sand. 20.75m.				

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 16/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.58

Co-ordinates E=339.000 N=(-)45.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	25
		Disturbed (DS)	24
Vane (V)		Water Sample (WS)	0

Commencement Date : 24/12/14
Completion Date : 27/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 80.057 m.
Water Struck At :
Standing Water Level : 26.5 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
20.75m				
		≥100	DS-12	21.00
		44 54 7.0 cm Pentn.	SPT-13	21.50-21.72
		≥100	DS-13	22.50
		47 61 10.0 cm Pentn.	SPT-14	23.00-23.25
		≥100	DS-14	24.00
		26 53 50 4.0 cm Pentn.	SPT-15	24.50-24.84
Very dense, brownish grey, silty sand.		≥100	DS-15	25.50
		37 60 13.0 cm Pentn.	SPT-16	26.00-26.28
		≥100	DS-16	27.00
		48 53 8.0 cm Pentn.	SPT-17	27.50-27.73
		≥100	DS-17	28.50
		57 52 6.0 cm Pentn.	SPT-18	29.00-29.21
30.00m				
		≥100	DS-18	30.00
		52 54 8.0 cm Pentn.	SPT-19	30.50-30.73
		≥100	DS-19	31.50
		61 50 5.0 cm Pentn.	SPT-20	32.00-32.20
Hard, brownish grey, clayey silt with traces of sand mixture. Obs. mica & concreation of silt.		≥100	DS-20	33.00
		62 50 6.0 cm Pentn.	SPT-21	33.50-33.71
		≥100	DS-21	34.50
		54 50 7.0 cm Pentn.	SPT-22	35.00-35.22
36.00m				
		≥100	DS-22	36.00
Hard, brownish grey, clayey silt with sand mixture & concreation of silt.		58 52 9.0 cm Pentn.	SPT-23	36.50-36.74
		≥100	DS-23	37.50
38.00m		49 54 8.0 cm Pentn.	SPT-24	38.00-38.23
Very dense, brownish grey, silty sand. Obs. gravels.			DS-24	39.00
		≥100		
40.21m		53 60 6.0 cm Pentn.	SPT-25	40.00-40.21

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 16/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.59

Co-ordinates E=187.000 N=-(-)134.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 28/12/14
Completion Date : 30/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 81.313 m.
Water Struck At :
Standing Water Level : 28.1 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of deep reddish grey, ash, gravels & coal dust.		30 40 59 — 99	DS-1	0.50
			SPT-1	1.00-1.45
1.50m.			UDS-1	2.00-2.45
Very dense, brownish grey, silty sand with traces of clay binder.		20 20 34 — 54	SPT-2	3.00-3.45
			UDS-2	4.00-4.45
5.00m.		12 14 14 — 28	SPT-3	5.00-5.45
			DS-2	6.00
			UDS-3	6.50-6.95
			DS-3	7.50
		6 20 52 — 72	SPT-4	8.00-8.45
Dense to very dense, yellowish brown, silty sand with traces of kankars.			DS-4	9.00
			UDS-4	9.50-9.95
			DS-5	10.50
		9 51 60 (9.0 cm) — >100 Pentn.	SPT-5	11.00-11.39
			DS-6	12.00
		12 55 62 (3.0 cm) — >100 Pentn.	SPT-6	12.50-12.83
			DS-7	13.50
14.00m.		21 38 64 (5.0 cm) — >100 Pentn.	SPT-7	14.00-14.35
			DS-8	15.00
		23 31 55 (8.0 cm) — >100 Pentn.	SPT-8	15.50-15.88
Hard, brownish grey, clayey silt with traces of sand. Obs. concreation of silt.			DS-9	16.50
		38 49 56 — >100	SPT-9	17.00-17.45
			DS-10	18.00
		40 48 60 (8.0 cm) — >100 Pentn.	SPT-10	18.50-18.88
			DS-11	19.50
20.00m.		42 58 (5.0 cm) — >100 Pentn.	SPT-11	20.00-20.20
Very dense, greyish brown, clayey sandy silt. Obs. mica. 20.75m.				

BH-59/Sheet-1

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 16/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.59

Co-ordinates E=187.000 N=-(-)134.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
		Disturbed (DS)	24
Vane (V)		Water Sample (WS)	0

Commencement Date : 28/12/14
Completion Date : 30/12/14
Bore Hole Diameter : 150 mm.
Level Of Ground : 81.313 m.
Water Struck At :
Standing Water Level : 28.1 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
20.75m				
Very dense, greyish brown, clayey sandy silt. Obs. mica.		45 59 ≥100 8.0 cm Pentn.	DS-12	21.00
			SPT-12	21.50-21.73
			DS-13	22.50
23.00m				
Very dense, brownish grey, silty sand. Obs. mica.		48 61 ≥100 9.0 cm Pentn.	SPT-13	23.00-23.24
			DS-14	24.00
		49 65 ≥100 10.0 cm Pentn.	SPT-14	24.50-24.75
			DS-15	25.00
26.00m				
Very dense, yellowish brown, silty sand with traces of clay. Obs. concreation of silt & mica.		48 53 ≥100 11.0 cm Pentn.	SPT-15	26.00-26.26
			DS-16	27.00
		48 58 ≥100 8.0 cm Pentn.	SPT-16	27.50-27.73
			DS-17	28.50
		45 56 ≥100 7.0 cm Pentn.	SPT-17	29.00-29.22
			DS-18	30.00
		46 58 ≥100 8.0 cm Pentn.	SPT-18	30.50-30.73
			DS-19	31.50
		49 62 ≥100 10.0 cm Pentn.	SPT-19	32.00-32.25
			DS-20	33.00
		48 63 ≥100 11.0 cm Pentn.	SPT-20	33.50-33.76
			DS-21	34.50
		53 51 ≥100 7.0 cm Pentn.	SPT-21	35.00-35.22
36.00m				
Very dense, brownish grey, sandy silt / silty fine sand. Obs. concreation of silt & mica.		56 58 ≥100 9.0 cm Pentn.	DS-22	36.00
			SPT-22	36.50-36.74
			DS-23	37.50
		41 60 ≥100 6.0 cm Pentn.	SPT-23	38.00-38.21
			DS-24	39.00
		51 56 ≥100 4.0 cm Pentn.	SPT-24	39.50-39.69
40.17m		56 50 ≥100 2.0 cm Pentn.	SPT-25	40.00-40.17

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 16/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.60

Co-ordinates E=(-)740.000 N=(-)72.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	26	Undisturbed (UDS)	2
Cone (Pc)		Penetrometer (SPT)	26
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 06/01/15
Completion Date : 09/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 78.01 m.
Water Struck At :
Standing Water Level : 21.85 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of brownish grey / blackish grey, sandy silt with coal dust & gravels.		4 7 9 — 16	DS-1	0.50
			SPT-1	1.00-1.45
2.00m.			UDS-1	2.00-2.45
		14 22 32 — 54	SPT-2	3.00-3.45
Very dense, yellowish brown, silty sand.		13 24 37 — 61	SPT-3	4.00-4.45
		16 32 43 — 75	SPT-4	5.00-5.45
			DS-2	6.00
		12 27 33 — 60	SPT-5	6.50-6.95
7.50m.			DS-3	7.50
		14 15 13 — 28	SPT-6	8.00-8.45
Very stiff, brownish grey, clayey sandy silt with sand mixture. Obs. mica & concreation of silt.			DS-4	9.00
			UDS-2	9.50-9.95
			DS-5	10.50
11.00m.		21 39 45 — 84	SPT-7	11.00-11.45
			DS-6	12.00
Very dense, brownish grey, sandy silt.		18 37 42 — 79	SPT-8	12.50-12.95
			DS-7	13.50
14.00m.		15 28 39 — 67	SPT-9	14.00-14.45
			DS-8	15.00
Very dense, brownish grey, clayey sandy silt. A clay pocket was observed around SPT-10.		13 21 34 — 55	SPT-10	15.50-15.95
			DS-9	16.50
17.00m.		32 44 54 — >100	SPT-11	17.00-17.37
		7.0 cm Pentn.		
			DS-10	18.00
Very dense, brownish grey, silty sand / sandy silt.		21 40 52 — >100	SPT-12	18.50-18.89
		9.0 cm Pentn.		
			DS-11	19.50
		30 43 54 — >100	SPT-13	20.00-20.37
20.75m.		7.0 cm Pentn.		

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 16/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.60

Co-ordinates E=(-)740.000 N=(-)72.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	26	Undisturbed (UDS)	2
Cone (Pc)		Penetrometer (SPT)	26
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 06/01/15
Completion Date : 09/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 78.01 m.
Water Struck At :
Standing Water Level : 21.85 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
20.75m			DS-12	21.00
Very dense, brownish grey, silty sand / sandy silt.		18 32 43 — 75	SPT-14	21.50-21.95
			DS-13	22.50
		19 30 34 — 64	SPT-15	23.00-23.45
			DS-14	24.00
24.50m		14 20 24 — 44	SPT-16	24.50-24.95
Hard, brownish grey, silty clay / clayey silt. Obs. concreation of silt.			DS-15	25.50
		17 23 29 — 52	SPT-17	26.00-26.45
			DS-16	27.00
27.50m		13 17 20 — 37	SPT-18	27.50-27.95
Dense, brownish grey, silty sand. Obs. gravels.			DS-17	28.50
29.00m		14 19 25 — 44	SPT-19	29.00-29.45
			DS-18	30.00
Hard, brownish grey, silty clay / clayey silt with concreation of silt. Obs. sand mixture.		20 27 31 — 58	SPT-20	30.50-30.95
			DS-19	31.50
		18 24 29 — 53	SPT-21	32.00-32.45
33.00m			DS-20	33.00
Very dense, brownish grey, clayey sandy silt. Obs. concreation of silt.		17 27 40 — 67	SPT-22	33.50-33.95
			DS-21	34.50
		28 30 48 — 78	SPT-23	35.00-35.45
36.00m			DS-22	36.00
		24 48 54 / 9.0 cm — ≥100 Pentn.	SPT-24	36.50-36.89
			DS-23	37.50
Very dense, brownish grey, sandy silt with traces of clay mixture. Obs. concreation of silt.		29 44 52 / 7.0 cm — ≥100 Pentn.	SPT-25	38.00-38.37
			DS-24	39.00
40.35m		34 53 50 / 5.0 cm — ≥100 Pentn.	SPT-26	40.00-40.35

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 16/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.61

Co-ordinates E=377.000 N=65.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 31/12/14
Completion Date : 01/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 80.441 m.
Water Struck At :
Standing Water Level : 24.7 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Filled up soil consists of light grey to deep grey, sandy silt. Obs. ash & gravels (coal dust).		3 5 7 — 12	DS-1	0.50
			SPT-1	1.00-1.45
			UDS-1	2.00-2.45
		5 8 9 — 17	SPT-2	3.00-3.45
4.00m.			UDS-2	4.00-4.45
Very stiff, brownish grey, clayey silt with traces of sand mixture.		6 7 9 — 16	SPT-3	5.00-5.45
			DS-2	6.00
6.50m.			*UDS-3	6.50-6.90
Dense to very dense, brownish grey, silty sand with traces of clay.		10 13 22 — 35	SPT-4	7.00-7.45
			DS-3	7.80
		12 19 35 — 54	SPT-5	8.00-8.45
			DS-4	9.00
			UDS-4	9.50-9.95
			DS-5	10.50
		29 41 42 — 83	SPT-6	11.00-11.45
			DS-6	12.00
			UDS-5	12.50-12.80
			DS-7	13.50
14.00m.		30 43 52 — >100	SPT-7	14.00-14.37
Hard, brownish grey, clayey silt with traces of sand mixture.		7.0 cm Pentn.	DS-8	15.00
		34 60 — >100	SPT-8	15.50-15.74
		9.0 cm Pentn.	DS-9	16.50
		28 47 52 — >100	SPT-9	17.00-17.38
		8.0 cm Pentn.	DS-10	18.00
18.50m.		41 55 — >100	SPT-10	18.50-18.75
Hard, brownish grey, clayey sandy silt.		10.0 cm Pentn.	DS-11	19.50
		45 52 — >100	SPT-11	20.00-20.23
20.75m.		8.0 cm Pentn.		

BH-61/Sheet-1

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | Created by : Chandrani | Created on : 16/01/2015 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.61

Co-ordinates E=377.000 N=65.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 31/12/14
Completion Date : 01/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 80.441 m.
Water Struck At :
Standing Water Level : 24.7 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
20.75m.			DS-12	21.00
		≥100	SPT-12	21.50-21.74
		40 56 9.0 cm Pentn.	DS-13	22.50
		90	SPT-13	23.00-23.45
		27 37 53	DS-14	24.00
		≥100	SPT-14	24.50-24.89
		33 41 52 9.0 cm Pentn.	DS-15	25.50
Hard, brownish grey, clayey sandy silt.		≥100	SPT-15	26.00-26.37
		40 45 55 7.0 cm Pentn.	DS-16	27.00
		≥100	SPT-16	27.50-27.85
		43 56 60 5.0 cm Pentn.	DS-17	28.50
		≥100	SPT-17	29.00-29.25
		49 69 10.0 cm Pentn.	DS-18	30.00
		≥100	SPT-18	30.50-30.88
		40 52 65 8.0 cm Pentn.	DS-19	31.50
32.00m.		≥100	SPT-19	32.00-32.37
		43 55 65 7.0 cm Pentn.	DS-20	33.00
		≥100	SPT-20	33.50-33.88
		44 58 65 8.0 cm Pentn.	DS-21	34.50
		≥100	SPT-21	35.00-35.23
		49 65 15 8.0 cm Pentn.	DS-22	36.00
Very dense, brownish grey, silty sand. Obs. gravels.		≥100	SPT-22	36.50-36.78
		53 62 13.0 cm Pentn.	DS-23	37.50
		≥100	SPT-23	38.00-38.25
		56 51 10.0 cm Pentn.	DS-24	39.00
		≥100	SPT-24	39.50-39.71
		51 60 6.0 cm Pentn.	SPT-25	40.00-40.18
40.18m.		≥100 54 51 3.0 cm Pentn.		

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 16/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.62

Co-ordinates E=470.000 N=120.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	23	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	23
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 03/01/15
Completion Date : 05/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 78.12 m.
Water Struck At :
Standing Water Level : 23.25 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				Ref. No	Depth (m)
0.00m							
Filled up soil consists of light grey, silty sand with stone chips, gravels & roots.						DS-1	0.50
1.00m		2	2	3	5	SPT-1	1.00-1.45
Loose, yellowish brown, silty sand with traces of kankars.						UDS-1	2.00-2.45
		4	4	3	7	SPT-2	3.00-3.45
4.00m						UDS-2	4.00-4.45
Medium dense, brownish grey, sandy silt.		5	5	7	12	SPT-3	5.00-5.45
						DS-2	6.00
						UDS-3	6.50-6.95
						DS-3	7.50
8.00m		5	9	11	20	SPT-4	8.00-8.45
						DS-4	9.00
						UDS-4	9.50-9.95
Medium dense, greyish brown, silty sand with traces of clay binders.						DS-5	10.50
		7	9	13	22	SPT-5	11.00-11.45
						DS-6	12.00
						UDS-5	12.50-12.95
13.50m						DS-7	13.50
		24	22	29	51	SPT-6	14.00-14.45
						DS-8	15.00
		25	26	32	58	SPT-7	15.50-15.95
Very dense, brownish grey, sandy silt with traces of clay. Obs. concreation of silt.						DS-9	16.50
		18	29	35	64	SPT-8	17.00-17.45
						DS-10	18.00
		17	22	43	65	SPT-9	18.50-18.95
						DS-11	19.50
		21	26	47	73	SPT-10	20.00-20.45
20.75m							

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | Created by : Chandrani | Created on : 16/01/2015 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.62

Co-ordinates E=470.000 N=120.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	23	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	23
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 03/01/15
Completion Date : 05/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 78.12 m.
Water Struck At :
Standing Water Level : 23.25 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
20.75m. Very dense, brownish grey, sandy silt with traces of clay. Obs. concreation of silt.		24 31 44 (75)	DS-12	21.00
			SPT-11	21.50-21.95
22.50m. Very dense, greyish brown, silty sand with mica.		37 41 60 (≥100) 8.0 cm Pentn.	DS-13	22.50
			SPT-12	23.00-23.38
		43 52 50 (≥100) 3.0 cm Pentn.	DS-14	24.00
			SPT-13	24.50-24.83
26.00m. Hard, brownish grey, clayey silt with traces of sand. Obs. concreation of silt.		14 25 38 (63)	DS-15	25.50
			SPT-14	26.00-26.45
		16 28 43 (71)	DS-16	27.00
			SPT-15	27.50-27.95
28.50m. Very dense, brownish grey, silty sand with gravels.		21 37 63 (≥100) 5.0 cm Pentn.	DS-17	28.50
			SPT-16	29.00-29.35
		28 43 60 (≥100) 7.0 cm Pentn.	DS-18	30.00
			SPT-17	30.50-30.87
		37 65 15 (≥100) 13.0 cm Pentn.	DS-19	31.50
			SPT-18	32.00-32.28
		43 58 (≥100) 11.0 cm Pentn.	DS-20	33.00
			SPT-19	33.50-33.76
		48 53 (≥100) 7.0 cm Pentn.	DS-21	34.50
			SPT-20	35.00-35.22
		52 59 (≥100) 10.0 cm Pentn.	DS-22	36.00
			SPT-21	36.50-36.75
		54 50 (≥100) 8.0 cm Pentn.	DS-23	37.50
			SPT-22	38.00-38.23
40.19m.		56 52 (≥100) 4.0 cm Pentn.	DS-24	39.00
			SPT-23	40.00-40.19

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 16/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.63

Co-ordinates E=650.000 N=(-)50.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	24
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 02/01/15
Completion Date : 05/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 62.387 m.
Water Struck At :
Standing Water Level : 13.6 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)				SAMPLES	
						Ref. No	Depth (m)
0.00m							
Filled up soil consists of light grey, silty sand with ash.					4	DS-1	0.50
		1	2	2		SPT-1	1.00-1.45
1.50m							
Loose, greyish brown, silty sand with traces of clay binders & mica.					7	UDS-1	2.00-2.45
		3	3	4		SPT-2	3.00-3.45
						UDS-2	4.00-4.45
4.50m							
Stiff, deep grey, silty clay / clayey silt. Obs. concreation of sand & mica.					13	SPT-3	5.00-5.45
		3	5	8		DS-2	6.00
						UDS-3	6.50-6.95
7.00m							
Dense to very dense, greyish brown, sandy silt / silty sand. Obs. gravels.					40	DS-3	7.50
		8	18	22		SPT-4	8.00-8.45
						DS-4	9.00
						*UDS-4	9.50-9.67
						DS-5	10.50
		12	24	36	60	SPT-5	11.00-11.45
12.00m						DS-6	12.00
Dense to very dense, brownish grey, silty sand with gravels.		12	26	31	57	SPT-6	12.50-12.95
						DS-7	13.50
		9	17	18	35	SPT-7	14.00-14.45
15.00m						DS-8	15.00
Very stiff, brownish grey, silty clay wtih gravels.		9	13	15	28	SPT-8	15.50-15.95
16.50m						DS-9	16.50
Very dense, brownish grey, silty sand with gravels.		17	38	49	87	SPT-9	17.00-17.45
						DS-10	18.00
18.50m					40		
Hard, yellowish brown, clayey silt.		19	17	23		SPT-10	18.50-18.95
						DS-11	19.50
Very dense, brownish grey, silty sand with traces of clay binders. Obs. concreation of silt & kankars. 20.00m					51	*UDS-5	20.00-20.15
20.75m		11	23	28		SPT-11	20.30-20.75

BH-63/Sheet-1

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 16/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.63

Co-ordinates E=650.000 N=(-)50.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	24	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	24
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 02/01/15
Completion Date : 05/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 62.387 m.
Water Struck At :
Standing Water Level : 13.6 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
			DS-12	21.00
		82		
		14 34 48	SPT-12	21.50-21.95
			DS-13	22.50
		93		
		23 39 54	SPT-13	23.00-23.45
			DS-14	24.00
		>100		
		37 48 52	SPT-14	24.50-24.87
		7.0 cm Pentn.		
		>100	DS-15	25.50
		34 46 54	SPT-15	26.00-26.39
		9.0 cm Pentn.		
		>100	DS-16	27.00
		38 49 56	SPT-16	27.50-27.84
		4.0 cm Pentn.		
		>100	DS-17	28.50
		43 58	SPT-17	29.00-29.27
		12.0 cm Pentn.		
		>100	DS-18	30.00
		48 53 50	SPT-18	30.50-30.82
		2.0 cm Pentn.		
		>100	DS-19	31.50
		51 54	SPT-19	32.00-32.26
		11.0 cm Pentn.		
		>100	DS-20	33.00
		59 50	SPT-20	33.50-33.75
		10.0 cm Pentn.		
		>100	DS-21	34.50
		57 52	SPT-21	35.00-35.23
		8.0 cm Pentn.		
		>100	DS-22	36.00
		55 51	SPT-22	36.50-36.74
		9.0 cm Pentn.		
		>100	DS-23	37.50
		58 53	SPT-23	38.00-38.23
		8.0 cm Pentn.		
			DS-24	39.00
		>100		
		57 50	SPT-24	40.00-40.21
		6.0 cm Pentn.		

20.75m

Very dense, brownish grey, silty sand with traces of clay binders. Obs. concreation of silt & kankars.

25.50m

Very dense, brownish grey, silty sand with gravels & pebbles.

40.21m

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 16/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.64

Co-ordinates E=610.000 N=35.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	22	Undisturbed (UDS)	7
Cone (Pc)		Penetrometer (SPT)	22
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 02/01/15
Completion Date : 05/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.246 m.
Water Struck At :
Standing Water Level : 13.85 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Filled up soil consists of deep grey. Obs. ash & gravels. 1.00m.						DS-1	0.50
		6	7	7	14	SPT-1	1.00-1.45
Brownish grey to blackish grey, sandy silt with coal dust & gravels. 3.00m.						UDS-1	2.00-2.45
		3	3	5	8	SPT-2	3.00-3.45
Loose to medium dense, brownish grey, silty sand / sandy silt. 6.00m.						UDS-2	4.00-4.45
		6	7	9	16	SPT-3	5.00-5.45
						DS-2	6.00
Very stiff, brownish grey, silty clay. 8.00m.						UDS-3	6.50-6.95
						DS-3	7.50
		6	11	17	28	SPT-4	8.00-8.45
Very stiff, bronwish grey, clayey silt. Obs. concreation of silt. 9.50m.						DS-4	9.00
						UDS-4	9.50-9.95
Dense, brownish grey, silty sand. 12.00m.						DS-5	10.50
		10	18	21	39	SPT-5	11.00-11.45
						DS-6	12.00
						UDS-5	12.50-12.95
Hard, brownish grey, clayey silt with traces of sand mixture. Obs. concreation of silt. 15.50m.						DS-7	13.50
		9	16	27	43	SPT-6	14.00-14.45
						DS-8	15.00
						UDS-6	15.50-15.95
						DS-9	16.50
		7	14	21	35	SPT-7	17.00-17.45
Very stiff to hard, yellowish brown, clayey silt with traces of sand mixture. Obs. mica.						DS-10	18.00
						*UDS-7	18.50-18.65
		7	13	17	30	SPT-8	18.80-19.25
20.00m.						DS-11	20.00
Hard, brownish grey, clayey silt / silty clay. Obs. kankars. 20.75m.		8	17	21	38	SPT-9	20.50-20.95

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 16/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.64

Co-ordinates E=610.000 N=35.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	22	Undisturbed (UDS)	7
Cone (Pc)		Penetrometer (SPT)	22
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 02/01/15
Completion Date : 05/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 63.246 m.
Water Struck At :
Standing Water Level : 13.85 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
20.75m. Hard, brownish grey, clayey silt / silty clay. Obs. kankars. 21.50m.		73	DS-12	21.50
		19 30 43	SPT-10	22.00-22.45
			DS-13	23.00
		>100		
		28 42 54	SPT-11	23.50-23.90
		10.0 cm Pentn.		
			DS-14	24.50
		>100		
		34 47 52	SPT-12	25.00-25.37
		7.0 cm Pentn.		
			DS-15	26.00
		>100		
		38 53 54	SPT-13	26.50-26.84
		4.0 cm Pentn.		
			DS-16	27.50
		>100		
		44 60	SPT-14	28.00-28.27
		12.0 cm Pentn.		
			DS-17	29.00
		>100		
		47 54	SPT-15	29.50-29.74
		9.0 cm Pentn.		
			DS-18	30.50
Very dense, brownish grey, silty sand with high % of gravels & pebbles.		>100		
		45 58	SPT-16	31.00-31.23
		8.0 cm Pentn.		
			DS-19	32.00
		>100		
		48 60	SPT-17	32.50-32.75
		10.0 cm Pentn.		
			DS-20	33.50
		>100		
		57 50	SPT-18	34.00-34.21
		6.0 cm Pentn.		
			DS-21	35.00
		>100		
		49 57	SPT-19	35.50-35.74
		9.0 cm Pentn.		
			DS-22	36.50
		>100		
		54 50	SPT-20	37.00-37.20
		5.0 cm Pentn.		
			DS-23	38.00
		>100		
		57 52	SPT-21	38.50-38.72
		7.0 cm Pentn.		
			DS-24	39.50
		>100		
40.19m.		54 50	SPT-22	40.00-40.19
		4.0 cm Pentn.		

N.B. - '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 19/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.T1

Co-ordinates E=(-)204.000 N=455.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 06/01/15
Completion Date : 09/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 78.947 m.
Water Struck At :
Standing Water Level : 22.9 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	SAMPLES Depth (m)
Filled up soil consists of yellowish brown, sandy silt. 0.00m – 0.50m						DS-1	0.50
Loose, greyish brown, sandy silt with traces of clay. 1.90m		2	2	3	5	SPT-1	1.00-1.45
						UDS-1	2.00-2.45
Medium dense, yellowish brown, silty sand with traces of clay binders. Obs. concreation of sand. 4.75m		3	4	7	11	SPT-2	3.00-3.45
						UDS-2	4.00-4.45
		5	11	15	26	SPT-3	5.00-5.45
Medium dense, greyish brown, sandy silt with traces of clay. 7.50m						DS-2	6.00
						UDS-3	6.50-6.95
						DS-3	7.50
		11	17	19	36	SPT-4	8.00-8.45
Brownish grey, clayey silt with sand mixture. 10.00m						DS-4	9.00
						UDS-4	9.50-9.95
						DS-5	10.50
		17	54	60 7.0 cm	>100 Pentn.	SPT-5	11.00-11.37
						DS-6	12.00
Dense to very dense, brownish grey, sandy silt with traces of clay.		22	56	62 7.0 cm	>100 Pentn.	SPT-6	12.50-12.87
						DS-7	13.50
		18	32	44	76	SPT-7	14.00-14.45
						DS-8	15.00
15.50m					64	SPT-8	15.50-15.95
		15	29	35		DS-9	16.50
					70	SPT-9	17.00-17.45
		16	28	42		DS-10	18.00
Very dense, greyish brown, silty sand.					74	SPT-10	18.50-18.95
		14	28	46		DS-11	19.50
					78	SPT-11	20.00-20.45
20.75m		17	30	48			

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 19/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.T1

Co-ordinates E=(-)204.000 N=455.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 06/01/15
Completion Date : 09/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 78.947 m.
Water Struck At :
Standing Water Level : 22.9 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.				SAMPLES Ref. No	SAMPLES Depth (m)
20.75m							
					77	DS-12	21.00
		14	28	49		SPT-12	21.50-21.95
						DS-13	22.50
					22		
Very dense, greyish brown, silty sand.		10	11	11		SPT-13	23.00-23.45
						DS-14	24.00
					68		
		21	28	40		SPT-14	24.50-24.95
25.50m						DS-15	25.50
					84		
		29	35	49		SPT-15	26.00-26.45
						DS-16	27.00
					>100		
Very dense, brownish grey, silty sand. Obs. gravels.		35	45	54		SPT-16	27.50-27.89
				9.0	cm Pentn.		
						DS-17	28.50
					>100		
		38	48	50		SPT-17	29.00-29.37
				7.0	cm Pentn.		
30.00m						DS-18	30.00
					59		
		14	24	35		SPT-18	30.50-30.95
						DS-19	31.50
					75		
		17	35	40		SPT-19	32.00-32.45
						DS-20	33.00
					82		
		22	38	44		SPT-20	33.50-33.95
						DS-21	34.50
Hard, brownish grey, clayey silt with traces of sand. Obs. concreation of silt & mica.					89		
		25	40	49		SPT-21	35.00-35.45
						DS-22	36.00
					97		
		28	42	55		SPT-22	36.50-36.95
						DS-23	37.50
					78		
		24	37	41		SPT-23	38.00-38.45
						DS-24	39.00
					70		
		20	33	37		SPT-24	39.50-39.95
					81		
		22	36	45		SPT-25	40.00-40.45
40.45m							

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 19/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.T2

Co-ordinates E=(-)204.000 N=420.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 07/01/15
Completion Date : 09/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 79.086 m.
Water Struck At :
Standing Water Level : 23.1 m.

DESCRIPTION	SYMBOL	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m. Loose, yellowish grey, sandy silt.			DS-1	0.50
1.00m. Loose, brownish grey, sandy silt with traces of clay.		3 4 4 (8)	SPT-1	1.00-1.45
2.00m.			UDS-1	2.00-2.45
Medium dense, brownish grey, sandy silt / silty sand. Obs. concreation of sand.		3 6 7 (13)	SPT-2	3.00-3.45
			UDS-2	4.00-4.45
5.00m. Medium dense, brownish grey, clayey sandy silt.		9 10 12 (22)	SPT-3	5.00-5.45
			DS-2	6.00
6.50m.			UDS-3	6.50-6.95
Dense, brownish grey, silty sand / sandy silt. Obs. concreation of sand.		13 22 25 (47)	DS-3	7.50
			SPT-4	8.00-8.45
9.00m.			DS-4	9.00
		15 25 28 (53)	*UDS-4	9.50-9.63
			SPT-5	9.63-10.08
			DS-5	11.00
		26 43 47 (90)	SPT-6	11.50-11.95
			DS-6	12.50
		34 46 54 (≥100) 10.0 cm Pentn.	SPT-7	13.00-13.40
Hard, brownish grey, clayey silt. Obs. calcareous nodules.			DS-7	14.00
		41 52 57 (≥100) 8.0 cm Pentn.	SPT-8	14.50-14.88
			DS-8	15.50
		45 54 (≥100) 9.0 cm Pentn.	SPT-9	16.00-16.24
			DS-9	17.00
		48 53 (≥100) 8.0 cm Pentn.	SPT-10	17.50-17.73
			DS-10	18.50
19.00m.		43 54 (≥100) 8.0 cm Pentn.	SPT-11	19.00-19.23
Very dense, brownish grey, silty sand. Obs. gravels.			DS-11	20.00
20.75m.		26 35 60 (≥100) 9.0 cm Pentn.	SPT-12	20.50-20.89

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 19/01/2015	Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.T2

Co-ordinates E=(-)204.000 N=420.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	4
Cone (Pc)		Penetrometer (SPT)	25
		Disturbed (DS)	24
Vane (V)		Water Sample (WS)	0

Commencement Date : 07/01/15
Completion Date : 09/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 79.086 m.
Water Struck At :
Standing Water Level : 23.1 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
20.75m				
			DS-12	21.50
		≥100		
		21 38 62	SPT-13	22.00-22.41
		11.0 cm Pentn.		
			DS-13	23.00
		≥100		
		18 41 53	SPT-14	23.50-23.89
Very dense, brownish grey, silty sand. Obs. gravels.		9.0 cm Pentn.		
			DS-14	24.50
		≥100		
		23 39 60	SPT-15	25.00-25.38
		8.0 cm Pentn.		
			DS-15	26.00
		≥100		
		27 43 55	SPT-16	26.50-26.89
		9.0 cm Pentn.		
			DS-16	27.50
28.00m		80		
		26 38 42	SPT-17	28.00-28.45
			DS-17	29.00
		79		
		22 35 44	SPT-18	29.50-29.95
			DS-18	30.50
		87		
		24 40 47	SPT-19	31.00-31.45
			DS-19	32.00
		83		
		11 30 53	SPT-20	32.50-32.95
			DS-20	33.50
Hard, brownish grey, clayey silt with traces of sand. Obs. concreation of silt, mica.		89		
		16 38 51	SPT-21	34.00-34.45
			DS-21	35.00
		95		
		19 46 49	SPT-22	35.50-35.95
			DS-22	36.50
		87		
		21 42 45	SPT-23	37.00-37.45
			DS-23	38.00
		80		
		18 39 41	SPT-24	38.50-38.95
			DS-24	39.50
		78		
		20 35 43	SPT-25	40.00-40.45
40.45m				

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | Created by : Chandrani | Created on : 19/01/2015 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.T3

Co-ordinates E=(-)204.000 N=385.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	23	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	23
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 07/01/15
Completion Date : 12/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 79.087 m.
Water Struck At :
Standing Water Level : 23.15 m.

DESCRIPTION	N-VALUE (EACH DIVN. = 15cm.)	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m			
Loose, brownish grey, sandy silt.	3 4 4 (8)	DS-1	0.50
		SPT-1	1.00-1.45
		UDS-1	2.00-2.45
3.00m			
Medium dense, brownish grey, clayey sandy silt.	6 7 9 (16)	SPT-2	3.00-3.45
		UDS-2	4.00-4.45
4.50m			
Very stiff, deep brownish grey, clayey silt.	7 9 13 (22)	SPT-3	5.00-5.45
6.00m		DS-2	6.00
		UDS-3	6.50-6.95
Dense, brownish grey, clayey silty sand.	10 12 27 (39)	DS-3	7.50
		SPT-4	8.00-8.45
9.00m		DS-4	9.00
		UDS-4	9.50-9.95
		DS-5	10.50
	14 22 38 (60)	SPT-5	11.00-11.45
		DS-6	12.00
Very dense, brownish grey, clayey silty sand.		*UDS-5	12.50-12.65
		DS-7	13.50
	21 31 46 (77)	SPT-6	14.00-14.45
		DS-8	15.00
15.50m	>100		
	23 52 53 / 7.0 cm Pentn.	SPT-7	15.50-15.87
Very dense, brownish grey, sandy silt / silty sand.		DS-9	16.50
17.00m	>100		
	27 55 50 / 9.0 cm Pentn.	SPT-8	17.00-17.39
Very dense, brownish grey, sandy silt with traces of clay.			
18.00m		DS-10	18.00
	>100		
	33 46 55 / 5.0 cm Pentn.	SPT-9	18.50-18.85
Very dense, brownish grey, silty sand. Obs. gravels.		DS-11	19.50
	>100		
	37 43 54 / 6.0 cm Pentn.	SPT-10	20.00-20.36
20.75m			

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | Created by : Chandrani | Created on : 19/01/2015 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.T3

Co-ordinates E=(-)204.000 N=385.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	23	Undisturbed (UDS)	5
Cone (Pc)		Penetrometer (SPT)	23
		Disturbed (DS)	24
Vane (V)		Water Sample (WS)	0

Commencement Date : 07/01/15
Completion Date : 12/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 79.087 m.
Water Struck At :
Standing Water Level : 23.15 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
			DS-12	21.00
		≥100	SPT-11	21.50-21.83
		28 47 53 3.0 cm Pentn.	DS-13	22.50
		≥100	SPT-12	23.00-23.35
		32 51 54 5.0 cm Pentn.	DS-14	24.00
		≥100	SPT-13	24.50-24.87
Very dense, brownish grey, silty sand. Obs. gravels.		30 48 52 7.0 cm Pentn.	DS-15	25.50
		≥100	SPT-14	26.00-26.35
		33 45 51 5.0 cm Pentn.	DS-16	27.00
		≥100	SPT-15	27.50-27.88
		37 52 55 8.0 cm Pentn.	DS-17	28.50
28.50m.				
		64	SPT-16	29.00-29.45
		13 28 36	DS-18	30.00
Hard, brownish grey, silty clay.		65	SPT-17	30.50-30.95
		11 25 40	DS-19	31.50
32.00m.		99	SPT-18	32.00-32.45
		24 46 53	DS-20	33.00
		≥100	SPT-19	33.50-33.90
		29 43 51 10.0 cm Pentn.	DS-21	34.50
		≥100	SPT-20	35.00-35.37
		33 46 53 7.0 cm Pentn.	DS-22	36.00
Very dense, brownish grey, silty sand. Obs. gravels.		≥100	SPT-21	36.50-36.74
		42 30 30 9.0 cm Pentn.	DS-23	37.50
		≥100	SPT-22	38.00-38.22
		45 50 7.0 cm Pentn.	DS-24	39.00
		≥100	SPT-23	40.00-40.24
40.24m.		51 50 9.0 cm Pentn.		

N.B. – '*' means sample could not be recovered.

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | **Created by : Chandrani** | **Created on : 19/01/2015** | **Sheet No:**

BORE LOG DATA SHEET

BORE HOLE NO.T4

Co-ordinates E=(-)204.000 N=355.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 11/01/15
Completion Date : 18/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 79.06 m.
Water Struck At :
Standing Water Level : 23.05 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
0.00m.				
Medium dense, yellowish brown, silty sand with calcareous nodules.		6 8 1 (19)	DS-1	0.50
			SPT-1	1.00-1.45
			UDS-1	2.00-2.45
		7 10 12 (22)	SPT-2	3.00-3.45
3.75m.			UDS-2	4.00-4.45
Hard, deep brownish grey, clayey silt with sand mixture.		13 17 19 (36)	SPT-3	5.00-5.45
			DS-2	6.00
			UDS-3	6.50-6.95
7.50m.			DS-3	7.50
Very dense, brownish grey, sandy silt.		20 35 42 (77)	SPT-4	8.00-8.45
9.00m.			DS-4	9.00
		25 38 45 (83)	SPT-5	9.50-9.95
			DS-5	10.50
		28 39 47 (86)	SPT-6	11.00-11.45
			DS-6	12.00
		35 40 49 (89)	SPT-7	12.50-12.95
			DS-7	13.50
Very dense, greyish brown, silty sand with gravels. Observed clay pocket around SPT-07.		38 42 55 (97)	SPT-8	14.00-14.45
			DS-8	15.00
		32 41 52 (93)	SPT-9	15.50-15.95
			DS-9	16.50
		39 43 57 (100)	SPT-10	17.00-17.45
			DS-10	18.00
		34 45 50 (>100) 7.0 cm Pentn.	SPT-11	18.50-18.87
			DS-11	19.50
		34 48 50 (>100) 6.0 cm Pentn.	SPT-12	20.00-20.36
20.75m.				

BH-4/Sheet-1

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat. CETEST

Job No : 3369 | Created by : Chandrani | Created on : 19/01/2015 | Sheet No:

BORE LOG DATA SHEET

BORE HOLE NO.T4

Co-ordinates E=(-)204.000 N=355.000

Field Test	Nos	Samples	Nos
Penetrometer (SPT)	25	Undisturbed (UDS)	3
Cone (Pc)		Penetrometer (SPT)	25
Vane (V)		Disturbed (DS)	24
		Water Sample (WS)	0

Commencement Date : 11/01/15
Completion Date : 18/01/15
Bore Hole Diameter : 150 mm.
Level Of Ground : 79.06 m.
Water Struck At :
Standing Water Level : 23.05 m.

DESCRIPTION	SYMBOL	N-VALUE EACH DIVN. = 15cm.	SAMPLES Ref. No	SAMPLES Depth (m)
20.75m.			DS-12	21.00
		≥100		
		40 45 50 9.0 cm Pentn.	SPT-13	21.50-21.89
			DS-13	22.50
		≥100		
Very dense, greyish brown, silty sand with gravels. Observed clay pocket around SPT-07.		42 47 50 10.0 cm Pentn.	SPT-14	23.00-23.40
			DS-14	24.00
		≥100		
		45 50 2 10.0 cm Pentn.	SPT-15	24.50-24.75
			DS-15	25.50
		≥100		
		58 56 7.0 cm Pentn.	SPT-16	26.00-26.22
26.50m.			DS-16	26.50
		71		
		23 31 40	SPT-17	27.50-27.95
			DS-17	28.00
		90		
		33 42 48	SPT-18	29.00-29.45
			DS-18	29.50
		86		
		30 37 49	SPT-19	30.50-30.95
			DS-19	31.00
		82		
		26 39 43	SPT-20	32.00-32.45
			DS-20	32.50
Hard, brownish grey, silty clay / clayey silt. Obs. concreation of sand & silt		88		
		29 41 47	SPT-21	33.50-33.95
			DS-21	34.00
		86		
		34 40 46	SPT-22	35.00-35.45
			DS-22	35.50
		85		
		30 37 48	SPT-23	36.50-36.95
			DS-23	37.00
		95		
		38 43 52	SPT-24	38.00-38.45
			DS-24	39.00
		≥100		
40.45m.		41 47 56	SPT-25	40.00-40.45

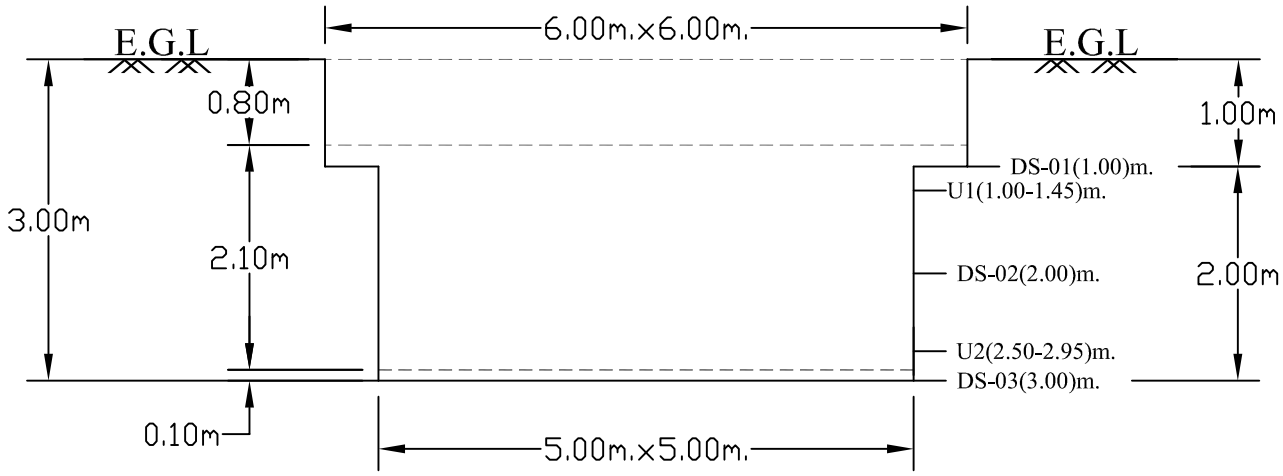
BH-4/Sheet-2

Project :	Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 22 / 12 / 2014	Sheet No:	

Commenced on: 23/12/2014
Completed on: 24/12/2014
Pit size: 5.00mX5.00mX3.00m(depth)
Load on pr.guage/divn.=10kg/sq.cm
Load on jack/divn. = 0.7091t
Plate size: 0.60mX0.60m
Load on plate/divn.= 1.97t/sq.m
Test Type: Routine PLT

Co-ordinates:
E = 650.000M.
N = 334.000M.
RL = 64.911M.

SWL = Not found



Description of Soil:-

(EGL-0.20)m:- Brownish grey, silty sand.

(0.20-2.90)m:- Brownish grey, sandy silt.

(2.90-3.00)m:- Light blackish grey, clayey silt.

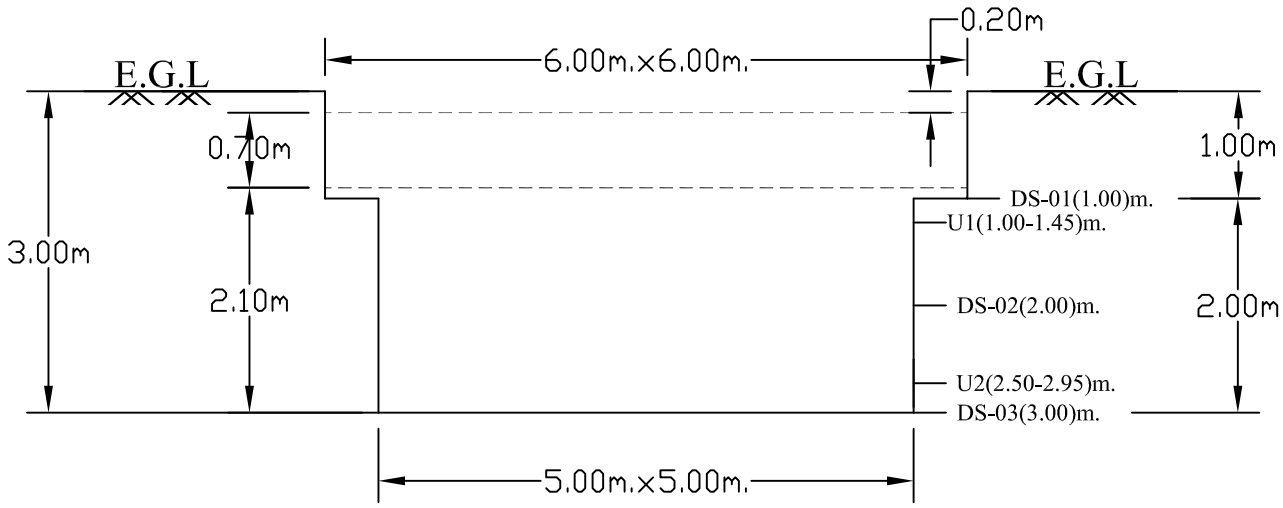
PIT LOG OF PLT - 01

Project :	Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 22 / 12 / 2014	Sheet No:	

Commenced on: 15/12/2014
Completed on: 16/12/2014
Pit size: 5.00mX5.00mX3.00m(depth)
Load on pr.guage/divn.=10kg/sq.cm
Load on jack/divn. = 0.7091t
Plate size: 060mX0.60m
Load on plate/divn.= 1.97t/sq.m
Test Type: Routine PLT

Co-ordinates:
E = 614.000M.
N = 222.000M.
RL = 65.903M.

SWL = Not found



Description of Soil:-

(EGL-0.20)m:- Brownish grey, sandy silt / silty sand.

(0.20-0.90)m:- Blackish grey, clayey silt / silty clay.

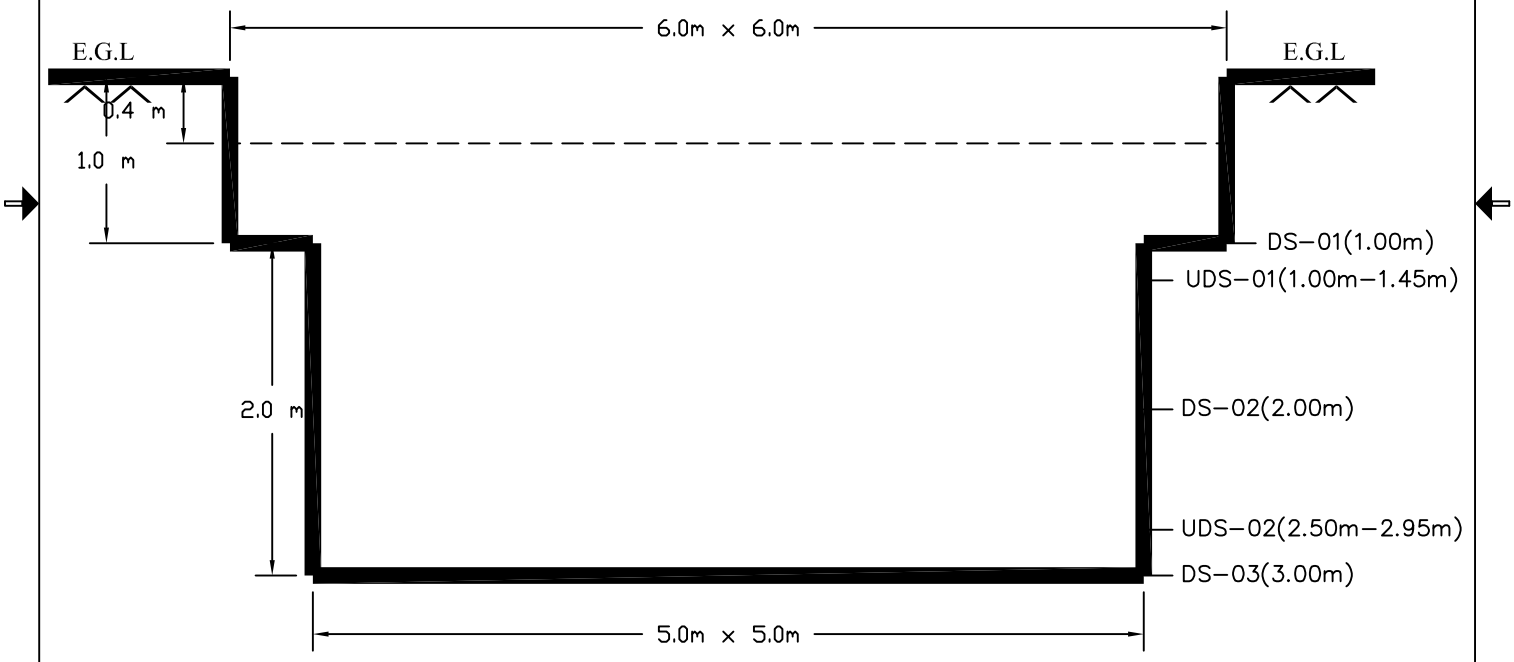
(0.90-3.00)m:- Yellowish grey / brownish grey, silty sand / sandy silt with concreation of sand.

PIT LOG OF PLT - 02

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3 3 6 9	Created by : S K D	Created on : 15/12/2014	Sheet No:

Commenced on: 27/11/2014
Completed on: 28/11/2014
Pit size: 5.00mX5.00mX3.00m(depth)
Load on pr.guage/divn.=10kg/sq.cm
Load on jack/divn. =0.7091te
Plate size: 0.60mX0.60m
Load on plate/divn.=1.97te/sq.m
Test Type: Routine PLT

Co-ordinates:
E = 569
N = 155
RL = 66.345M



EGL-0.40m:-	Filled up with ash.
0.40m-3.00m:-	Yellowish grey, silty sand / sandy silt with silty clay patches.

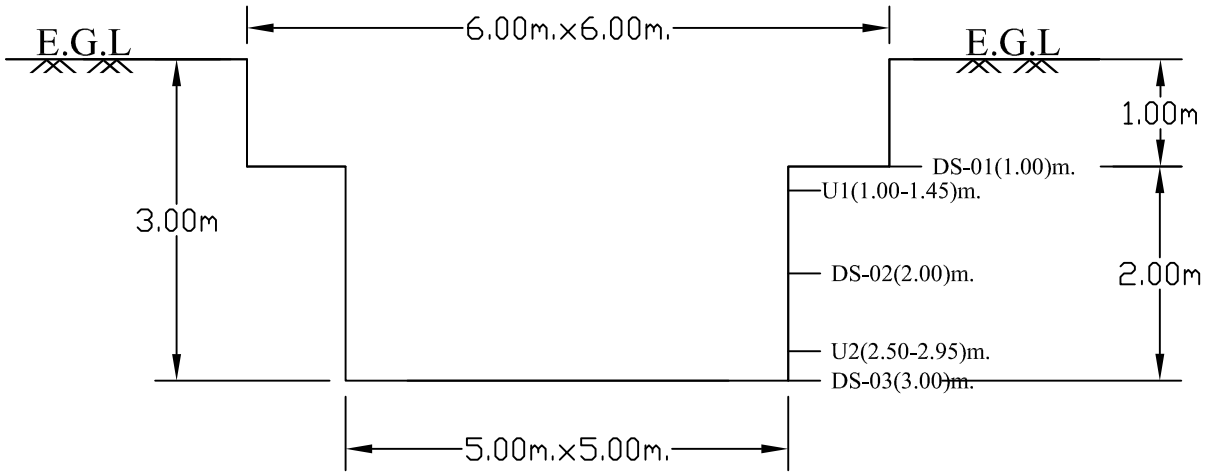
PIT LOG OF PLT-03

Project :	Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 14 / 01 / 2015	Sheet No:	

Commenced on: 29/12/2014
Completed on: 29/12/2014
Pit size: 5.00mX5.00mX3.00m(depth)
Load on pr.guage/divn.=10kg/sq.cm
Load on jack/divn. = 0.7091t
Plate size: 0.60mX0.60m
Load on plate/divn.= 1.97t/sq.m
Test Type: Routine PLT

Co-ordinates:
E = 500.000M.
N = (-)200.000M.
RL = 67.919M.

SWL = Not found



Description of Soil:-

(EGL - 3.00)m :- Light grey, ash.

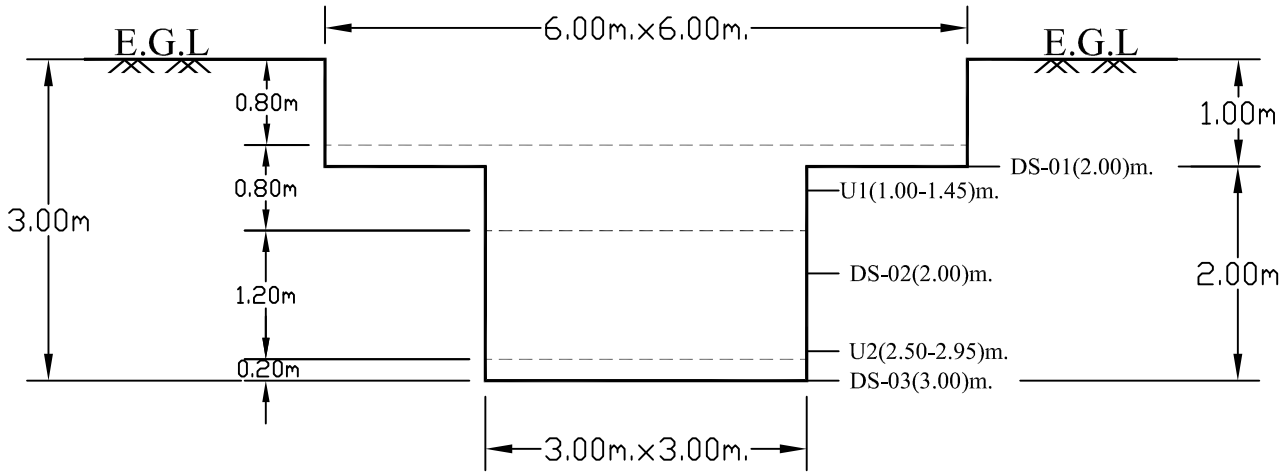
PIT LOG OF PLT - 04

Project :	Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 15 / 12 / 2014	Sheet No:	

Commenced on: 11/11/2014
Completed on: 12/11/2014
Pit size: 3.00mX3.00mX3.00m(depth)
Load on pr.guage/divn.=10kg/sq.cm
Load on jack/divn. = 0.7091t
Plate size: 060mX0.60m
Load on plate/divn.= 1.97t/sq.m
Test Type: Routine PLT

Co-ordinates:
E = 725.000M.
N = 6.000M.
RL = 63.629M.

SWL = Not found



Description of Soil:-

(EGL-0.80)m:- Top soil consists of light grey / brownish grey, ash, silty sand with stone pieces.

(0.80-1.60)m:- Yellowish grey, silty sand / sandy silt.

(1.60-2.80)m:- Blackish grey, silty clay.

(2.80-3.00)m:- Brownish grey, silty clay / clayey silt with traces of sand mixture.

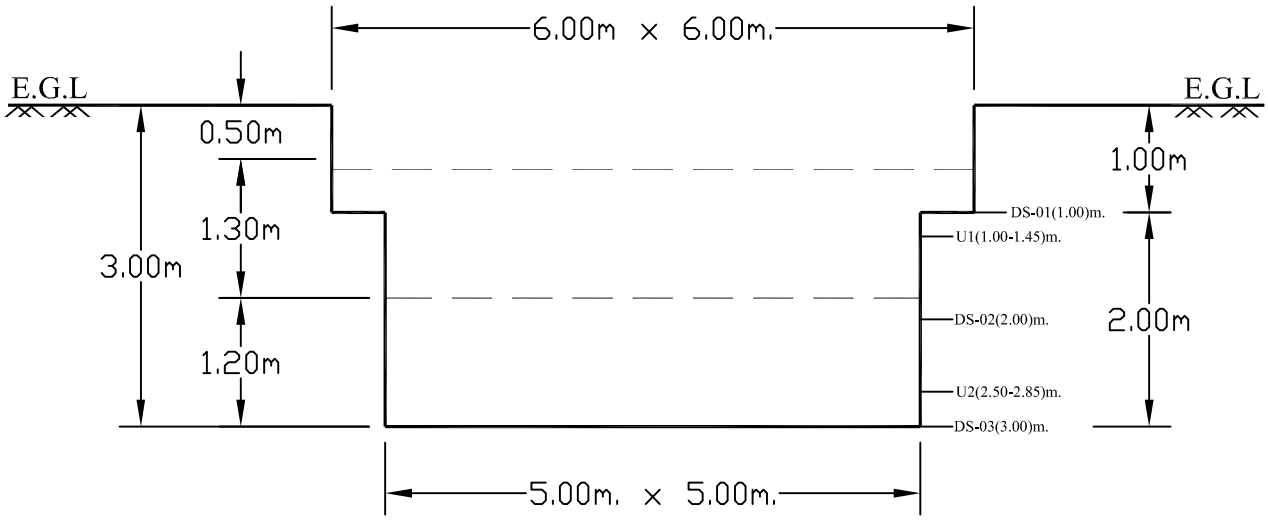
PIT LOG OF PLT - 05

Project :	Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 15 / 12 / 2014	Sheet No:	

Commenced on: 21/11/2014
Completed on: 21/11/2014
Pit size: 5.00mX5.00mX3.00m(depth)
Load on pr.guage/divn.=10kg/sq.cm
Load on jack/divn. = 0.709t
Plate size: 060mX0.60m
Load on plate/divn.= 1.97t/sq.m
Test Type: Routine PLT

Co-ordinates:
E = 615.000M.
N = (-)124.000M.
RL = 65.104M.

SWL = Not found



Description of Soil:-

(EGL-0.60)m:- Top soil consists of ash & stone pieces.

(0.60-1.80)m:- Yellowish grey, clayey silt with fine sand mixture.

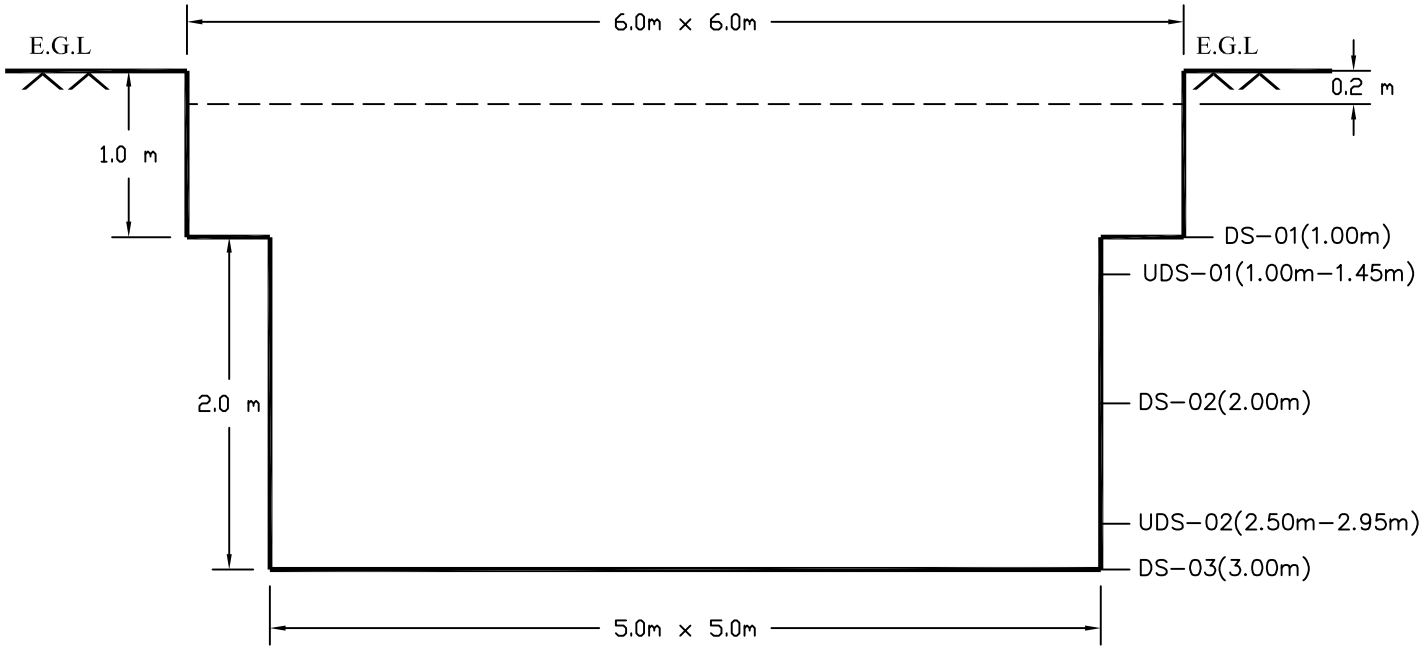
(1.80-3.00)m:- Yellowish grey, sandy silt / silty sand with silty clay patches.

PIT LOG OF CPLT - 01

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3 3 6 9	Created by : S K D	Created on : 15/12/2014	Sheet No:

Commenced on: 3/12/2014
Completed on: 3/12/2014
Pit size: 5.00mX5.00mX3.00m(depth)
Load on pr.guage/divn.=10kg/sq.cm
Load on jack/divn. =0.7091te
Plate size: 0.60mX0.60m
Load on plate/divn.=1.97te/sq.m
Test Type: CPLT

Co-ordinates:
E = 680
N = -129
RL = 64.439M



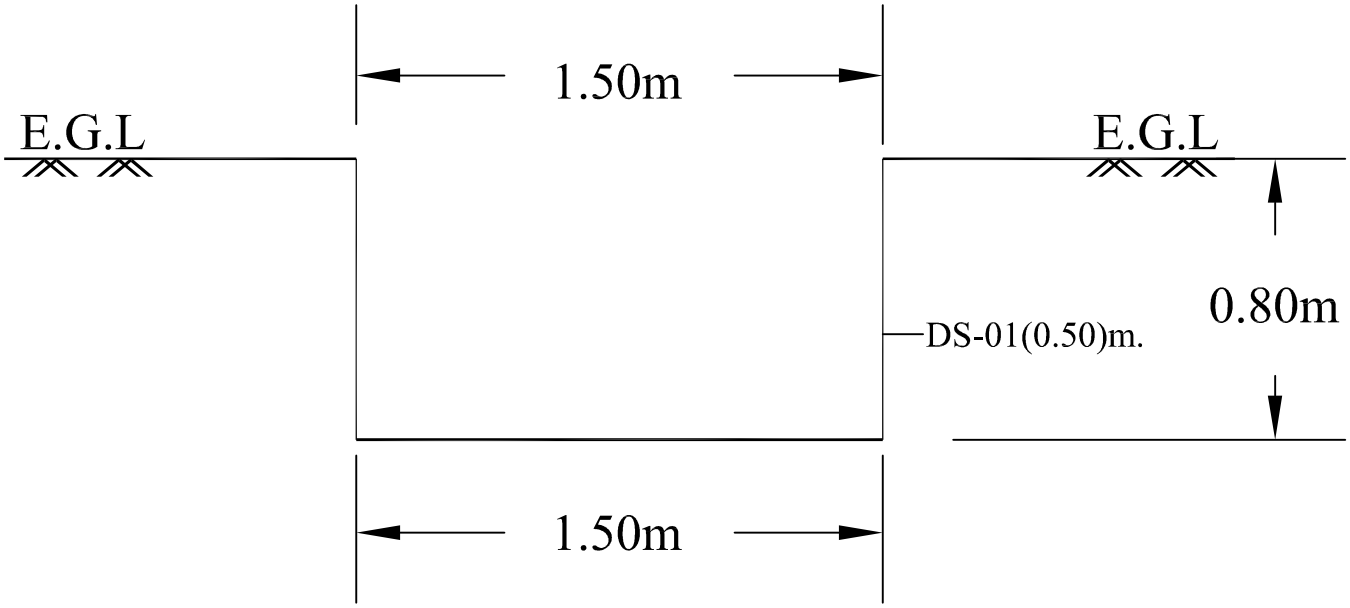
EGL-0.20m:-	Filled up with ash.
0.20m-3.00m:-	Yellowish grey, silty sand / sandy silt with laminated grey colour silty clay.

PIT LOG OF CPLT-02

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 12 / 12 / 2014	Sheet No:

Co-Ordinate:-
E = 647.000
N = 379.000
RL = 64.579

S.W.L. = Not Found.



Description Of Soil:-

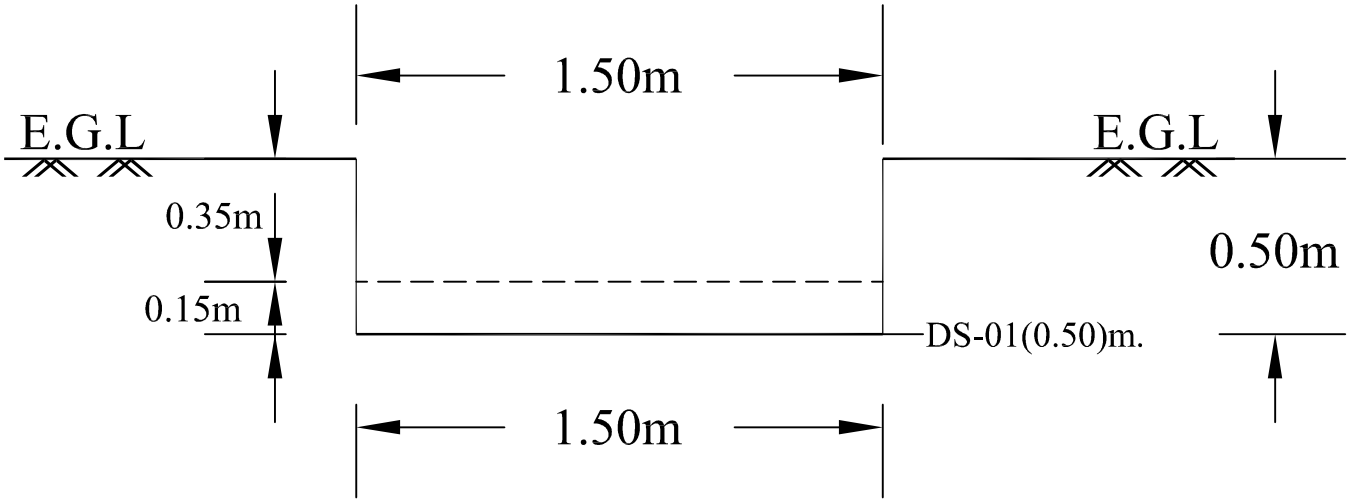
EGL-0.80m :- Yellowish grey, silty sand / sandy silt.

PIT LOG FOR CBR - 01

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 12 / 12 / 2014	Sheet No:

Co-Ordinate:-
E = 747.000
N = 116.000
RL = 63.446

S.W.L. = Not Found.



Description Of Soil:-

EGL-0.35m :- Top soil consists of ash & stone pieces.

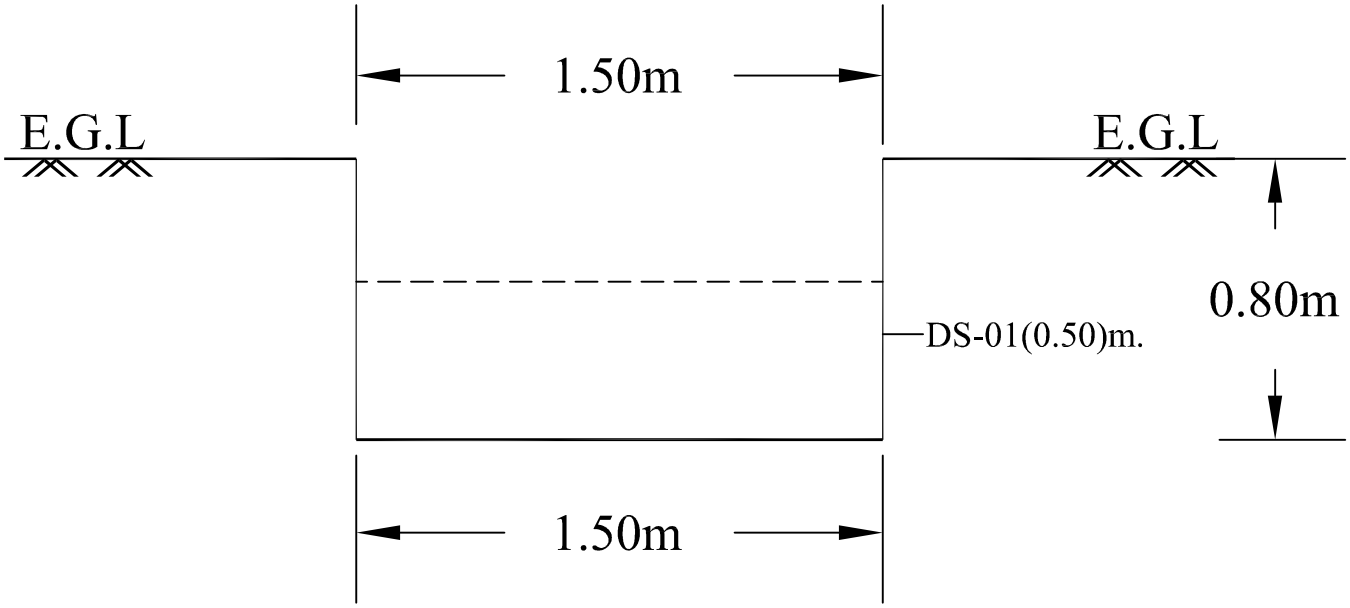
0.35-0.50m :- Yellowish grey, silty sand / sandy silt.

PIT LOG FOR CBR - 02

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 12 / 12 / 2014	Sheet No:

Co-Ordinate:-
E = 363.000
N = (-)32.000
RL = 74.248

S.W.L. = Not Found.



Description Of Soil:-

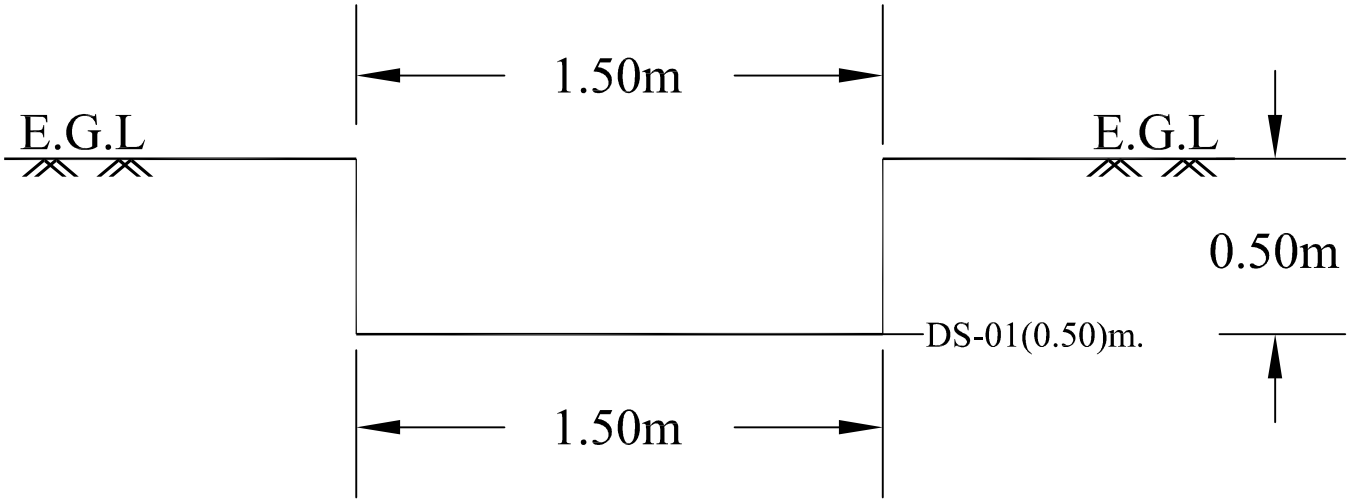
EGL-0.80m :- Brownish grey / light grey, silty sand with ash.

PIT LOG FOR CBR - 03

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 12 / 12 / 2014	Sheet No:

Co-Ordinate:-
E = 652.000
N = (-)167.000
RL = 70.366

S.W.L. = Not Found.



Description Of Soil:-

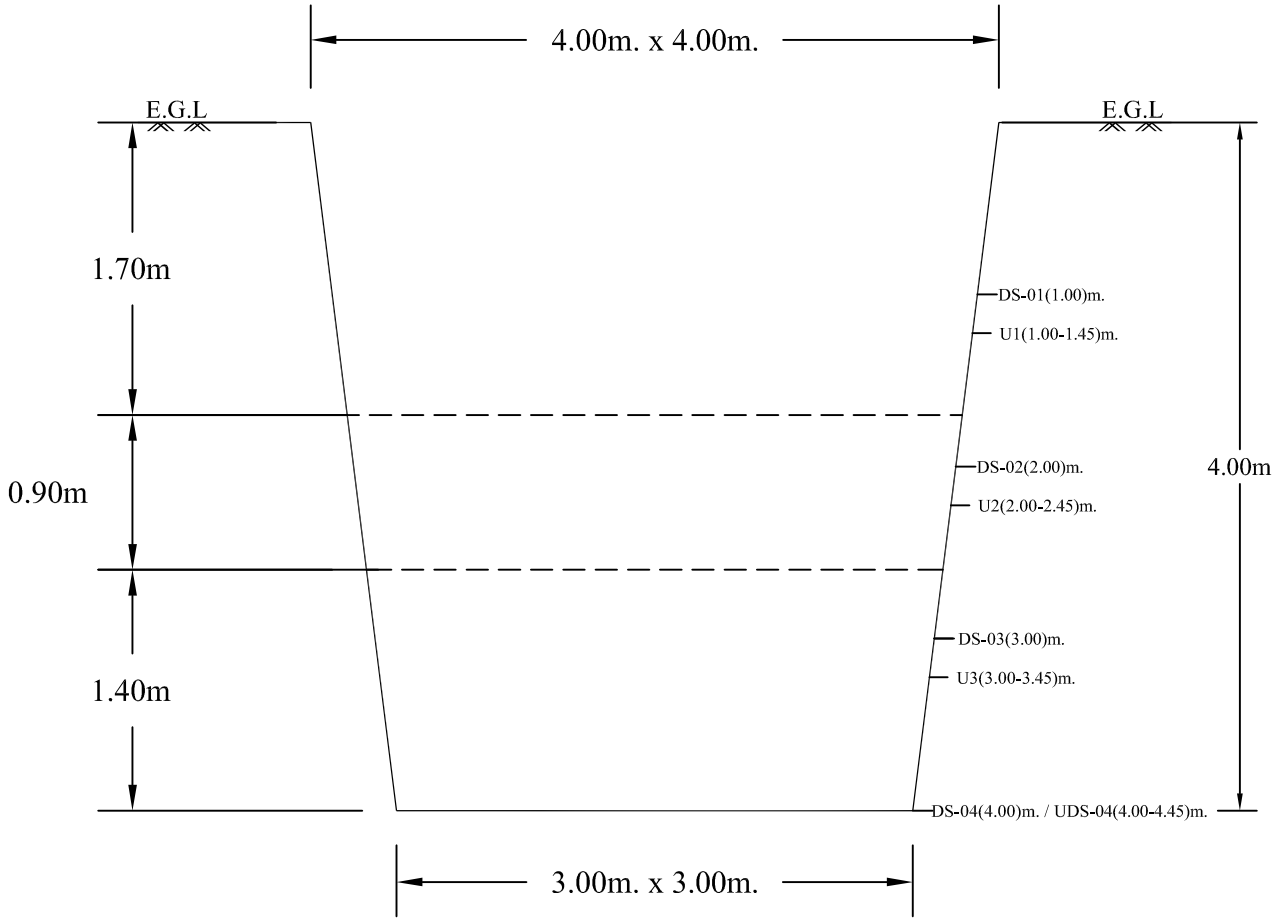
EGL-0.50m :- Yellowish grey, silty sand / sandy silt.

PIT LOG FOR CBR - 04

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 12 / 12 / 2014	Sheet No:

Co-Ordinate:-
E = 712.000
N = 336.000
RL = 65.159

S.W.L. = Not Found.



Description Of Soil:-

EGL-1.70m :- Brownish grey, sandy silt / silty sand.

1.70m-2.60m :- Yellowish grey, silty sand.

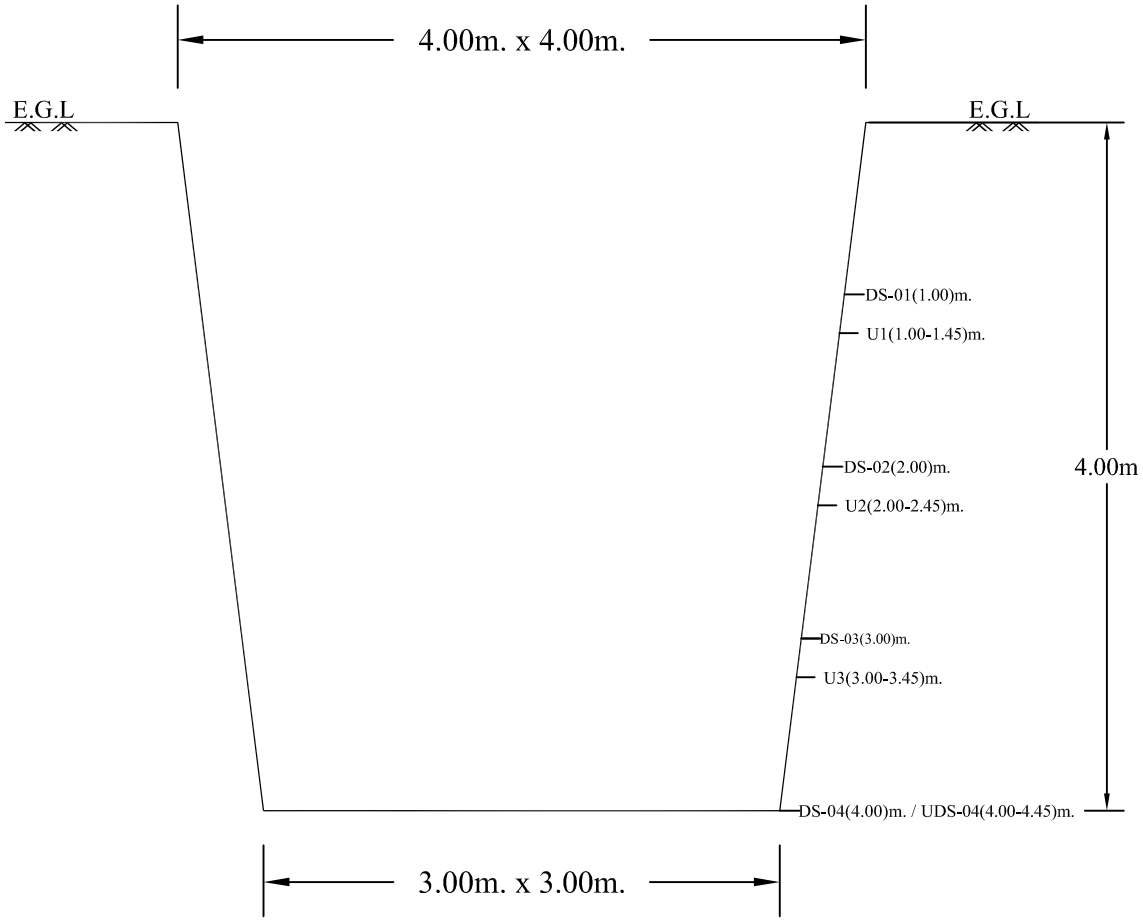
2.60m-4.00m :- Blackish grey, silty clay.

PIT LOG FOR TP - 01

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 14 / 01 / 2015	Sheet No:

Co-Ordinate:-
E = 456.000
N = 277.000
RL = 67.316

S.W.L. = Not Found.



Description Of Soil:-

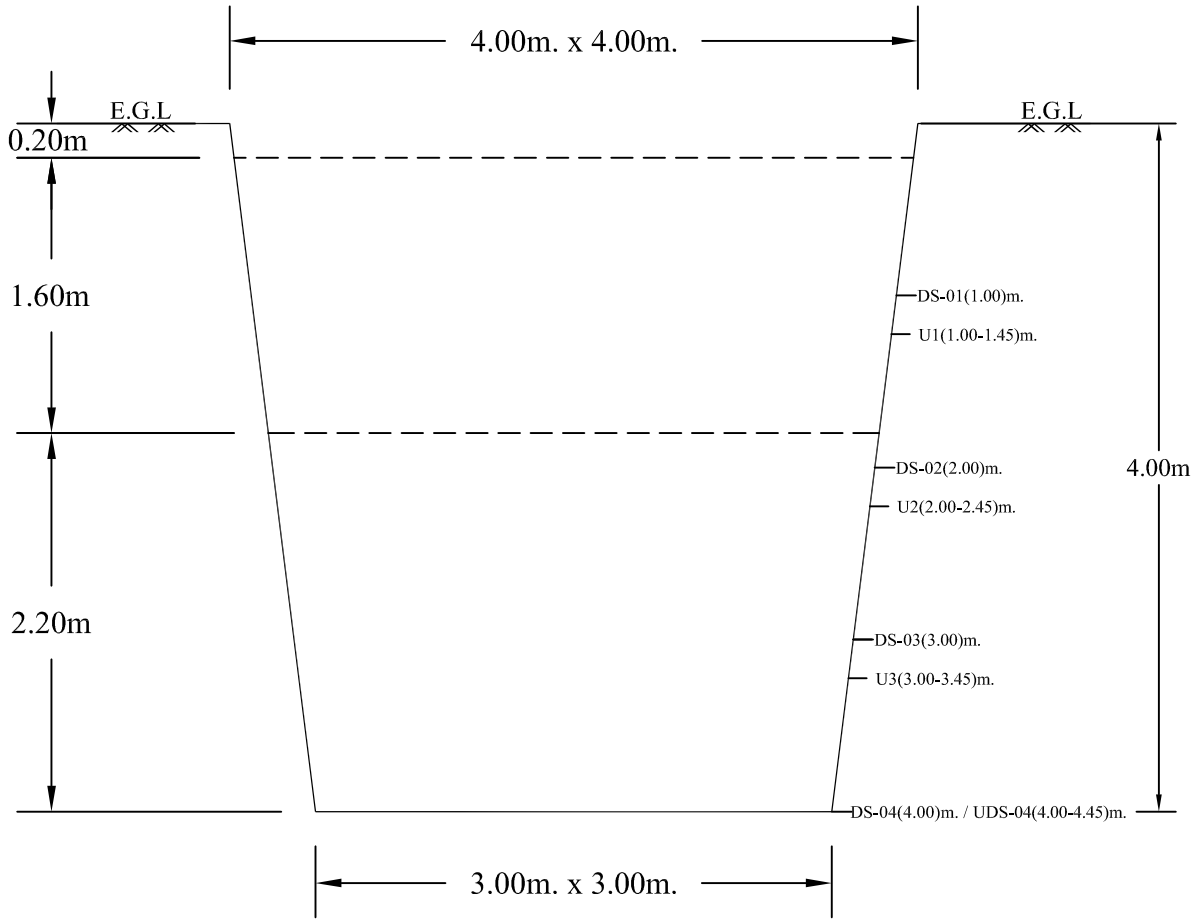
EGL - 4.00m :- Yellowish brown, sandy silt. Obs. concreation of sand.

PIT LOG FOR TP - 02

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 12 / 12 / 2014	Sheet No:

Co-Ordinate:-
E = 619.000
N = 185.000
RL = 67.076

S.W.L. = Not Found.



Description Of Soil:-

EGL-0.20m :- Top soil consists of ash & stone pieces.

0.20m-1.60m :- Brownish grey, silty sand / sandy silt.

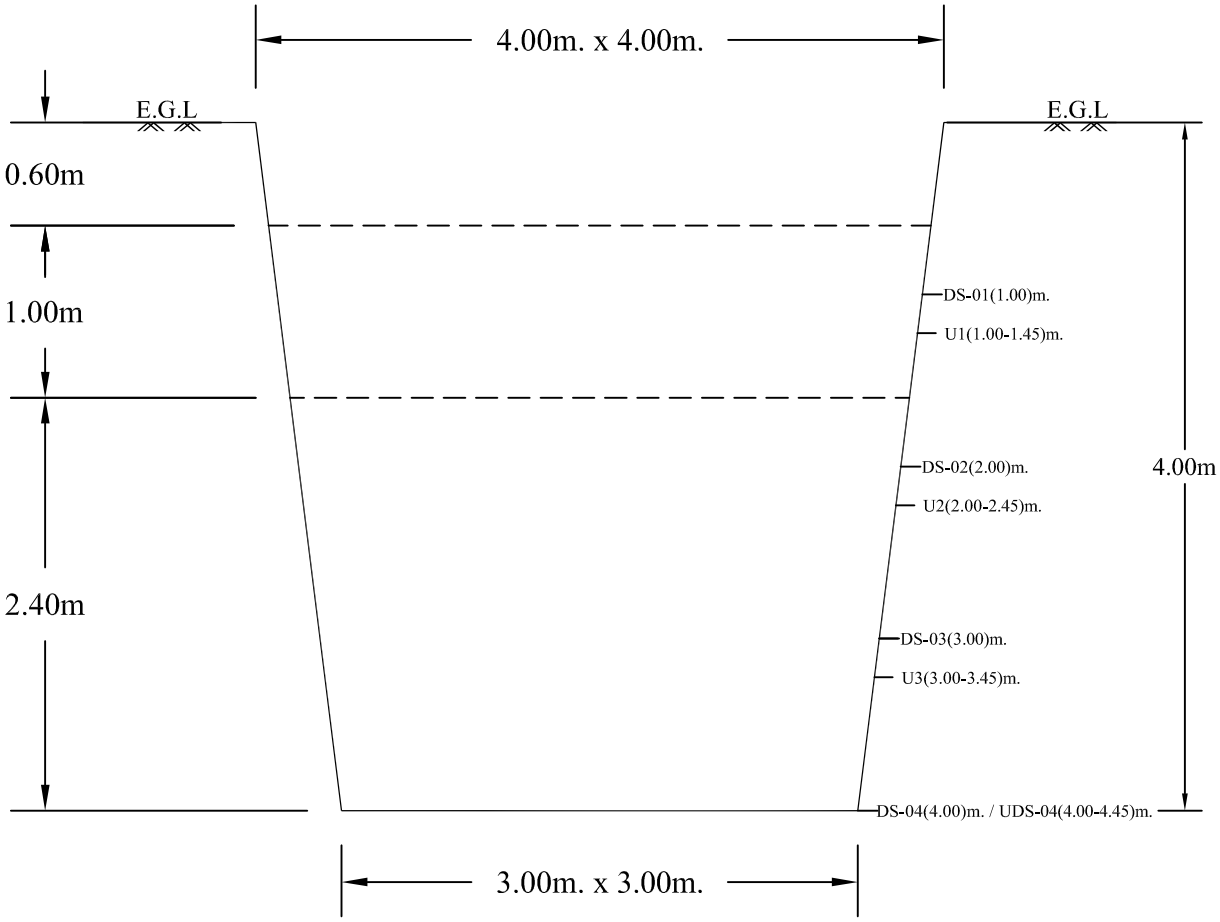
1.60m-4.00m :- Brownish grey, silty sand.

PIT LOG FOR TP - 03

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 12 / 12 / 2014	Sheet No:

Co-Ordinate:-
E = 780.000
N = 137.000
RL = 62.679

S.W.L. = Not Found.



Description Of Soil:-

EGL-0.60m :- Yellowish grey, silty sand.

0.60m-1.60m :- Blackish grey, silty clay.

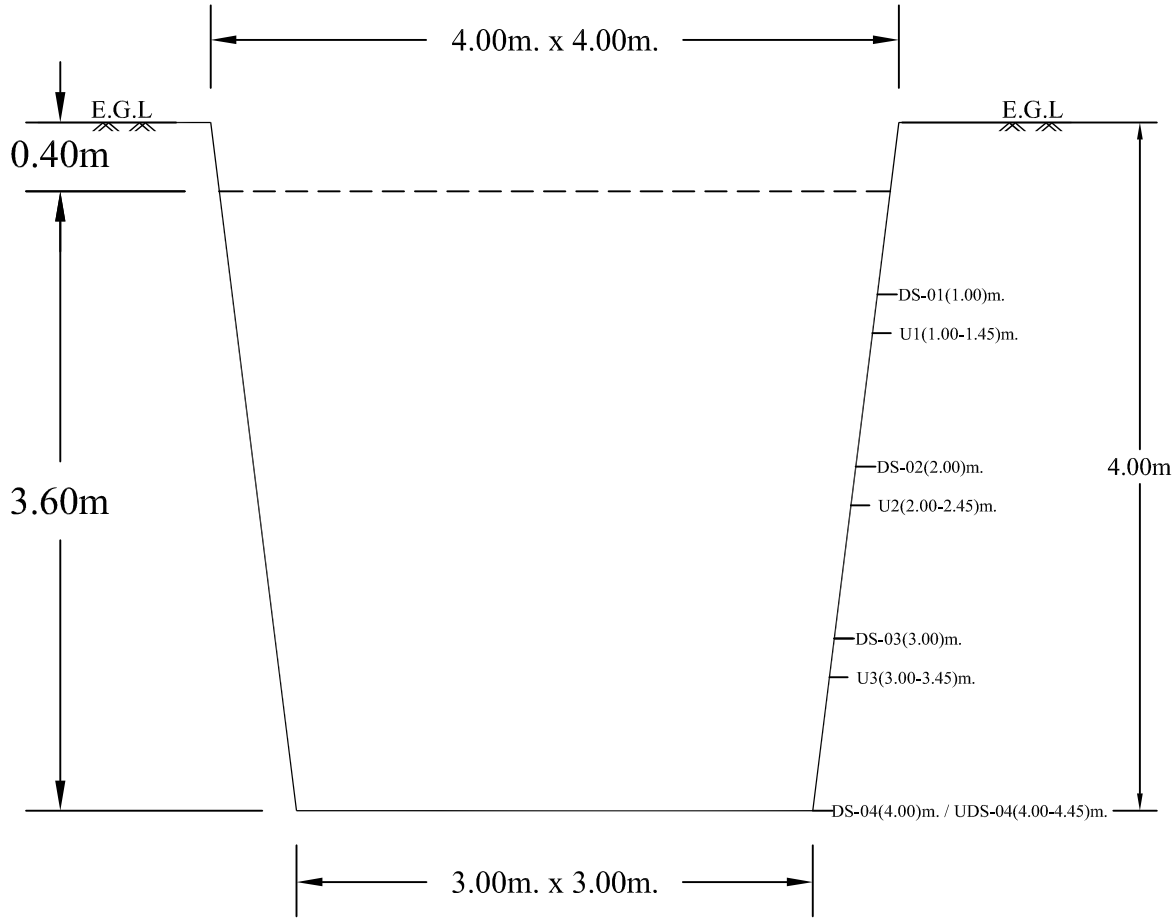
1.60m-4.00m :- Brownish grey, clayey silt / silty clay.

PIT LOG FOR TP - 04

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			
Job No : 3369	Created by : Chandrani	Created on : 14 / 01 / 2015	Sheet No:

Co-Ordinate:-
E = (-)12.000
N = (-)106.000
RL = 78.783

S.W.L. = Not Found.



Description Of Soil:-

EGL - 0.40m :- Filled up soil consists of blackish grey to brownish grey, sandy silt / silty sand with gravels & boulders.

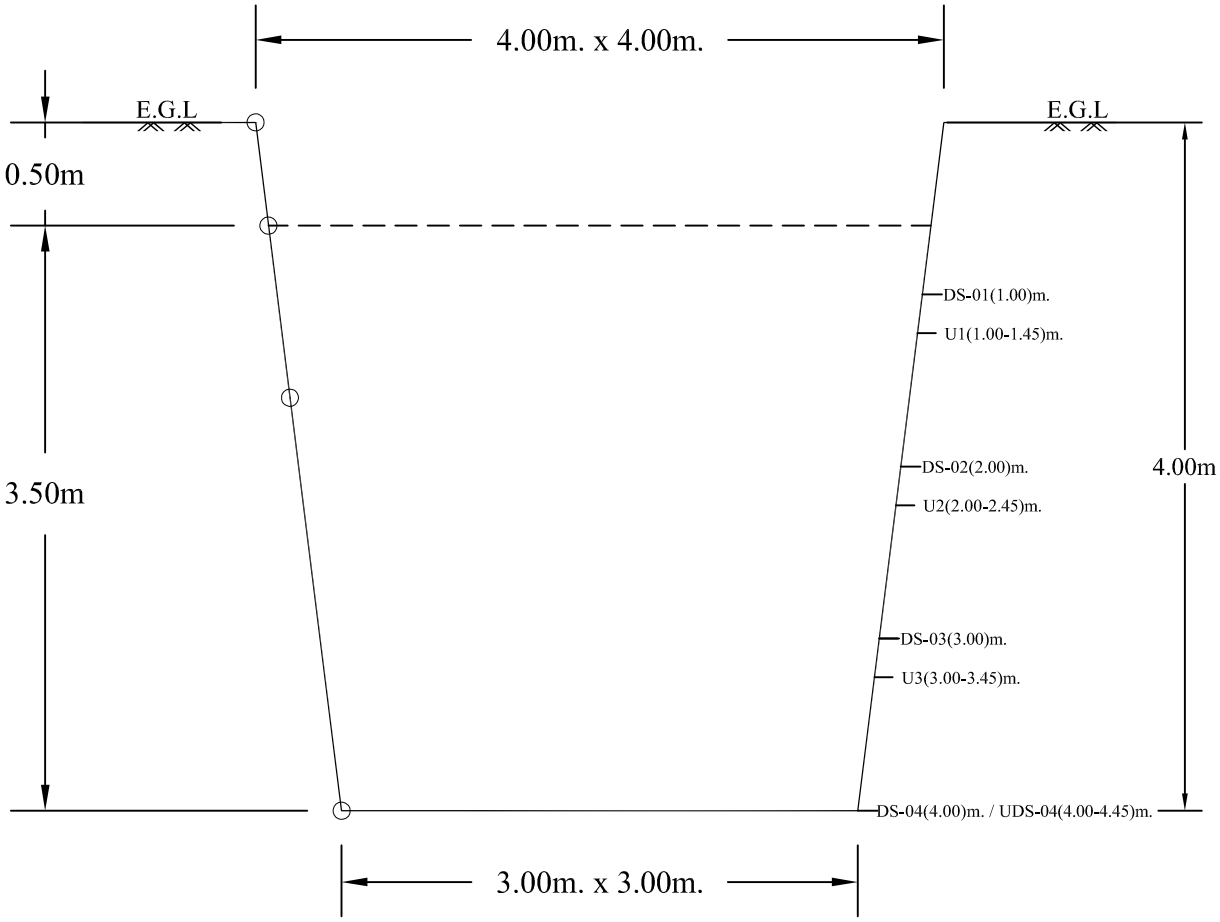
0.40m - 4.00m :- Yellowish brown, sandy silt. Obs. concreation of sand.

PIT LOG FOR TP - 05

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 14 / 01 / 2015	Sheet No:

Co-Ordinate:-
E = (-)419.000
N = (-)45.000
RL = 78.200

S.W.L. = Not Found.



Description Of Soil:-

EGL - 0.50m :- Filled up soil consists of blackish grey to brownish grey, silty sand / sandy silt with gravels & brick bats.

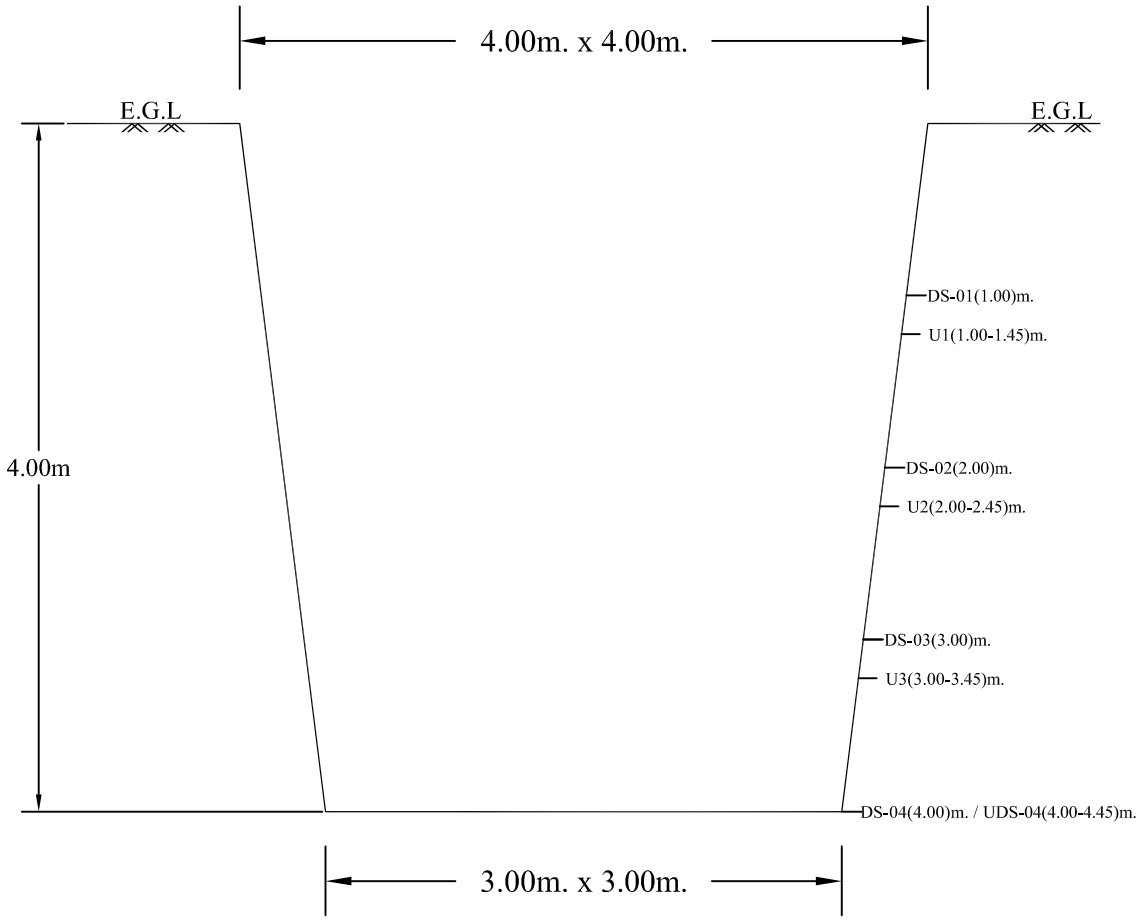
0.50m - 4.00m :- Yellowish brown, sandy silt. Obs. concreation of silt.

PIT LOG FOR TP - 06

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 12 / 12 / 2014	Sheet No:

Co-Ordinate:-
E = 436.000
N = (-)145.000
RL = 71.558

S.W.L. = Not Found.



Description Of Soil:-

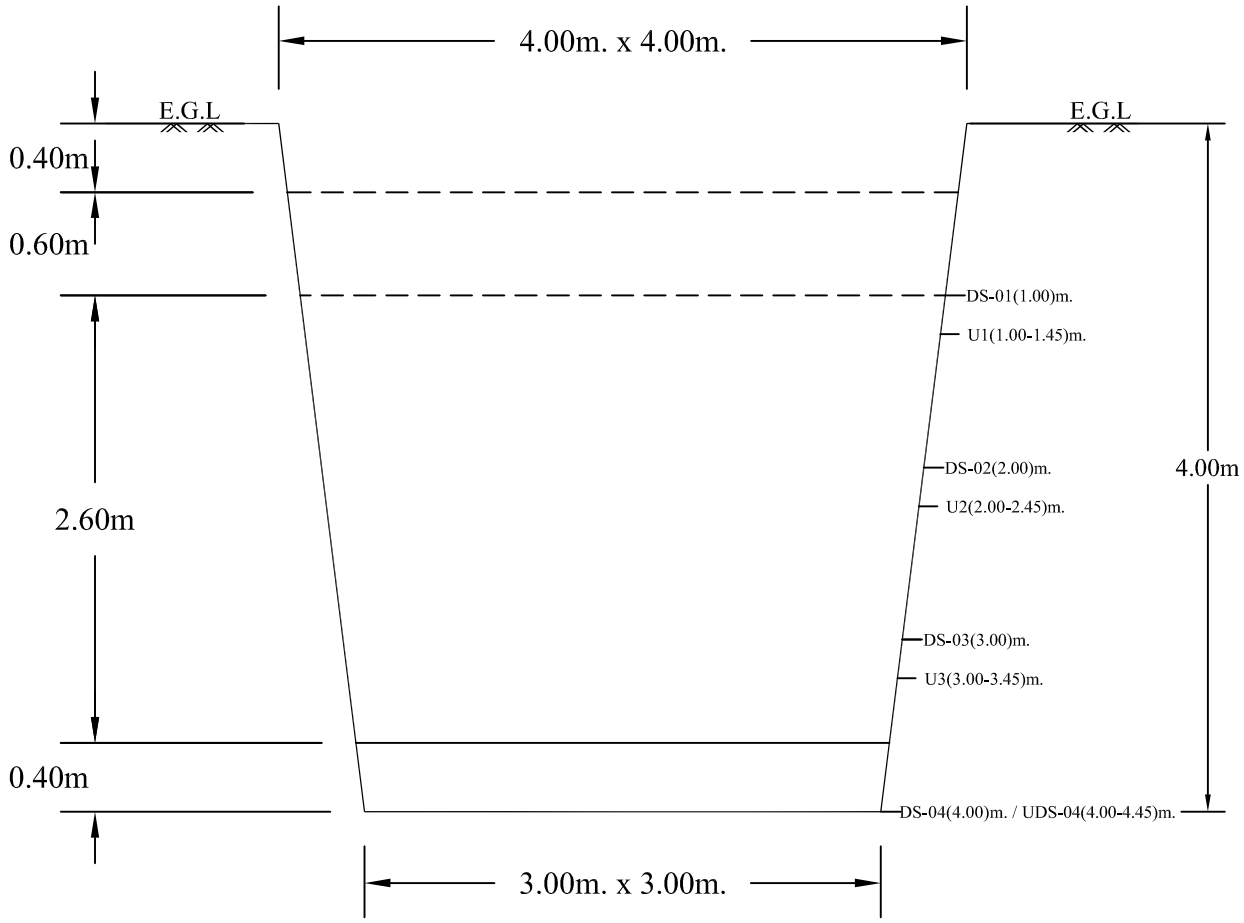
EGL-4.00m :- Blackish grey / grey, ash.

PIT LOG FOR TP - 07

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 12 / 12 / 2014	Sheet No:

Co-Ordinate:-
E = 775.000
N = (-)82.000
RL = 64.247

S.W.L. = Not Found.



Description Of Soil:-

EGL-0.40m :- Top soil consists of ash & stone pieces.

0.40m-1.00m :- Yellowish grey, silty sand.

1.00m-3.60m :- Blackish grey, silty clay.

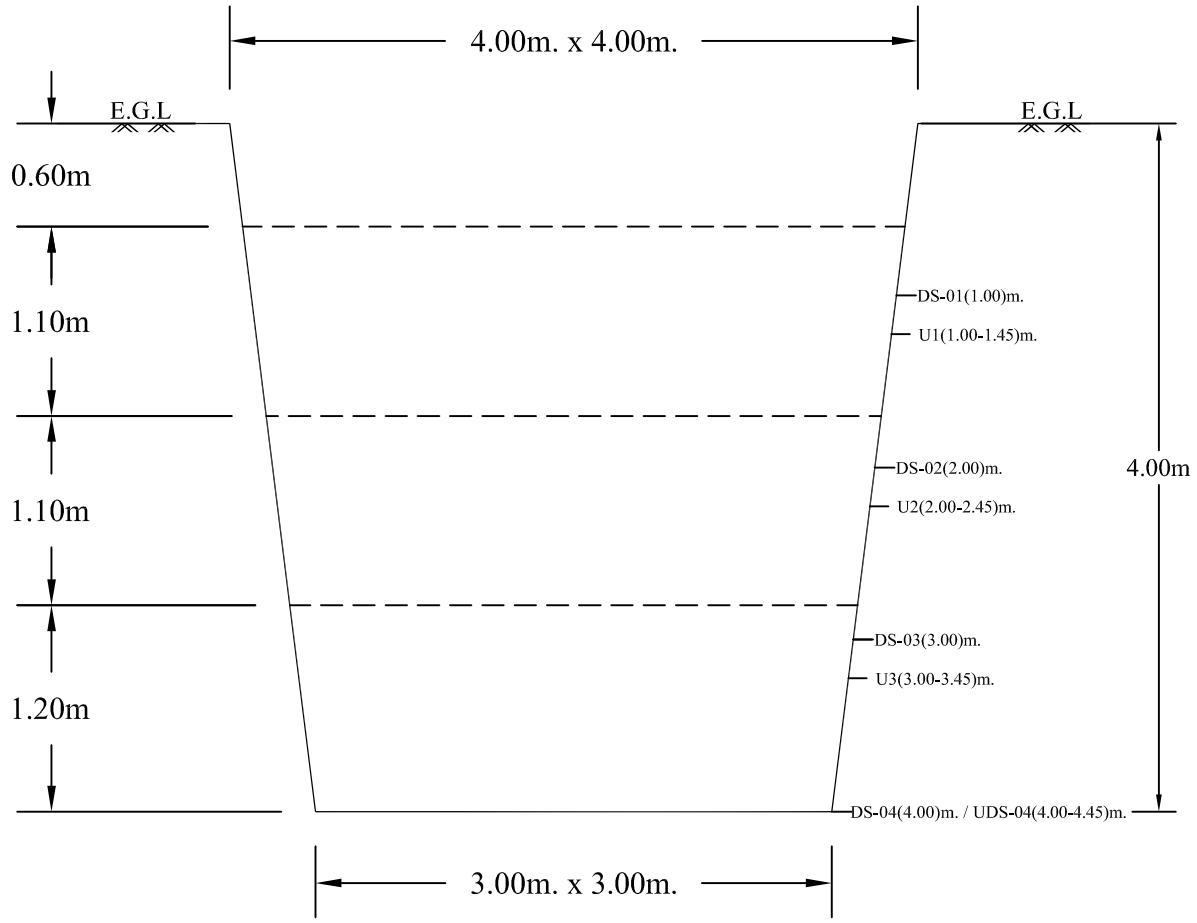
3.60m-4.00m :- Brownish grey, silty clay / clayey silt.

PIT LOG FOR TP - 08

Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.			CETEST
Job No : 3369	Created by : Chandrani	Created on : 12 / 12 / 2014	Sheet No:

Co-Ordinate:-
E = 947.000
N = (-)39.000
RL = 64.807

S.W.L. = Not Found.



Description Of Soil:-

EGL-0.60m :- Top soil consists of silty sand, ash.

0.60m-1.70m :- Yellowish grey, silty sand.

1.70m-2.80m :- Blackish grey, silty clay.

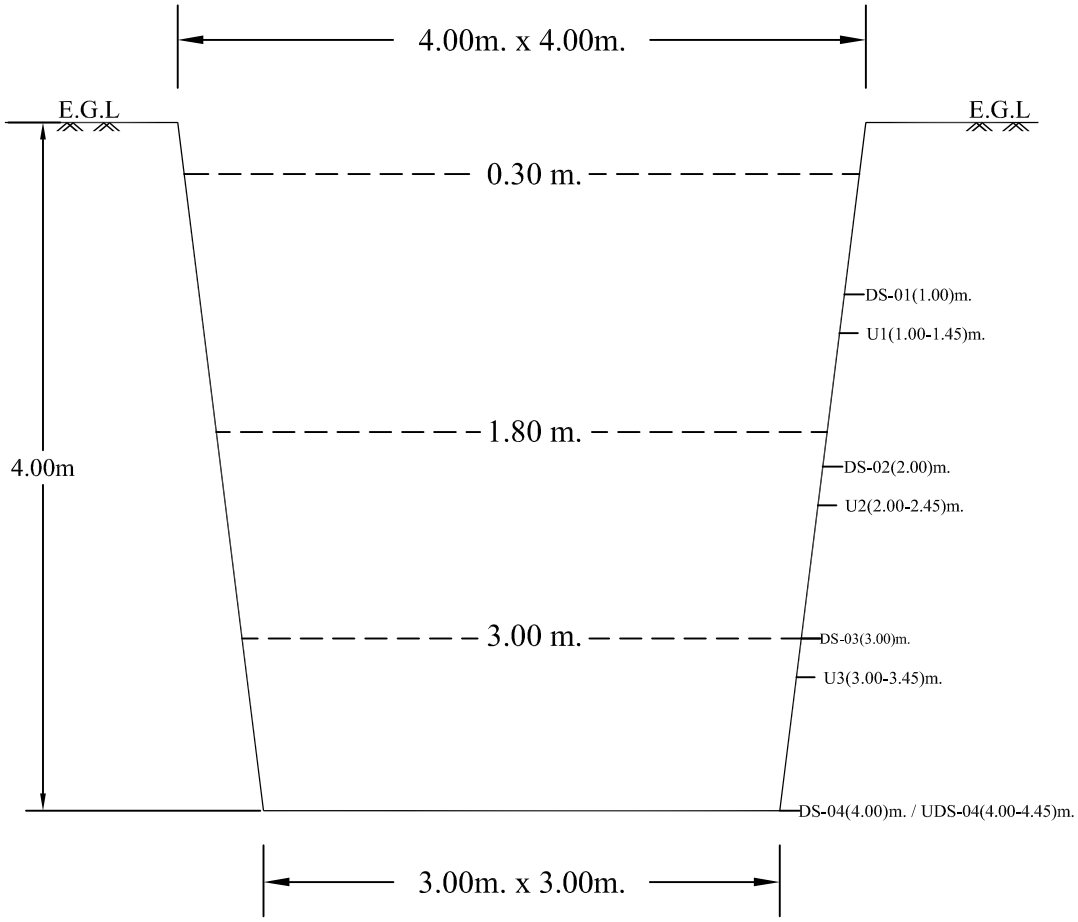
2.80m-4.00m :- Brownish grey, silty clay.

PIT LOG FOR TP - 09

Project : Geotech. Inv. work for 1x800 MW Wanakbori TPS, Gujarat.			
Job No : 3369	Created by : Chandrani	Created on : 29 / 01 / 2015	Sheet No:

Co-Ordinate:-
E = (-)218.000
N = 400.000
RL = 79.000

S.W.L. = Not Found.



Description Of Soil:-

EGL-0.30m :- Filled up soil consists of brownish grey, sandy silt / silty sand.

0.30m-1.80m :- Yellowish grey, silty sand. Obs. concreation of sand.

1.80m-4.00m :- Yellowish grey, sandy silt / silty sand.

PIT LOG FOR TTP - 01

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH01	1.00	1.45	1.23	8	12	71.10	I	31
BH01	3.00	3.45	3.23	22	22	69.10	II	
BH01	5.00	5.45	5.23	34	34	67.10	II	
BH01	8.00	8.45	8.23	52	52	64.10	II	
BH01	11.00	11.45	11.23	69	69	61.10	IV	
BH01	12.50	12.75	12.63	>100	100	59.70	IV	
BH01	14.00	14.38	14.19	>100	100	58.13	IV	
BH01	15.50	15.87	15.69	>100	100	56.64	IV	
BH01	17.00	17.26	17.13	>100	100	55.19	IV	
BH01	18.50	18.77	18.64	>100	100	53.69	IV	
BH01	20.00	20.45	20.23	52	23	52.10	III	35
BH01	21.50	21.95	21.73	55	23	50.60	III	35
BH01	23.00	23.45	23.23	64	25	49.10	III	36
BH01	24.50	24.95	24.73	34	17	47.60	III	33
BH01	26.00	26.45	26.23	51	21	46.10	III	34
BH01	27.50	27.74	27.62	>100	>50	44.70	V	42
BH01	29.00	29.21	29.11	>100	>50	43.22	V	42
BH01	30.00	30.23	30.12	>100	>50	42.21	V	42
BH02	1.00	1.45	1.23	13	17	64.91	I	33
BH02	3.00	3.45	3.23	7	07	62.91	IIA	
BH02	5.00	5.45	5.23	12	12	60.91	II	
BH02	8.00	8.45	8.23	42	42	57.91	IV	
BH02	11.00	11.45	11.23	40	23	54.91	III	35
BH02	14.00	14.45	14.23	52	26	51.91	III	36
BH02	15.50	15.95	15.73	59	28	50.41	III	36
BH02	17.00	17.45	17.23	70	31	48.91	III	37
BH02	18.50	18.95	18.73	71	71	47.41	IV	
BH02	20.00	20.45	20.23	74	31	45.91	III	37
BH02	21.50	21.89	21.70	>100	>50	44.44	V	42
BH02	23.00	23.37	23.19	>100	>50	42.95	V	42
BH02	24.50	24.74	24.62	>100	>50	41.51	V	42
BH02	26.00	26.22	26.11	>100	>50	40.02	V	42
BH02	27.50	27.73	27.62	>100	>50	38.52	V	42
BH02	29.00	29.21	29.11	>100	>50	37.03	V	42
BH02	30.00	30.19	30.10	>100	>50	36.04	V	42
BH03	1.00	1.45	1.23	5	07	65.04	I	29
BH03	3.00	3.45	3.23	4	05	63.04	I	28
BH03	5.00	5.45	5.23	14	14	61.04	I	32
BH03	8.00	8.45	8.23	51	51	58.04	II	
BH03	9.50	9.95	9.73	72	72	56.54	IV	
BH03	11.00	11.40	11.20	>100	>50	55.07	III	42
BH03	12.50	12.87	12.69	>100	100	53.58	IV	

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH03	14.00	14.38	14.19	>100	100	52.08	IV	
BH03	15.50	15.95	15.73	40	21	50.54	III	34
BH03	17.00	17.45	17.23	36	36	49.04	IV	
BH03	18.80	19.25	19.03	52	24	47.24	III	35
BH03	20.50	20.95	20.73	75	31	45.54	V	37
BH03	22.00	22.40	22.20	>100	>50	44.07	V	42
BH03	23.50	23.85	23.68	>100	>50	42.59	V	42
BH03	25.00	25.27	25.14	>100	>50	41.13	V	42
BH03	26.50	26.73	26.62	>100	>50	39.65	V	42
BH03	28.00	28.24	28.12	>100	>50	38.15	V	42
BH03	30.00	30.22	30.11	>100	>50	36.16	V	42
BH04	1.00	1.45	1.23	6	09	64.86	I	29
BH04	3.00	3.45	3.23	4	05	62.86	I	28
BH04	5.00	5.45	5.23	7	07	60.86	II	
BH04	8.00	8.45	8.23	24	24	57.86	II	
BH04	11.00	11.45	11.23	42	24	54.86	III	35
BH04	12.80	13.25	13.03	72	72	53.06	IV	
BH04	14.50	14.95	14.73	63	63	51.36	IV	
BH04	16.00	16.45	16.23	81	35	49.86	V	38
BH04	17.50	17.95	17.73	94	38	48.36	V	39
BH04	19.00	19.40	19.20	>100	>50	46.89	V	42
BH04	20.50	20.88	20.69	>100	>50	45.40	V	42
BH04	22.00	22.34	22.17	>100	>50	43.92	V	42
BH04	23.50	23.90	23.70	>100	>50	42.39	V	42
BH04	25.00	25.39	25.20	>100	>50	40.89	V	42
BH04	26.50	26.72	26.61	>100	>50	39.48	V	42
BH04	28.00	28.20	28.10	>100	>50	37.99	V	42
BH04	30.00	30.19	30.10	>100	>50	35.99	V	42
BH05	1.00	1.45	1.23	14	18	70.02	I	33
BH05	3.00	3.45	3.23	62	62	68.02	IV	
BH05	5.00	5.45	5.23	58	58	66.02	IV	
BH05	6.50	6.95	6.73	53	53	64.52	IV	
BH05	8.00	8.45	8.23	45	45	63.02	IV	
BH05	11.00	11.45	11.23	63	63	60.02	IV	
BH05	12.50	12.95	12.73	78	78	58.52	IV	
BH05	14.00	14.45	14.23	87	87	57.02	IV	
BH05	15.50	15.70	15.60	>100	100	55.65	IV	
BH05	17.00	17.37	17.19	>100	>50	54.06	V	42
BH05	18.50	18.95	18.73	79	31	52.52	V	39
BH05	20.00	20.45	20.23	80	31	51.02	V	37
BH05	21.50	21.95	21.73	74	29	49.52	V	37
BH05	23.00	23.45	23.23	81	30	48.02	V	37

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH05	24.50	24.87	24.69	>100	>50	46.56	V	42
BH05	26.00	26.39	26.20	>100	>50	45.05	V	42
BH05	27.50	27.86	27.68	>100	>50	43.57	V	42
BH05	29.00	29.38	29.19	>100	>50	42.06	V	42
BH05	30.00	30.27	30.14	>100	>50	41.11	V	42
BH06	1.00	1.45	1.23	12	16	70.87	I	32
BH06	3.00	3.45	3.23	20	19	68.87	I	33
BH06	5.00	5.45	5.23	14	14	66.87	II	
BH06	8.00	8.45	8.23	14	14	63.87	II	
BH06	11.00	11.45	11.23	18	18	60.87	II	
BH06	14.00	14.45	14.23	88	38	57.87	III	39
BH06	15.50	15.95	15.73	80	34	56.37	III	38
BH06	17.00	17.45	17.23	81	33	54.87	III	38
BH06	18.50	18.95	18.73	54	24	53.37	III	35
BH06	20.00	20.45	20.23	45	20	51.87	III	34
BH06	21.50	21.95	21.73	57	24	50.37	V	35
BH06	23.00	23.45	23.23	65	25	48.87	V	36
BH06	24.50	24.95	24.73	55	22	47.37	V	35
BH06	26.00	26.45	26.23	71	26	45.87	V	36
BH06	27.50	27.95	27.73	77	77	44.37	IV	
BH06	29.00	29.45	29.23	65	24	42.87	V	35
BH06	30.50	30.85	30.68	>100	>50	41.42	V	42
BH06	32.00	32.25	32.13	>100	>50	39.97	V	42
BH06	33.50	33.72	33.61	>100	>50	38.49	V	42
BH06	35.00	35.18	35.09	>100	>50	37.01	V	42
BH07	1.00	1.45	1.23	28	28	67.54	I	36
BH07	3.00	3.45	3.23	14	16	65.54	I	32
BH07	5.00	5.45	5.23	16	16	63.54	I	32
BH07	8.00	8.45	8.23	20	16	60.54	I	32
BH07	11.00	11.45	11.23	13	13	57.54	II	
BH07	14.00	14.45	14.23	69	31	54.54	III	37
BH07	15.50	15.95	15.73	61	28	53.04	III	36
BH07	17.00	17.45	17.23	54	25	51.54	III	36
BH07	18.50	18.95	18.73	24	15	50.04	III	32
BH07	20.00	20.45	20.23	82	33	48.54	III	38
BH07	21.50	21.95	21.73	70	29	47.04	III	37
BH07	23.00	23.37	23.19	>100	100	45.58	IV	
BH07	24.50	24.85	24.68	>100	100	44.09	IV	
BH07	26.00	26.45	26.23	87	32	42.54	V	38
BH07	27.50	27.90	27.70	>100	>50	41.07	V	42
BH07	29.00	29.38	29.19	>100	>50	39.58	V	42
BH07	30.00	30.21	30.11	>100	>50	38.66	V	42

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH08	1.00	1.45	1.23	9	13	63.21	I	31
BH08	3.00	3.45	3.23	13	13	61.21	II	
BH08	5.00	5.45	5.23	14	14	59.21	II	
BH08	8.00	8.45	8.23	16	14	56.21	I	32
BH08	10.00	10.45	10.23	22	16	54.21	I	32
BH08	13.00	13.45	13.23	82	37	51.21	III	39
BH08	14.50	14.89	14.70	>100	100	49.74	IV	
BH08	16.00	16.45	16.23	37	37	48.21	IV	
BH08	17.50	17.95	17.73	64	29	46.71	V	37
BH08	19.00	19.38	19.19	>100	>50	45.24	V	42
BH08	20.50	20.85	20.68	>100	>50	43.76	V	42
BH08	22.00	22.25	22.13	>100	>50	42.31	V	42
BH08	23.50	23.72	23.61	>100	>50	40.82	V	42
BH08	25.00	25.24	25.12	>100	>50	39.31	V	42
BH08	26.50	26.71	26.61	>100	>50	37.83	V	42
BH08	28.00	28.23	28.12	>100	>50	36.32	V	42
BH08	30.00	30.20	30.10	>100	>50	34.33	V	42
BH09	1.00	1.45	1.23	7	07	63.54	IIA	
BH09	3.00	3.45	3.23	11	11	61.54	II	
BH09	5.00	5.45	5.23	18	18	59.54	II	
BH09	8.00	8.45	8.23	22	17	56.54	I	33
BH09	9.75	10.20	9.98	43	25	54.79	III	35
BH09	11.50	11.95	11.73	54	28	53.04	III	36
BH09	13.00	13.45	13.23	45	45	51.54	IV	
BH09	14.50	14.95	14.73	65	65	50.04	IV	
BH09	16.00	16.45	16.23	75	75	48.54	IV	
BH09	17.50	17.95	17.73	51	51	47.04	IV	
BH09	19.00	19.45	19.23	84	84	45.54	IV	
BH09	20.50	20.95	20.73	95	35	44.04	V	38
BH09	22.00	22.24	22.12	>100	>50	42.65	V	42
BH09	23.50	23.71	23.61	>100	>50	41.16	V	42
BH09	25.00	25.18	25.09	>100	>50	39.68	V	42
BH09	26.50	26.70	26.60	>100	>50	38.17	V	42
BH09	28.00	28.26	28.13	>100	>50	36.64	V	42
BH09	30.00	30.17	30.09	>100	>50	34.68	V	42
BH10	1.00	1.45	1.23	21	21	63.50	II	
BH10	3.00	3.45	3.23	44	44	61.50	II	
BH10	5.00	5.45	5.23	61	61	59.50	IV	
BH10	6.50	6.95	6.73	77	77	58.00	IV	
BH10	8.00	8.45	8.23	69	37	56.50	V	39
BH10	9.50	9.95	9.73	90	44	55.00	V	41

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH10	11.00	11.39	11.20	>100	>50	53.53	V	42
BH10	12.50	12.74	12.62	>100	>50	52.11	V	42
BH10	14.00	14.24	14.12	>100	>50	50.61	V	42
BH10	15.50	15.70	15.60	>100	>50	49.13	V	42
BH10	17.00	17.21	17.11	>100	>50	47.62	V	42
BH10	18.50	18.73	18.62	>100	>50	46.11	V	42
BH10	20.00	20.21	20.11	>100	>50	44.62	V	42
BH10	21.50	21.74	21.62	>100	>50	43.11	V	42
BH10	23.00	23.22	23.11	>100	>50	41.62	V	42
BH10	24.50	24.73	24.62	>100	>50	40.11	V	42
BH10	26.00	26.21	26.11	>100	>50	38.62	V	42
BH10	27.50	27.74	27.62	>100	>50	37.11	V	42
BH10	29.00	29.22	29.11	>100	>50	35.62	V	42
BH10	30.00	30.21	30.11	>100	>50	34.62	V	42
BH11	1.00	1.45	1.23	7	07	62.70	IIA	
BH11	3.00	3.45	3.23	12	12	60.70	II	
BH11	5.00	5.45	5.23	37	37	58.70	II	
BH11	8.00	8.45	8.23	47	28	55.70	III	36
BH11	9.80	10.25	10.03	91	91	53.90	IV	
BH11	11.50	11.95	11.73	66	66	52.20	IV	
BH11	13.00	13.45	13.23	44	44	50.70	IV	
BH11	14.50	14.95	14.73	50	50	49.20	IV	
BH11	16.00	16.45	16.23	44	44	47.70	IV	
BH11	17.50	17.95	17.73	47	47	46.20	IV	
BH11	19.00	19.45	19.23	68	30	44.70	V	37
BH11	20.00	20.45	20.23	83	35	43.70	V	38
BH11	21.50	21.71	21.61	>100	>50	42.32	V	42
BH11	23.00	23.19	23.10	>100	>50	40.83	V	42
BH11	24.50	24.83	24.67	>100	>50	39.26	V	42
BH11	26.00	26.18	26.09	>100	>50	37.84	V	42
BH11	27.50	27.72	27.61	>100	>50	36.32	V	42
BH11	29.00	29.20	29.10	>100	>50	34.83	V	42
BH11	30.00	30.18	30.09	>100	>50	33.84	V	42
BH12	1.00	1.45	1.23	6	06	62.85	IIA	
BH12	3.00	3.45	3.23	12	12	60.85	II	
BH12	5.00	5.45	5.23	34	34	58.85	II	
BH12	8.00	8.45	8.23	44	27	55.85	III	36
BH12	9.80	10.25	10.03	80	40	54.05	V	40
BH12	11.50	11.95	11.73	72	35	52.35	V	38
BH12	13.00	13.45	13.23	80	37	50.85	V	39
BH12	14.50	14.95	14.73	65	31	49.35	V	37
BH12	16.00	16.45	16.23	55	27	47.85	V	36

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH12	17.50	17.95	17.73	62	29	46.35	V	37
BH12	19.00	19.20	19.10	>100	>50	44.98	V	42
BH12	20.50	20.68	20.59	>100	>50	43.49	V	42
BH12	22.00	22.21	22.11	>100	>50	41.97	V	42
BH12	23.50	23.77	23.64	>100	>50	40.44	V	42
BH12	25.00	25.23	25.12	>100	>50	38.96	V	42
BH12	26.50	26.69	26.60	>100	>50	37.48	V	42
BH12	28.00	28.20	28.10	>100	>50	35.98	V	42
BH12	30.00	30.23	30.12	>100	>50	33.96	V	42
BH13	1.00	1.45	1.23	9	13	63.27	I	31
BH13	3.00	3.45	3.23	11	13	61.27	I	31
BH13	5.00	5.45	5.23	20	20	59.27	II	
BH13	8.00	8.45	8.23	33	22	56.27	III	34
BH13	9.75	10.20	9.98	46	26	54.52	III	36
BH13	11.50	11.95	11.73	65	32	52.77	III	38
BH13	13.00	13.45	13.23	57	28	51.27	V	36
BH13	14.50	14.95	14.73	55	27	49.77	V	36
BH13	16.00	16.45	16.23	59	59	48.27	IV	
BH13	17.50	17.95	17.73	50	24	46.77	V	35
BH13	18.50	18.73	18.62	>100	>50	45.88	V	42
BH13	20.00	20.24	20.12	>100	>50	44.38	V	42
BH13	21.50	21.73	21.62	>100	>50	42.88	V	42
BH13	23.00	23.22	23.11	>100	>50	41.39	V	42
BH13	24.50	24.74	24.62	>100	>50	39.88	V	42
BH13	26.00	26.23	26.12	>100	>50	38.38	V	42
BH13	27.50	27.75	27.63	>100	>50	36.87	V	42
BH13	29.00	29.24	29.12	>100	>50	35.38	V	42
BH13	30.00	30.21	30.11	>100	>50	34.39	V	42
BH14	1.00	1.45	1.23	4	06	62.68	I	28
BH14	3.00	3.45	3.23	9	09	60.68	II	
BH14	5.00	5.45	5.23	22	22	58.68	II	
BH14	8.00	8.45	8.23	31	31	55.68	II	
BH14	11.00	11.45	11.23	36	36	52.68	II	
BH14	14.00	14.45	14.23	36	36	49.68	II	
BH14	17.00	17.45	17.23	62	29	46.68	V	37
BH14	18.50	18.95	18.73	53	25	45.18	V	36
BH14	20.00	20.22	20.11	>100	>50	43.80	V	42
BH14	21.50	21.70	21.60	>100	>50	42.31	V	42
BH14	23.00	23.23	23.12	>100	>50	40.79	V	42
BH14	24.50	24.69	24.60	>100	>50	39.31	V	42
BH14	26.00	26.22	26.11	>100	>50	37.80	V	42
BH14	27.50	27.95	27.73	82	31	36.18	V	37

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH14	29.00	29.45	29.23	66	26	34.68	V	36
BH14	30.00	30.45	30.23	83	31	33.68	V	37
BH15	1.00	1.45	1.23	11	16	62.49	I	32
BH15	3.00	3.45	3.23	16	17	60.49	I	33
BH15	5.00	5.45	5.23	13	13	58.49	I	31
BH15	8.00	8.45	8.23	28	28	55.49	II	
BH15	11.00	11.45	11.23	51	27	52.49	V	36
BH15	14.00	14.45	14.23	78	36	49.49	V	39
BH15	17.00	17.27	17.14	>100	42	46.58	V	40
BH15	18.50	18.73	18.62	>100	42	45.10	V	40
BH15	20.00	20.45	20.23	95	39	43.49	V	39
BH15	21.50	21.95	21.73	86	35	41.99	V	38
BH15	23.00	23.19	23.10	>100	>50	40.62	V	42
BH15	24.50	24.71	24.61	>100	>50	39.11	V	42
BH15	26.00	26.19	26.10	>100	>50	37.62	V	42
BH15	27.50	27.70	27.60	>100	>50	36.12	V	42
BH15	29.00	29.17	29.09	>100	>50	34.63	V	42
BH15	30.00	30.19	30.10	>100	>50	33.62	V	42
BH16	1.00	1.45	1.23	16	19	65.37	I	34
BH16	3.00	3.45	3.23	28	24	63.37	I	35
BH16	5.00	5.45	5.23	34	25	61.37	I	35
BH16	8.00	8.45	8.23	13	13	58.37	II	
BH16	11.00	11.45	11.23	53	28	55.37	V	36
BH16	12.50	12.95	12.73	82	37	53.87	V	39
BH16	14.00	14.45	14.23	88	38	52.37	V	39
BH16	15.50	15.95	15.73	55	26	50.87	V	36
BH16	17.00	17.40	17.20	>100	100	49.40	IV	
BH16	18.50	18.77	18.64	>100	100	47.96	IV	
BH16	20.00	20.45	20.23	62	27	46.37	V	36
BH16	21.50	21.95	21.73	89	35	44.87	V	38
BH16	23.00	23.40	23.20	>100	>50	43.40	V	42
BH16	24.50	24.85	24.68	>100	>50	41.92	V	42
BH16	26.00	26.25	26.13	>100	>50	40.47	V	42
BH16	27.50	27.72	27.61	>100	>50	38.99	V	42
BH16	29.00	29.24	29.12	>100	>50	37.48	V	42
BH16	30.00	30.21	30.11	>100	>50	36.49	V	42
BH17	1.00	1.45	1.23	15	18	67.26	I	33
BH17	3.00	3.45	3.23	18	18	65.26	I	33
BH17	5.00	5.45	5.23	22	19	63.26	I	33
BH17	8.00	8.45	8.23	16	14	60.26	I	32
BH17	11.00	11.45	11.23	62	31	57.26	V	37

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH17	12.50	12.95	12.73	69	33	55.76	V	38
BH17	14.00	14.45	14.23	83	36	54.26	V	39
BH17	15.50	15.95	15.73	74	32	52.76	V	38
BH17	17.00	17.45	17.23	79	33	51.26	V	38
BH17	18.50	18.95	18.73	58	58	49.76	IV	
BH17	20.00	20.45	20.23	86	34	48.26	V	38
BH17	21.50	21.95	21.73	77	31	46.76	V	37
BH17	23.00	23.45	23.23	88	33	45.26	V	38
BH17	24.50	24.87	24.69	>100	>50	43.80	V	42
BH17	26.00	26.35	26.18	>100	>50	42.31	V	42
BH17	27.50	27.76	27.63	>100	>50	40.85	V	42
BH17	29.00	29.24	29.12	>100	>50	39.36	V	42
BH17	30.00	30.17	30.09	>100	>50	38.40	V	42
BH18	1.00	1.45	1.23	9	13	75.37	I	31
BH18	3.00	3.45	3.23	13	15	73.37	I	32
BH18	5.00	5.45	5.23	19	17	71.37	I	33
BH18	8.00	8.45	8.23	20	16	68.37	I	32
BH18	11.00	11.45	11.23	28	18	65.37	I	33
BH18	14.00	14.45	14.23	33	19	62.37	III	33
BH18	17.00	17.45	17.23	92	92	59.37	IV	
BH18	18.50	18.90	18.70	>100	100	57.89	IV	
BH18	20.00	20.37	20.19	>100	100	56.41	IV	
BH18	21.50	21.88	21.69	>100	100	54.90	IV	
BH18	23.00	23.45	23.23	46	20	53.37	III	34
BH18	24.50	24.95	24.73	64	24	51.87	III	35
BH18	26.00	26.45	26.23	67	24	50.37	III	35
BH18	27.50	27.95	27.73	68	24	48.87	V	35
BH18	29.00	29.45	29.23	79	26	47.37	V	36
BH18	30.50	30.95	30.73	84	27	45.87	V	36
BH18	32.00	32.45	32.23	75	24	44.37	V	35
BH18	33.50	33.91	33.71	>100	>50	42.89	V	42
BH18	35.00	35.38	35.19	>100	>50	41.40	V	42
BH19	1.00	1.45	1.23	7	10	66.25	I	30
BH19	3.00	3.45	3.23	9	10	64.25	I	30
BH19	5.00	5.45	5.23	10	10	62.25	I	30
BH19	8.00	8.45	8.23	43	43	59.25	IV	
BH19	11.00	11.45	11.23	98	45	56.25	V	41
BH19	14.00	14.45	14.23	80	35	53.25	V	38
BH19	15.50	15.95	15.73	78	34	51.75	V	38
BH19	17.00	17.45	17.23	74	74	50.25	IV	
BH19	18.50	18.95	18.73	87	87	48.75	IV	
BH19	20.00	20.34	20.17	>100	>50	47.30	V	42

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH19	21.50	21.83	21.67	>100	>50	45.81	V	42
BH19	23.00	23.23	23.12	>100	>50	44.36	V	42
BH19	24.50	24.84	24.67	>100	>50	42.80	V	42
BH19	26.00	26.26	26.13	>100	>50	41.34	V	42
BH19	27.50	27.71	27.61	>100	>50	39.87	V	42
BH19	29.00	29.23	29.12	>100	>50	38.36	V	42
BH19	30.00	30.20	30.10	>100	>50	37.37	V	42
BH20	1.00	1.45	1.23	8	12	65.21	I	31
BH20	3.00	3.45	3.23	16	17	63.21	I	33
BH20	5.00	5.45	5.23	15	15	61.21	I	32
BH20	8.00	8.45	8.23	13	13	58.21	II	
BH20	11.00	11.45	11.23	52	28	55.21	III	36
BH20	12.50	12.95	12.73	69	33	53.71	III	38
BH20	14.00	14.45	14.23	92	40	52.21	III	40
BH20	15.50	15.95	15.73	60	60	50.71	IV	
BH20	17.00	17.45	17.23	83	83	49.21	IV	
BH20	18.50	18.95	18.73	77	77	47.71	IV	
BH20	20.00	20.45	20.23	54	25	46.21	V	35
BH20	21.50	21.88	21.69	>100	>50	44.75	V	42
BH20	23.00	23.35	23.18	>100	>50	43.26	V	42
BH20	24.50	24.83	24.67	>100	>50	41.77	V	42
BH20	26.00	26.25	26.13	>100	>50	40.31	V	42
BH20	27.50	27.72	27.61	>100	>50	38.83	V	42
BH20	29.00	29.24	29.12	>100	>50	37.32	V	42
BH20	30.50	30.73	30.62	>100	>50	35.82	V	42
BH20	32.00	32.25	32.13	>100	>50	34.31	V	42
BH20	33.50	33.70	33.60	>100	>50	32.84	V	42
BH20	35.00	35.19	35.10	>100	>50	31.34	V	42
BH21	1.00	1.45	1.23	6	06	62.49	IIA	
BH21	3.00	3.45	3.23	7	07	60.49	IIA	
BH21	5.00	5.45	5.23	22	22	58.49	II	
BH21	8.00	8.45	8.23	41	25	55.49	III	36
BH21	11.00	11.45	11.23	52	52	52.49	IV	
BH21	14.00	14.45	14.23	57	57	49.49	IV	
BH21	15.50	15.95	15.73	58	58	47.99	IV	
BH21	17.00	17.36	17.18	>100	42	46.53	V	40
BH21	18.50	18.95	18.73	56	26	44.99	V	36
BH21	20.00	20.45	20.23	36	19	43.49	V	34
BH21	21.50	21.95	21.73	50	24	41.99	V	35
BH21	23.00	23.18	23.09	>100	>50	40.62	V	42
BH21	24.50	24.74	24.62	>100	>50	39.09	V	42
BH21	26.00	26.23	26.12	>100	>50	37.60	V	42

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH21	27.50	27.71	27.61	>100	>50	36.11	V	42
BH21	29.00	29.28	29.14	>100	>50	34.57	V	42
BH21	30.50	30.75	30.63	>100	>50	33.09	V	42
BH21	32.00	32.22	32.11	>100	>50	31.60	V	42
BH21	33.50	33.71	33.61	>100	>50	30.11	V	42
BH21	35.00	35.22	35.11	>100	>50	28.60	V	42
BH22	1.00	1.45	1.23	10	10	62.70	II	
BH22	3.00	3.45	3.23	12	12	60.70	II	
BH22	5.00	5.45	5.23	28	28	58.70	II	
BH22	8.00	8.45	8.23	56	32	55.70	III	37
BH22	9.80	10.25	10.03	55	30	53.90	III	37
BH22	11.50	11.95	11.73	77	77	52.20	IV	
BH22	13.00	13.45	13.23	53	53	50.70	IV	
BH22	14.50	14.95	14.73	35	35	49.20	IV	
BH22	16.00	16.45	16.23	40	40	47.70	IV	
BH22	17.50	17.95	17.73	43	43	46.20	IV	
BH22	19.00	19.45	19.23	44	44	44.70	IV	
BH22	20.50	20.95	20.73	33	33	43.20	IV	
BH22	22.00	22.45	22.23	58	25	41.70	V	36
BH22	23.50	23.74	23.62	>100	>50	40.31	V	42
BH22	25.00	25.45	25.23	54	23	38.70	V	35
BH22	26.50	26.95	26.73	47	21	37.20	V	34
BH22	28.00	28.45	28.23	38	18	35.70	V	33
BH22	29.50	29.95	29.73	34	34	34.20	IV	
BH22	31.00	31.45	31.23	45	45	32.70	IV	
BH22	32.50	32.95	32.73	49	49	31.20	IV	
BH22	34.00	34.23	34.12	>100	>50	29.81	V	42
BH22	35.00	35.21	35.11	>100	>50	28.82	V	42
BH23	1.00	1.45	1.23	14	14	63.12	II	
BH23	3.00	3.45	3.23	13	13	61.12	II	
BH23	5.00	5.45	5.23	22	22	59.12	II	
BH23	8.00	8.45	8.23	45	27	56.12	III	36
BH23	9.80	10.25	10.03	49	27	54.32	III	36
BH23	13.00	13.45	13.23	36	36	51.12	IV	
BH23	14.80	15.25	15.03	50	50	49.32	IV	
BH23	16.50	16.95	16.73	54	54	47.62	IV	
BH23	18.00	18.45	18.23	45	45	46.12	IV	
BH23	19.50	19.95	19.73	59	59	44.62	IV	
BH23	21.00	21.23	21.12	>100	>50	43.23	V	42
BH23	22.50	22.95	22.73	48	22	41.62	V	35
BH23	24.00	24.45	24.23	78	31	40.12	V	37
BH23	25.50	25.95	25.73	50	50	38.62	IV	

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH23	27.00	27.45	27.23	61	61	37.12	IV	
BH23	28.50	28.95	28.73	32	32	35.62	IV	
BH23	30.00	30.45	30.23	53	53	34.12	IV	
BH23	31.50	31.95	31.73	50	50	32.62	IV	
BH23	33.00	33.45	33.23	49	49	31.12	IV	
BH23	35.00	35.39	35.20	>100	100	29.15	IV	
BH24	1.00	1.45	1.23	7	10	62.64	I	30
BH24	3.00	3.45	3.23	10	10	60.64	II	
BH24	5.00	5.45	5.23	19	19	58.64	II	
BH24	8.00	8.45	8.23	32	32	55.64	II	
BH24	9.80	10.25	10.03	64	33	53.84	III	38
BH24	11.50	11.95	11.73	36	36	52.14	IV	
BH24	13.00	13.45	13.23	70	70	50.64	IV	
BH24	14.50	14.95	14.73	67	67	49.14	IV	
BH24	16.00	16.45	16.23	74	74	47.64	IV	
BH24	17.50	17.95	17.73	73	73	46.14	IV	
BH24	19.00	19.45	19.23	69	69	44.64	IV	
BH24	20.50	20.95	20.73	69	30	43.14	V	37
BH24	22.00	22.45	22.23	76	32	41.64	V	37
BH24	23.50	23.73	23.62	>100	>50	40.25	V	42
BH24	25.00	25.21	25.11	>100	>50	38.76	V	42
BH24	26.50	26.72	26.61	>100	>50	37.25	V	42
BH24	28.00	28.20	28.10	>100	>50	35.76	V	42
BH24	29.50	29.71	29.61	>100	>50	34.26	V	42
BH24	31.00	31.35	31.18	>100	>50	32.69	V	42
BH24	32.50	32.87	32.69	>100	>50	31.18	V	42
BH24	34.00	34.36	34.18	>100	>50	29.68	V	42
BH24	35.50	35.73	35.62	>100	>50	28.25	V	42
BH24	37.00	37.21	37.11	>100	>50	26.76	V	42
BH24	38.50	38.74	38.62	>100	>50	25.24	V	42
BH24	40.00	40.22	40.11	>100	>50	23.75	V	42
BH25	1.00	1.45	1.23	13	13	63.17	II	
BH25	3.00	3.45	3.23	10	10	61.17	II	
BH25	5.00	5.45	5.23	13	13	59.17	I	31
BH25	8.00	8.45	8.23	45	27	56.17	III	36
BH25	9.75	10.20	9.98	37	22	54.42	III	35
BH25	11.50	11.95	11.73	61	61	52.67	IV	
BH25	13.00	13.45	13.23	48	48	51.17	IV	
BH25	14.50	14.95	14.73	86	86	49.67	IV	
BH25	16.00	16.45	16.23	56	27	48.17	V	36
BH25	17.50	17.95	17.73	67	30	46.67	V	37
BH25	19.00	19.45	19.23	75	33	45.17	V	38

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH25	20.50	20.95	20.73	100	40	43.67	V	40
BH25	22.00	22.37	22.19	>100	40	42.21	V	40
BH25	23.50	23.95	23.73	56	25	40.67	V	35
BH25	25.00	25.28	25.14	>100	>50	39.25	V	42
BH25	26.50	26.77	26.64	>100	>50	37.76	V	42
BH25	28.00	28.25	28.13	>100	>50	36.27	V	42
BH25	30.00	30.23	30.12	>100	>50	34.28	V	42
BH25	31.50	31.74	31.62	>100	>50	32.77	V	42
BH25	33.00	33.22	33.11	>100	>50	31.28	V	42
BH25	34.50	34.69	34.60	>100	>50	29.80	V	42
BH25	36.00	36.18	36.09	>100	>50	28.30	V	42
BH25	37.50	37.70	37.60	>100	>50	26.79	V	42
BH25	39.00	39.17	39.09	>100	>50	25.31	V	42
BH25	40.00	40.19	40.10	>100	>50	24.30	V	42
BH26	1.00	1.45	1.23	5	07	64.58	I	29
BH26	3.00	3.45	3.23	11	13	62.58	I	31
BH26	5.00	5.45	5.23	14	14	60.58	I	32
BH26	8.00	8.45	8.23	20	20	57.58	II	
BH26	11.00	11.45	11.23	43	24	54.58	III	35
BH26	12.75	13.20	12.98	49	49	52.83	IV	
BH26	14.50	14.95	14.73	87	87	51.08	IV	
BH26	16.00	16.45	16.23	82	82	49.58	IV	
BH26	17.50	17.95	17.73	42	42	48.08	IV	
BH26	19.00	19.45	19.23	40	20	46.58	V	34
BH26	20.50	20.84	20.67	>100	>50	45.13	V	42
BH26	22.00	22.25	22.13	>100	>50	43.68	V	42
BH26	23.50	23.85	23.68	>100	>50	42.13	V	42
BH26	25.00	25.45	25.23	35	35	40.58	IV	
BH26	26.50	26.95	26.73	40	40	39.08	IV	
BH26	27.50	27.95	27.73	41	41	38.08	IV	
BH26	29.00	29.34	29.17	>100	>50	36.63	V	42
BH26	30.50	30.76	30.63	>100	>50	35.17	V	42
BH26	32.00	32.24	32.12	>100	>50	33.68	V	42
BH26	33.50	33.72	33.61	>100	>50	32.19	V	42
BH26	35.00	35.20	35.10	>100	>50	30.70	V	42
BH27	1.00	1.45	1.23	30	29	65.40	I	37
BH27	3.00	3.45	3.23	32	26	63.40	I	36
BH27	5.00	5.45	5.23	13	13	61.40	I	31
BH27	8.00	8.45	8.23	20	20	58.40	II	
BH27	9.80	10.25	10.03	53	29	56.60	III	37
BH27	11.50	11.95	11.73	56	29	54.90	III	37
BH27	13.00	13.45	13.23	59	29	53.40	III	37

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH27	14.50	14.95	14.73	67	67	51.90	IV	
BH27	16.00	16.45	16.23	91	91	50.40	IV	
BH27	17.50	17.90	17.70	>100	>50	48.92	V	42
BH27	19.00	19.24	19.12	>100	>50	47.50	V	42
BH27	20.50	20.76	20.63	>100	>50	45.99	V	42
BH27	22.00	22.25	22.13	>100	>50	44.50	V	42
BH27	23.50	23.72	23.61	>100	>50	43.01	V	42
BH27	25.00	25.27	25.14	>100	>50	41.49	V	42
BH27	26.50	26.74	26.62	>100	>50	40.00	V	42
BH27	28.00	28.22	28.11	>100	>50	38.51	V	42
BH27	29.50	29.75	29.63	>100	>50	37.00	V	42
BH27	31.00	31.23	31.12	>100	>50	35.51	V	42
BH27	32.50	32.74	32.62	>100	>50	34.00	V	42
BH27	34.00	34.21	34.11	>100	>50	32.52	V	42
BH27	35.00	35.20	35.10	>100	>50	31.52	V	42
BH28	1.00	1.45	1.23	49	49	64.39	Fill	
BH28	3.00	3.45	3.23	7	08	62.39	III	29
BH28	5.00	5.45	5.23	13	13	60.39	II	
BH28	8.00	8.45	8.23	15	13	57.39	III	31
BH28	11.00	11.45	11.23	27	18	54.39	III	33
BH28	13.05	13.50	13.28	28	18	52.34	III	33
BH28	14.50	14.95	14.73	40	40	50.89	IV	
BH28	17.50	17.75	17.63	>100	>50	47.99	V	42
BH28	19.00	19.23	19.12	>100	>50	46.50	V	42
BH28	20.50	20.69	20.60	>100	>50	45.02	V	42
BH28	22.00	22.24	22.12	>100	>50	43.49	V	42
BH28	23.50	23.72	23.61	>100	>50	42.00	V	42
BH28	25.00	25.24	25.12	>100	>50	40.49	V	42
BH28	26.50	26.70	26.60	>100	>50	39.01	V	42
BH28	28.00	28.27	28.14	>100	>50	37.48	V	42
BH28	29.50	29.78	29.64	>100	>50	35.97	V	42
BH28	31.00	31.23	31.12	>100	>50	34.50	V	42
BH28	32.50	32.70	32.60	>100	>50	33.01	V	42
BH28	34.00	34.21	34.11	>100	>50	31.51	V	42
BH28	35.00	35.18	35.09	>100	>50	30.52	V	42
BH29	1.00	1.45	1.23	5	07	66.53	I	29
BH29	3.00	3.45	3.23	10	11	64.53	I	31
BH29	5.00	5.45	5.23	27	21	62.53	I	34
BH29	8.00	8.45	8.23	37	37	59.53	IV	
BH29	11.00	11.45	11.23	62	31	56.53	III	37
BH29	12.80	13.25	13.03	60	29	54.73	III	37
BH29	14.50	14.95	14.73	46	23	53.03	III	35

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH29	16.00	16.45	16.23	47	47	51.53	IV	
BH29	17.50	17.95	17.73	52	52	50.03	IV	
BH29	19.00	19.45	19.23	39	39	48.53	IV	
BH29	20.50	20.95	20.73	72	30	47.03	V	37
BH29	22.00	22.37	22.19	>100	>50	45.57	V	42
BH29	23.50	23.85	23.68	>100	>50	44.08	V	42
BH29	25.00	25.34	25.17	>100	>50	42.58	V	42
BH29	26.50	26.75	26.63	>100	>50	41.13	V	42
BH29	28.00	28.23	28.12	>100	>50	39.64	V	42
BH29	29.50	29.74	29.62	>100	>50	38.13	V	42
BH29	31.00	31.27	31.14	>100	>50	36.62	V	42
BH29	32.50	32.73	32.62	>100	>50	35.14	V	42
BH29	34.00	34.20	34.10	>100	>50	33.65	V	42
BH29	35.00	35.19	35.10	>100	>50	32.66	V	42
BH30	1.00	1.45	1.23	40	40	77.62	Fill	
BH30	3.00	3.45	3.23	12	14	75.62	I	32
BH30	5.00	5.45	5.23	18	17	73.62	I	33
BH30	8.00	8.45	8.23	23	17	70.62	I	33
BH30	11.00	11.45	11.23	46	46	67.62	IV	
BH30	12.63	13.08	12.86	79	79	65.99	IV	
BH30	14.00	14.45	14.23	78	78	64.62	IV	
BH30	15.50	15.95	15.73	89	89	63.12	IV	
BH30	17.00	17.41	17.21	>100	>50	61.64	V	42
BH30	18.50	18.88	18.69	>100	>50	60.15	V	42
BH30	20.00	20.37	20.19	>100	>50	58.66	V	42
BH30	21.50	21.89	21.70	>100	>50	57.15	V	42
BH30	23.00	23.26	23.13	>100	>50	55.71	V	42
BH30	24.50	24.73	24.62	>100	>50	54.23	V	42
BH30	26.00	26.25	26.13	>100	>50	52.72	V	42
BH30	27.50	27.73	27.62	>100	>50	51.23	V	42
BH30	29.00	29.37	29.19	>100	>50	49.66	V	42
BH30	30.50	30.76	30.63	>100	>50	48.21	V	42
BH30	32.00	32.28	32.14	>100	>50	46.70	V	42
BH30	33.50	33.90	33.70	>100	>50	45.14	V	42
BH30	35.00	35.38	35.19	>100	>50	43.65	V	42
BH30	36.50	36.73	36.62	>100	>50	42.23	V	42
BH30	38.00	38.22	38.11	>100	>50	40.73	V	42
BH30	40.00	40.22	40.11	>100	>50	38.73	V	42
BH31	1.00	1.45	1.23	32	32	78.68	Fill	
BH31	2.13	2.58	2.36	28	28	77.55	Fill	
BH31	3.00	3.45	3.23	17	17	76.68	I	33
BH31	5.00	5.45	5.23	29	22	74.68	I	35

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH31	8.00	8.45	8.23	37	37	71.68	IV	
BH31	11.00	11.45	11.23	79	38	68.68	V	39
BH31	12.50	12.95	12.73	67	32	67.18	V	38
BH31	14.00	14.45	14.23	88	38	65.68	V	39
BH31	15.50	15.95	15.73	93	38	64.18	V	39
BH31	17.00	17.41	17.21	>100	>50	62.70	V	42
BH31	18.50	18.89	18.70	>100	>50	61.21	V	42
BH31	20.00	20.37	20.19	>100	>50	59.72	V	42
BH31	21.50	21.95	21.73	>100	>50	58.18	V	42
BH31	23.00	23.45	23.23	92	31	56.68	V	37
BH31	24.50	24.89	24.70	>100	>50	55.21	V	42
BH31	26.00	26.39	26.20	>100	>50	53.71	V	42
BH31	27.50	27.87	27.69	>100	>50	52.22	V	42
BH31	29.00	29.37	29.19	>100	>50	50.72	V	42
BH31	30.50	30.84	30.67	>100	>50	49.24	V	42
BH31	32.00	32.27	32.14	>100	>50	47.77	V	42
BH31	33.50	33.74	33.62	>100	>50	46.29	V	42
BH31	35.00	35.28	35.14	>100	>50	44.77	V	42
BH31	36.50	36.73	36.62	>100	>50	43.29	V	42
BH31	38.00	38.25	38.13	>100	>50	41.78	V	42
BH31	40.00	40.22	40.11	>100	>50	39.80	V	42
BH32	1.00	1.45	1.23	42	42	78.69	Fill	
BH32	3.00	3.45	3.23	11	13	76.69	I	31
BH32	5.00	5.45	5.23	16	16	74.69	I	32
BH32	8.00	8.45	8.23	25	18	71.69	I	33
BH32	11.00	11.45	11.23	24	24	68.69	II	
BH32	12.80	13.25	13.03	58	58	66.89	IV	
BH32	14.00	14.45	14.23	72	72	65.69	IV	
BH32	15.50	15.90	15.70	>100	100	64.22	IV	
BH32	17.00	17.37	17.19	>100	>50	62.73	V	42
BH32	18.50	18.89	18.70	>100	>50	61.22	V	42
BH32	20.00	20.40	20.20	>100	>50	59.72	V	42
BH32	21.50	21.87	21.69	>100	>50	58.23	V	42
BH32	23.00	23.20	23.10	>100	>50	56.82	V	42
BH32	24.50	24.88	24.69	>100	>50	55.23	V	42
BH32	26.00	26.24	26.12	>100	>50	53.80	V	42
BH32	27.50	27.68	27.59	>100	>50	52.33	V	42
BH32	29.00	29.42	29.21	>100	>50	50.71	V	42
BH32	30.50	30.87	30.69	>100	>50	49.23	V	42
BH32	32.00	32.39	32.20	>100	>50	47.72	V	42
BH32	33.50	33.78	33.64	>100	>50	46.28	V	42
BH32	35.00	35.24	35.12	>100	>50	44.80	V	42
BH32	36.50	36.73	36.62	>100	>50	43.30	V	42

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH32	38.00	38.22	38.11	>100	>50	41.81	V	42
BH32	40.00	40.24	40.12	>100	>50	39.80	V	42
BH33	1.00	1.45	1.23	9	09	75.25	Fill	
BH33	3.00	3.45	3.23	17	17	73.25	I	33
BH33	5.00	5.45	5.23	28	22	71.25	I	34
BH33	8.00	8.45	8.23	32	21	68.25	III	34
BH33	11.00	11.25	11.13	>100	100	65.35	IV	
BH33	12.50	12.89	12.70	>100	100	63.78	IV	
BH33	14.00	14.26	14.13	>100	100	62.35	IV	
BH33	15.50	15.74	15.62	>100	100	60.86	IV	
BH33	17.00	17.22	17.11	>100	100	59.37	IV	
BH33	18.50	18.70	18.60	>100	>50	57.88	V	42
BH33	20.00	20.23	20.12	>100	>50	56.36	V	42
BH33	21.50	21.95	21.73	79	79	54.75	IV	
BH33	23.00	23.45	23.23	84	84	53.25	IV	
BH33	24.50	24.90	24.70	>100	>50	51.78	V	42
BH33	26.00	26.35	26.18	>100	>50	50.30	V	42
BH33	27.50	27.75	27.63	>100	>50	48.85	V	42
BH33	29.00	29.23	29.12	>100	>50	47.36	V	42
BH33	30.50	30.85	30.68	>100	>50	45.80	V	42
BH33	32.00	32.24	32.12	>100	>50	44.36	V	42
BH33	33.50	33.72	33.61	>100	>50	42.87	V	42
BH33	35.00	35.23	35.12	>100	>50	41.36	V	42
BH33	36.50	36.74	36.62	>100	>50	39.86	V	42
BH33	38.00	38.22	38.11	>100	>50	38.37	V	42
BH33	40.00	40.23	40.12	>100	>50	36.36	V	42
BH34	1.00	1.45	1.23	11	16	78.16	I	32
BH34	3.00	3.45	3.23	10	11	76.16	I	31
BH34	5.00	5.45	5.23	17	16	74.16	I	32
BH34	8.00	8.45	8.23	21	17	71.16	I	33
BH34	11.00	11.45	11.23	48	48	68.16	IV	
BH34	12.65	13.10	12.88	38	38	66.51	IV	
BH34	14.00	14.45	14.23	54	54	65.16	IV	
BH34	15.50	15.95	15.73	67	67	63.66	IV	
BH34	17.00	17.45	17.23	78	78	62.16	IV	
BH34	18.50	18.72	18.61	>100	100	60.78	IV	
BH34	20.00	20.38	20.19	>100	100	59.20	IV	
BH34	21.50	21.86	21.68	>100	100	57.71	IV	
BH34	23.00	23.45	23.23	>100	100	56.16	IV	
BH34	24.50	24.89	24.70	>100	100	54.69	IV	
BH34	26.00	26.45	26.23	34	16	53.16	III	32
BH34	27.50	27.95	27.73	46	18	51.66	III	33

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH34	29.30	29.75	29.53	59	21	49.86	III	34
BH34	31.00	31.45	31.23	77	77	48.16	IV	
BH34	32.50	32.84	32.67	>100	>50	46.72	V	42
BH34	34.00	34.36	34.18	>100	>50	45.21	V	42
BH34	35.50	35.75	35.63	>100	>50	43.76	V	42
BH34	37.00	37.22	37.11	>100	>50	42.28	V	42
BH34	38.50	38.74	38.62	>100	>50	40.77	V	42
BH34	40.00	40.23	40.12	>100	>50	39.27	V	42
BH35	1.00	1.45	1.23	3	04	66.79	I	28
BH35	3.00	3.45	3.23	3	03	64.79	I	27
BH35	5.00	5.45	5.23	15	15	62.79	I	32
BH35	8.00	8.45	8.23	88	88	59.79	IV	
BH35	11.00	11.27	11.14	>100	100	56.88	IV	
BH35	12.00	12.45	12.23	90	41	55.79	V	40
BH35	14.00	14.45	14.23	86	37	53.79	V	39
BH35	15.50	15.95	15.73	78	34	52.29	V	38
BH35	17.00	17.45	17.23	77	33	50.79	V	38
BH35	18.50	18.95	18.73	91	36	49.29	V	39
BH35	20.00	20.45	20.23	76	31	47.79	V	37
BH35	22.00	22.28	22.14	>100	>50	45.87	V	42
BH35	23.50	23.72	23.61	>100	>50	44.40	V	42
BH35	25.00	25.17	25.09	>100	>50	42.93	V	42
BH35	26.50	26.71	26.61	>100	>50	41.41	V	42
BH35	28.00	28.24	28.12	>100	>50	39.89	V	42
BH35	29.50	29.68	29.59	>100	>50	38.42	V	42
BH35	31.00	31.23	31.12	>100	>50	36.90	V	42
BH35	32.00	32.20	32.10	>100	>50	35.91	V	42
BH35	33.50	33.74	33.62	>100	>50	34.39	V	42
BH35	35.00	35.19	35.10	>100	>50	32.92	V	42
BH36	1.00	1.45	1.23	7	10	65.02	I	30
BH36	3.00	3.45	3.23	13	15	63.02	I	32
BH36	5.00	5.45	5.23	14	14	61.02	I	32
BH36	8.00	8.45	8.23	29	20	58.02	I	34
BH36	11.00	11.45	11.23	86	86	55.02	IV	
BH36	12.50	12.95	12.73	76	76	53.52	IV	
BH36	14.00	14.45	14.23	75	34	52.02	V	38
BH36	15.50	15.95	15.73	89	38	50.52	V	39
BH36	17.00	17.45	17.23	65	29	49.02	V	37
BH36	18.50	18.95	18.73	69	30	47.52	V	37
BH36	20.00	20.45	20.23	68	29	46.02	V	37
BH36	21.50	21.95	21.73	94	37	44.52	V	39
BH36	23.00	23.21	23.11	>100	>50	43.14	V	42

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH36	24.50	24.68	24.59	>100	>50	41.66	V	42
BH36	26.00	26.22	26.11	>100	>50	40.14	V	42
BH36	27.50	27.88	27.69	>100	>50	38.56	V	42
BH36	29.00	29.28	29.14	>100	>50	37.11	V	42
BH36	30.00	30.26	30.13	>100	>50	36.12	V	42
BH37	1.00	1.45	1.23	14	18	62.80	I	33
BH37	3.00	3.45	3.23	15	16	60.80	I	32
BH37	4.80	5.25	5.03	11	11	59.00	I	30
BH37	8.00	8.45	8.23	20	16	55.80	I	32
BH37	11.00	11.45	11.23	30	30	52.80	IV	
BH37	12.75	13.20	12.98	43	43	51.05	IV	
BH37	14.50	14.95	14.73	48	48	49.30	IV	
BH37	16.00	16.45	16.23	95	41	47.80	V	40
BH37	17.50	17.93	17.72	>100	>50	46.31	V	42
BH37	19.00	19.35	19.18	>100	>50	44.85	V	42
BH37	20.50	20.90	20.70	>100	>50	43.33	V	42
BH37	22.00	22.39	22.20	>100	>50	41.83	V	42
BH37	23.50	23.87	23.69	>100	100	40.34	IV	
BH37	25.00	25.34	25.17	>100	100	38.86	IV	
BH37	26.50	26.95	26.73	52	52	37.30	IV	
BH37	28.00	28.45	28.23	59	59	35.80	IV	
BH37	29.50	29.95	29.73	73	73	34.30	IV	
BH37	31.00	31.45	31.23	77	77	32.80	IV	
BH37	32.50	32.95	32.73	82	30	31.30	V	37
BH37	34.00	34.22	34.11	>100	>50	29.92	V	42
BH37	35.50	35.70	35.60	>100	>50	28.43	V	42
BH37	37.00	37.18	37.09	>100	>50	26.94	V	42
BH37	38.50	38.69	38.60	>100	>50	25.43	V	42
BH37	40.00	40.17	40.09	>100	>50	23.94	V	42
BH38	1.00	1.45	1.23	11	16	62.46	I	32
BH38	3.00	3.45	3.23	11	13	60.46	I	31
BH38	5.00	5.45	5.23	13	13	58.46	I	31
BH38	8.00	8.45	8.23	43	26	55.46	III	36
BH38	9.80	10.25	10.03	48	27	53.66	III	36
BH38	11.50	11.95	11.73	45	25	51.96	III	35
BH38	13.00	13.45	13.23	38	38	50.46	IV	
BH38	14.50	14.95	14.73	57	57	48.96	IV	
BH38	16.00	16.45	16.23	36	36	47.46	IV	
BH38	17.80	18.25	18.03	39	39	45.66	IV	
BH38	19.00	19.45	19.23	80	80	44.46	IV	
BH38	20.50	20.95	20.73	55	55	42.96	IV	
BH38	22.00	22.45	22.23	84	34	41.46	V	38

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH38	23.50	23.87	23.69	>100	>50	40.00	V	42
BH38	25.00	25.45	25.23	73	73	38.46	IV	
BH38	26.50	26.77	26.64	>100	>50	37.05	V	42
BH38	28.00	28.40	28.20	>100	>50	35.48	V	42
BH38	29.50	29.87	29.69	>100	>50	34.00	V	42
BH38	31.00	31.45	31.23	68	26	32.46	V	36
BH38	32.50	32.95	32.73	82	30	30.96	V	37
BH38	34.00	34.45	34.23	97	33	29.46	V	38
BH38	35.00	35.18	35.09	>100	>50	28.59	V	42
BH39	1.00	1.45	1.23	7	10	62.30	I	30
BH39	3.00	3.45	3.23	12	14	60.30	I	32
BH39	5.00	5.45	5.23	19	19	58.30	II	
BH39	8.00	8.45	8.23	36	36	55.30	II	
BH39	9.50	9.95	9.73	43	25	53.80	III	35
BH39	11.00	11.45	11.23	45	25	52.30	III	35
BH39	12.50	12.95	12.73	34	20	50.80	III	34
BH39	14.00	14.45	14.23	38	21	49.30	III	34
BH39	15.50	15.95	15.73	53	53	47.80	IV	
BH39	17.00	17.45	17.23	61	61	46.30	IV	
BH39	18.50	18.95	18.73	52	52	44.80	IV	
BH39	19.50	19.95	19.73	71	30	43.80	V	37
BH39	21.00	21.45	21.23	74	31	42.30	V	37
BH39	22.50	22.95	22.73	80	32	40.80	V	38
BH39	24.00	24.45	24.23	83	32	39.30	V	38
BH39	25.50	25.95	25.73	92	34	37.80	V	38
BH39	27.00	27.38	27.19	>100	>50	36.33	V	42
BH39	28.50	28.90	28.70	>100	>50	34.82	V	42
BH39	30.00	30.28	30.14	>100	>50	33.38	V	42
BH39	31.50	31.75	31.63	>100	>50	31.90	V	42
BH39	33.00	33.20	33.10	>100	>50	30.42	V	42
BH39	34.50	34.70	34.60	>100	>50	28.92	V	42
BH39	35.00	35.45	35.23	80	28	28.30	V	36
BH40	1.00	1.45	1.23	4	04	65.15	Fill	
BH40	3.00	3.45	3.23	15	16	63.15	I	32
BH40	5.00	5.45	5.23	12	12	61.15	I	31
BH40	8.00	8.45	8.23	17	17	58.15	II	
BH40	11.00	11.45	11.23	26	26	55.15	II	
BH40	14.00	14.45	14.23	41	22	52.15	III	35
BH40	15.75	16.20	15.98	49	49	50.40	IV	
BH40	17.50	17.95	17.73	65	65	48.65	IV	
BH40	19.00	19.45	19.23	95	39	47.15	V	39
BH40	20.50	20.95	20.73	91	37	45.65	V	39

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH40	22.00	22.37	22.19	>100	100	44.19	IV	
BH40	23.50	23.84	23.67	>100	100	42.71	IV	
BH40	25.00	25.19	25.10	>100	100	41.28	IV	
BH40	26.50	26.78	26.64	>100	>50	39.74	V	42
BH40	28.00	28.21	28.11	>100	100	38.27	IV	
BH40	29.50	29.95	29.73	83	83	36.65	IV	
BH40	31.00	31.35	31.18	>100	100	35.20	IV	
BH40	32.50	32.83	32.67	>100	>50	33.71	V	42
BH40	34.00	34.28	34.14	>100	>50	32.24	V	42
BH40	35.00	35.18	35.09	>100	>50	31.29	V	42
BH40	37.00	37.17	37.09	>100	>50	29.29	V	42
BH41	1.00	1.45	1.23	28	28	62.59	I	36
BH41	3.00	3.45	3.23	9	10	60.59	I	30
BH41	5.00	5.45	5.23	13	13	58.59	II	
BH41	8.00	8.45	8.23	58	33	55.59	III	38
BH41	9.50	9.95	9.73	63	33	54.09	III	38
BH41	11.00	11.45	11.23	68	34	52.59	III	38
BH41	12.50	12.95	12.73	54	27	51.09	III	36
BH41	14.00	14.45	14.23	58	28	49.59	III	36
BH41	15.50	15.95	15.73	41	41	48.09	IV	
BH41	17.00	17.45	17.23	45	45	46.59	IV	
BH41	18.50	18.95	18.73	50	50	45.09	IV	
BH41	20.00	20.25	20.13	>100	>50	43.69	V	42
BH41	21.50	21.70	21.60	>100	>50	42.21	V	42
BH41	23.00	23.18	23.09	>100	>50	40.72	V	42
BH41	24.50	24.65	24.58	>100	>50	39.24	V	42
BH41	26.00	26.45	26.23	81	31	37.59	V	37
BH41	27.50	27.90	27.70	>100	>50	36.11	V	42
BH41	29.00	29.20	29.10	>100	>50	34.71	V	42
BH41	30.50	30.95	30.73	92	32	33.09	V	38
BH41	32.00	32.35	32.18	>100	>50	31.64	V	42
BH41	33.50	33.80	33.65	>100	>50	30.16	V	42
BH41	35.00	35.36	35.18	>100	>50	28.63	V	42
BH42	1.00	1.45	1.23	5	07	62.39	I	29
BH42	3.00	3.45	3.23	7	08	60.39	I	29
BH42	5.00	5.45	5.23	31	31	58.39	II	
BH42	8.00	8.45	8.23	40	40	55.39	II	
BH42	10.00	10.45	10.23	43	43	53.39	IV	
BH42	11.50	11.95	11.73	47	47	51.89	IV	
BH42	13.00	13.45	13.23	45	45	50.39	IV	
BH42	14.50	14.95	14.73	42	42	48.89	IV	
BH42	16.00	16.45	16.23	53	53	47.39	IV	

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH42	17.50	17.95	17.73	57	57	45.89	IV	
BH42	19.00	19.45	19.23	88	36	44.39	V	39
BH42	20.50	20.92	20.71	>100	>50	42.91	V	42
BH42	22.00	22.40	22.20	>100	>50	41.42	V	42
BH42	23.50	23.85	23.68	>100	>50	39.94	V	42
BH42	25.00	25.45	25.23	91	34	38.39	V	38
BH42	26.50	26.95	26.73	68	27	36.89	V	36
BH42	28.00	28.45	28.23	50	22	35.39	V	34
BH42	29.50	29.75	29.63	>100	>50	33.99	V	42
BH42	31.00	31.25	31.13	>100	>50	32.49	V	42
BH42	32.50	32.70	32.60	>100	>50	31.02	V	42
BH42	34.00	34.21	34.11	>100	>50	29.51	V	42
BH42	35.50	35.75	35.63	>100	>50	27.99	V	42
BH42	37.00	37.20	37.10	>100	>50	26.52	V	42
BH42	38.50	38.65	38.58	>100	>50	25.04	V	42
BH42	40.00	40.10	40.05	>100	>50	23.57	V	42
BH43	1.00	1.45	1.23	15	15	62.30	II	
BH43	3.00	3.45	3.23	17	17	60.30	II	
BH43	5.00	5.45	5.23	31	31	58.30	II	
BH43	8.00	8.45	8.23	38	24	55.30	III	35
BH43	9.50	9.95	9.73	42	25	53.80	III	35
BH43	11.00	11.45	11.23	53	28	52.30	III	36
BH43	12.50	12.95	12.73	58	29	50.80	III	37
BH43	14.00	14.45	14.23	34	19	49.30	III	34
BH43	15.50	15.95	15.73	36	20	47.80	III	34
BH43	17.00	17.45	17.23	39	21	46.30	III	34
BH43	18.50	18.95	18.73	43	22	44.80	III	34
BH43	20.00	20.45	20.23	29	17	43.30	III	33
BH43	21.50	21.95	21.73	41	20	41.80	III	34
BH43	23.00	23.45	23.23	45	21	40.30	III	34
BH43	24.50	24.95	24.73	46	21	38.80	III	34
BH43	26.00	26.45	26.23	50	22	37.30	III	34
BH43	27.50	27.95	27.73	59	24	35.80	V	35
BH43	28.50	28.95	28.73	78	29	34.80	V	37
BH43	30.00	30.45	30.23	90	32	33.30	V	38
BH44	1.00	1.45	1.23	21	23	62.81	I	35
BH44	3.00	3.45	3.23	10	11	60.81	I	31
BH44	5.00	5.45	5.23	9	09	58.81	I	30
BH44	8.00	8.45	8.23	28	28	55.81	II	
BH44	11.00	11.45	11.23	45	45	52.81	IV	
BH44	14.50	14.95	14.73	81	81	49.31	IV	
BH44	16.00	16.45	16.23	87	87	47.81	IV	

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH44	17.50	17.84	17.67	>100	100	46.36	IV	
BH44	19.00	19.45	19.23	76	76	44.81	IV	
BH44	20.50	20.95	20.73	42	21	43.31	III	34
BH44	22.00	22.45	22.23	45	21	41.81	III	34
BH44	23.50	23.95	23.73	51	51	40.31	IV	
BH44	25.00	25.45	25.23	54	54	38.81	IV	
BH44	26.50	26.95	26.73	58	58	37.31	IV	
BH44	28.00	28.45	28.23	60	60	35.81	IV	
BH44	29.50	29.95	29.73	81	81	34.31	IV	
BH44	31.00	31.25	31.13	>100	>50	32.91	V	42
BH44	32.50	32.72	32.61	>100	>50	31.42	V	42
BH44	33.50	33.67	33.59	>100	>50	30.45	V	42
BH44	35.00	35.21	35.11	>100	>50	28.93	V	42
BH45	1.00	1.45	1.23	6	06	63.81	Fill	
BH45	3.00	3.45	3.23	9	10	61.81	I	30
BH45	5.00	5.45	5.23	19	19	59.81	II	
BH45	8.00	8.45	8.23	49	49	56.81	IV	
BH45	9.75	10.20	9.98	52	52	55.06	IV	
BH45	11.00	11.45	11.23	90	42	53.81	III	40
BH45	12.50	12.95	12.73	64	31	52.31	III	37
BH45	14.00	14.45	14.23	53	53	50.81	IV	
BH45	15.50	15.95	15.73	54	54	49.31	IV	
BH45	17.00	17.45	17.23	46	46	47.81	IV	
BH45	18.50	18.95	18.73	63	63	46.31	IV	
BH45	20.00	20.45	20.23	76	76	44.81	IV	
BH45	21.50	21.95	21.73	90	90	43.31	IV	
BH45	23.00	23.32	23.16	>100	100	41.88	IV	
BH45	24.50	24.88	24.69	>100	100	40.35	IV	
BH45	26.00	26.28	26.14	>100	100	38.90	IV	
BH45	27.50	27.73	27.62	>100	>50	37.42	V	42
BH45	29.00	29.21	29.11	>100	>50	35.93	V	42
BH45	30.50	30.69	30.60	>100	>50	34.44	V	42
BH45	31.50	31.74	31.62	>100	>50	33.42	V	42
BH45	33.00	33.27	33.14	>100	>50	31.90	V	42
BH45	34.50	34.68	34.59	>100	>50	30.45	V	42
BH45	35.50	35.82	35.66	>100	>50	29.38	V	42
BH45	37.00	37.28	37.14	>100	>50	27.90	V	42
BH46	1.00	1.45	1.23	9	09	62.22	II	
BH46	3.00	3.45	3.23	23	23	60.22	II	
BH46	5.00	5.45	5.23	39	39	58.22	II	
BH46	6.75	7.20	6.98	61	35	56.47	V	38
BH46	8.50	8.95	8.73	73	38	54.72	V	39

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH46	10.00	10.37	10.19	>100	>50	53.26	V	42
BH46	11.50	11.83	11.67	>100	>50	51.78	V	42
BH46	12.50	12.79	12.65	>100	>50	50.80	V	42
BH46	13.50	13.88	13.69	>100	>50	49.76	V	42
BH46	15.00	15.41	15.21	>100	>50	48.24	V	42
BH46	16.50	16.95	16.73	97	40	46.72	V	40
BH46	18.00	18.45	18.23	86	36	45.22	V	39
BH46	19.50	19.95	19.73	62	62	43.72	IV	
BH46	21.00	21.45	21.23	78	78	42.22	IV	
BH46	22.50	22.95	22.73	49	23	40.72	III	35
BH46	24.00	24.45	24.23	54	24	39.22	III	35
BH46	25.50	25.78	25.64	>100	>50	37.81	V	42
BH46	27.00	27.25	27.13	>100	>50	36.32	V	42
BH46	28.50	28.73	28.62	>100	>50	34.83	V	42
BH46	30.00	30.24	30.12	>100	>50	33.33	V	42
BH46	31.50	31.72	31.61	>100	>50	31.84	V	42
BH46	33.00	33.25	33.13	>100	>50	30.32	V	42
BH46	34.00	34.20	34.10	>100	>50	29.35	V	42
BH46	35.00	35.18	35.09	>100	>50	28.36	V	42
BH47	1.00	1.45	1.23	6	06	63.06	IIA	
BH47	3.00	3.45	3.23	10	10	61.06	II	
BH47	5.00	5.45	5.23	13	13	59.06	II	
BH47	8.00	8.45	8.23	19	19	56.06	II	
BH47	11.00	11.45	11.23	49	26	53.06	III	36
BH47	12.75	13.20	12.98	34	34	51.31	IV	
BH47	14.50	14.95	14.73	27	27	49.56	IV	
BH47	16.00	16.45	16.23	43	43	48.06	IV	
BH47	17.50	17.95	17.73	42	42	46.56	IV	
BH47	19.00	19.45	19.23	54	54	45.06	IV	
BH47	20.50	20.95	20.73	100	100	43.56	IV	
BH47	22.00	22.45	22.23	98	98	42.06	IV	
BH47	23.50	23.75	23.63	>100	100	40.66	IV	
BH47	25.00	25.25	25.13	>100	100	39.16	IV	
BH47	26.50	26.74	26.62	>100	100	37.66	IV	
BH47	28.00	28.21	28.11	>100	>50	36.18	V	42
BH47	29.50	29.69	29.60	>100	>50	34.69	V	42
BH47	31.00	31.20	31.10	>100	>50	33.18	V	42
BH47	32.50	32.68	32.59	>100	>50	31.69	V	42
BH47	34.00	34.19	34.10	>100	>50	30.19	V	42
BH47	35.00	35.18	35.09	>100	>50	29.19	V	42
BH48	1.00	1.45	1.23	8	08	62.90	Fill	
BH48	3.00	3.45	3.23	6	06	60.90	Fill	

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH48	5.00	5.45	5.23	10	10	58.90	II	
BH48	8.00	8.45	8.23	15	15	55.90	II	
BH48	11.00	11.45	11.23	17	13	52.90	I	31
BH48	14.00	14.45	14.23	37	37	49.90	IV	
BH48	15.80	16.25	16.03	46	46	48.10	IV	
BH48	17.50	17.95	17.73	45	45	46.40	IV	
BH48	19.00	19.45	19.23	51	51	44.90	IV	
BH48	21.00	21.38	21.19	>100	>50	42.94	V	42
BH48	22.50	22.95	22.73	100	>50	41.40	V	42
BH48	24.00	24.45	24.23	>100	>50	39.90	V	42
BH48	25.50	25.72	25.61	>100	>50	38.52	V	42
BH48	27.00	27.21	27.11	>100	>50	37.02	V	42
BH48	28.50	28.68	28.59	>100	>50	35.54	V	42
BH48	30.00	30.20	30.10	>100	>50	34.03	V	42
BH48	31.50	31.71	31.61	>100	>50	32.52	V	42
BH48	33.00	33.19	33.10	>100	>50	31.03	V	42
BH48	34.50	34.71	34.61	>100	>50	29.52	V	42
BH48	35.00	35.18	35.09	>100	>50	29.04	V	42
BH49	1.00	1.45	1.23	16	16	63.79	Fill	
BH49	3.00	3.45	3.23	33	33	61.79	II	
BH49	5.00	5.45	5.23	28	28	59.79	II	
BH49	8.00	8.45	8.23	73	73	56.79	IV	
BH49	9.80	10.25	10.03	53	53	54.99	IV	
BH49	11.50	11.88	11.69	>100	45	53.32	V	41
BH49	13.50	13.82	13.66	>100	45	51.35	V	41
BH49	15.00	15.23	15.12	>100	45	49.90	V	41
BH49	16.50	16.69	16.60	>100	45	48.42	V	41
BH49	18.00	18.26	18.13	>100	45	46.88	V	41
BH49	19.50	19.95	19.73	50	24	45.29	V	35
BH49	21.00	21.45	21.23	72	30	43.79	V	37
BH49	23.00	23.37	23.19	>100	>50	41.82	V	42
BH49	24.50	24.78	24.64	>100	>50	40.36	V	42
BH49	26.00	26.23	26.12	>100	>50	38.89	V	42
BH49	27.50	27.83	27.67	>100	>50	37.34	V	42
BH49	29.00	29.27	29.14	>100	>50	35.87	V	42
BH49	30.50	30.85	30.68	>100	>50	34.33	V	42
BH49	32.00	32.31	32.16	>100	>50	32.85	V	42
BH49	33.50	33.76	33.63	>100	>50	31.37	V	42
BH49	35.00	35.24	35.12	>100	>50	29.88	V	42
BH49	37.00	37.22	37.11	>100	>50	27.89	V	42
BH50	1.00	1.45	1.23	4	06	63.07	I	28
BH50	3.00	3.45	3.23	5	06	61.07	I	28

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH50	5.00	5.45	5.23	10	10	59.07	II	
BH50	8.00	8.45	8.23	15	15	56.07	II	
BH50	11.00	11.45	11.23	57	29	53.07	III	37
BH50	12.80	13.25	13.03	54	27	51.27	III	36
BH50	14.50	14.95	14.73	42	22	49.57	III	35
BH50	16.00	16.45	16.23	31	18	48.07	III	33
BH50	17.50	17.74	17.62	>100	41	46.68	V	40
BH50	19.00	19.45	19.23	86	35	45.07	V	38
BH50	20.50	20.95	20.73	81	33	43.57	V	38
BH50	22.00	22.34	22.17	>100	>50	42.13	V	42
BH50	24.00	24.27	24.14	>100	>50	40.16	V	42
BH50	25.50	25.95	25.73	79	38	38.57	V	39
BH50	27.00	27.45	27.23	94	34	37.07	V	38
BH50	28.50	28.74	28.62	>100	>50	35.68	V	42
BH50	30.00	30.22	30.11	>100	>50	34.19	V	42
BH50	31.50	31.74	31.62	>100	>50	32.68	V	42
BH50	33.00	33.23	33.12	>100	>50	31.18	V	42
BH50	34.50	34.75	34.63	>100	>50	29.67	V	42
BH50	35.00	35.19	35.10	>100	>50	29.20	V	42
BH51	1.00	1.45	1.23	5	05	60.29	Fill	
BH51	3.00	3.45	3.23	14	14	58.29	II	
BH51	5.00	5.45	5.23	11	11	56.29	II	
BH51	8.00	8.45	8.23	12	12	53.29	II	
BH51	11.00	11.45	11.23	51	27	50.29	III	36
BH51	12.50	12.95	12.73	30	30	48.79	II	
BH51	14.00	14.45	14.23	39	22	47.29	III	34
BH51	15.50	15.95	15.73	43	23	45.79	III	35
BH51	17.00	17.45	17.23	60	28	44.29	III	37
BH51	18.50	18.95	18.73	61	28	42.79	III	36
BH51	20.00	20.45	20.23	55	26	41.29	III	36
BH51	21.50	21.95	21.73	67	29	39.79	V	37
BH51	23.00	23.45	23.23	61	27	38.29	V	36
BH51	24.50	24.95	24.73	64	27	36.79	V	36
BH51	26.00	26.45	26.23	74	30	35.29	V	37
BH51	27.50	27.85	27.68	>100	>50	33.84	V	42
BH51	29.00	29.28	29.14	>100	>50	32.38	V	42
BH51	30.50	30.73	30.62	>100	>50	30.90	V	42
BH51	32.00	32.21	32.11	>100	>50	29.41	V	42
BH51	33.50	33.69	33.60	>100	>50	27.92	V	42
BH51	35.00	35.20	35.10	>100	>50	26.42	V	42
BH52	1.00	1.45	1.23	8	12	63.75	I	31
BH52	3.00	3.45	3.23	18	18	61.75	I	33

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH52	5.00	5.45	5.23	24	20	59.75	I	34
BH52	8.00	8.45	8.23	39	39	56.75	II	
BH52	11.00	11.36	11.18	>100	46	53.79	III	41
BH52	12.50	12.83	12.67	>100	46	52.31	III	41
BH52	14.00	14.45	14.23	41	22	50.75	III	34
BH52	15.50	15.95	15.73	44	22	49.25	III	35
BH52	17.00	17.45	17.23	41	21	47.75	III	34
BH52	18.00	18.45	18.23	35	19	46.75	III	33
BH52	19.50	19.95	19.73	55	55	45.25	IV	
BH52	21.00	21.45	21.23	78	78	43.75	IV	
BH52	22.50	22.95	22.73	81	81	42.25	IV	
BH52	24.00	24.45	24.23	86	86	40.75	IV	
BH52	25.50	25.95	25.73	88	88	39.25	IV	
BH52	27.00	27.45	27.23	95	95	37.75	IV	
BH52	28.50	28.84	28.67	>100	>50	36.30	V	42
BH52	30.00	30.22	30.11	>100	>50	34.86	V	42
BH52	31.50	31.68	31.59	>100	>50	33.38	V	42
BH52	33.00	33.27	33.14	>100	>50	31.84	V	42
BH52	34.50	34.73	34.62	>100	>50	30.36	V	42
BH52	36.00	36.25	36.13	>100	>50	28.85	V	42
BH52	37.50	37.71	37.61	>100	>50	27.37	V	42
BH52	39.00	39.19	39.10	>100	>50	25.88	V	42
BH52	40.00	40.22	40.11	>100	>50	24.86	V	42
BH53	1.00	1.45	1.23	5	05	71.00	Fill	
BH53	3.00	3.45	3.23	6	06	69.00	Fill	
BH53	5.00	5.45	5.23	20	18	67.00	I	33
BH53	8.00	8.45	8.23	17	15	64.00	I	32
BH53	11.00	11.45	11.23	30	30	61.00	II	
BH53	14.00	14.45	14.23	30	18	58.00	III	33
BH53	17.00	17.45	17.23	34	18	55.00	III	33
BH53	20.00	20.45	20.23	50	22	52.00	III	34
BH53	21.50	21.95	21.73	72	27	50.50	V	36
BH53	23.00	23.45	23.23	73	27	49.00	V	36
BH53	24.50	24.84	24.67	>100	>50	47.56	V	42
BH53	26.00	26.27	26.14	>100	>50	46.09	V	42
BH53	27.50	27.72	27.61	>100	>50	44.62	V	42
BH53	29.00	29.24	29.12	>100	>50	43.11	V	42
BH53	30.50	30.68	30.59	>100	>50	41.64	V	42
BH53	32.00	32.20	32.10	>100	>50	40.13	V	42
BH53	33.50	33.67	33.59	>100	>50	38.64	V	42
BH53	35.00	35.19	35.10	>100	>50	37.13	V	42
BH54	1.00	1.45	1.23	3	03	71.25	Fill	

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH54	3.00	3.45	3.23	6	06	69.25	Fill	
BH54	5.00	5.45	5.23	17	17	67.25	II	
BH54	8.00	8.45	8.23	23	17	64.25	I	33
BH54	11.00	11.45	11.23	26	18	61.25	I	33
BH54	14.00	14.45	14.23	29	29	58.25	II	
BH54	17.00	17.45	17.23	44	21	55.25	III	34
BH54	20.00	20.45	20.23	53	23	52.25	III	35
BH54	21.50	21.95	21.73	56	23	50.75	III	35
BH54	23.00	23.45	23.23	60	23	49.25	III	35
BH54	24.50	24.95	24.73	47	20	47.75	III	34
BH54	26.00	26.45	26.23	61	23	46.25	III	35
BH54	27.50	27.95	27.73	73	73	44.75	IV	
BH54	29.00	29.45	29.23	55	55	43.25	IV	
BH54	30.50	30.95	30.73	61	61	41.75	IV	
BH54	32.00	32.45	32.23	65	22	40.25	V	35
BH54	33.50	33.95	33.73	84	26	38.75	V	36
BH54	35.00	35.45	35.23	85	26	37.25	V	36
BH55	1.00	1.45	1.23	6	06	70.02	Fill	
BH55	3.00	3.45	3.23	8	08	68.02	Fill	
BH55	5.00	5.45	5.23	11	11	66.02	I	30
BH55	8.00	8.45	8.23	11	10	63.02	I	30
BH55	11.00	11.45	11.23	34	34	60.02	IV	
BH55	14.00	14.45	14.23	50	50	57.02	IV	
BH55	15.50	15.95	15.73	55	26	55.52	V	36
BH55	17.00	17.45	17.23	58	26	54.02	V	36
BH55	18.50	18.95	18.73	70	29	52.52	V	37
BH55	20.00	20.39	20.20	>100	>50	51.05	V	42
BH55	21.50	21.73	21.62	>100	>50	49.63	V	42
BH55	23.00	23.20	23.10	>100	>50	48.15	V	42
BH55	24.50	24.74	24.62	>100	>50	46.63	V	42
BH55	26.00	26.21	26.11	>100	>50	45.14	V	42
BH55	27.50	27.68	27.59	>100	>50	43.66	V	42
BH55	29.00	29.20	29.10	>100	>50	42.15	V	42
BH55	30.00	30.17	30.09	>100	>50	41.16	V	42
BH56	1.00	1.45	1.23	10	15	63.29	I	32
BH56	3.00	3.45	3.23	14	16	61.29	I	32
BH56	5.00	5.45	5.23	16	16	59.29	I	32
BH56	8.00	8.45	8.23	34	34	56.29	IV	
BH56	11.00	11.45	11.23	59	30	53.29	V	37
BH56	12.50	12.78	12.64	>100	>50	51.88	V	42
BH56	14.00	14.26	14.13	>100	>50	50.39	V	42
BH56	15.50	15.75	15.63	>100	>50	48.89	V	42

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH56	17.00	17.26	17.13	>100	>50	47.39	V	42
BH56	18.50	18.73	18.62	>100	>50	45.90	V	42
BH56	20.00	20.25	20.13	>100	>50	44.39	V	42
BH56	21.50	21.76	21.63	>100	>50	42.89	V	42
BH56	23.00	23.22	23.11	>100	>50	41.41	V	42
BH56	24.50	24.71	24.61	>100	>50	39.91	V	42
BH56	26.00	26.24	26.12	>100	>50	38.40	V	42
BH56	27.50	27.72	27.61	>100	>50	36.91	V	42
BH56	29.00	29.25	29.13	>100	>50	35.39	V	42
BH56	30.00	30.23	30.12	>100	>50	34.40	V	42
BH57	1.00	1.45	1.23	13	17	67.00	I	33
BH57	3.00	3.45	3.23	14	16	65.00	I	32
BH57	5.00	5.45	5.23	19	17	63.00	I	33
BH57	8.00	8.45	8.23	19	19	60.00	II	
BH57	11.00	11.45	11.23	99	99	57.00	IV	
BH57	12.50	12.88	12.69	>100	>50	55.54	V	42
BH57	14.00	14.29	14.15	>100	>50	54.08	V	42
BH57	15.50	15.75	15.63	>100	>50	52.60	V	42
BH57	17.00	17.28	17.14	>100	>50	51.09	V	42
BH57	18.50	18.83	18.67	>100	>50	49.56	V	42
BH57	20.00	20.23	20.12	>100	>50	48.11	V	42
BH57	21.50	21.88	21.69	>100	>50	46.54	V	42
BH57	23.00	23.26	23.13	>100	>50	45.10	V	42
BH57	24.50	24.76	24.63	>100	>50	43.60	V	42
BH57	26.00	26.23	26.12	>100	>50	42.11	V	42
BH57	27.50	27.71	27.61	>100	>50	40.62	V	42
BH57	29.00	29.18	29.09	>100	>50	39.14	V	42
BH57	30.00	30.20	30.10	>100	>50	38.13	V	42
BH58	1.00	1.45	1.23	27	27	78.83	I	36
BH58	3.00	3.45	3.23	23	21	76.83	I	34
BH58	5.00	5.45	5.23	14	14	74.83	I	32
BH58	8.00	8.45	8.23	54	31	71.83	III	37
BH58	9.50	9.84	9.67	>100	100	70.39	IV	
BH58	11.00	11.27	11.14	>100	100	68.92	IV	
BH58	12.50	12.74	12.62	>100	100	67.44	IV	
BH58	14.00	14.26	14.13	>100	100	65.93	IV	
BH58	15.50	15.72	15.61	>100	100	64.45	IV	
BH58	17.00	17.25	17.13	>100	100	62.93	IV	
BH58	18.50	18.74	18.62	>100	100	61.44	IV	
BH58	20.00	20.20	20.10	>100	100	59.96	IV	
BH58	21.50	21.72	21.61	>100	>50	58.45	V	42
BH58	23.00	23.25	23.13	>100	>50	56.93	V	42

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH58	24.50	24.84	24.67	>100	>50	55.39	V	42
BH58	26.00	26.28	26.14	>100	>50	53.92	V	42
BH58	27.50	27.73	27.62	>100	>50	52.44	V	42
BH58	29.00	29.21	29.11	>100	>50	50.95	V	42
BH58	30.50	30.73	30.62	>100	100	49.44	IV	
BH58	32.00	32.20	32.10	>100	100	47.96	IV	
BH58	33.50	33.71	33.61	>100	100	46.45	IV	
BH58	35.00	35.22	35.11	>100	100	44.95	IV	
BH58	36.50	36.74	36.62	>100	100	43.44	IV	
BH58	38.00	38.23	38.12	>100	>50	41.94	V	42
BH58	40.00	40.21	40.11	>100	>50	39.95	V	42
BH59	1.00	1.45	1.23	99	99	80.09	Fill	
BH59	3.00	3.45	3.23	54	39	78.09	III	39
BH59	5.00	5.45	5.23	28	22	76.09	III	34
BH59	8.00	8.45	8.23	72	39	73.09	III	39
BH59	11.00	11.39	11.20	>100	>50	70.12	III	42
BH59	12.50	12.83	12.67	>100	>50	68.65	III	42
BH59	14.00	14.35	14.18	>100	100	67.14	IV	
BH59	15.50	15.88	15.69	>100	100	65.62	IV	
BH59	17.00	17.45	17.23	>100	100	64.09	IV	
BH59	18.50	18.88	18.69	>100	100	62.62	IV	
BH59	20.00	20.20	20.10	>100	>50	61.21	V	42
BH59	21.50	21.73	21.62	>100	>50	59.70	V	42
BH59	23.00	23.24	23.12	>100	>50	58.19	V	42
BH59	24.50	24.75	24.63	>100	>50	56.69	V	42
BH59	26.00	26.26	26.13	>100	>50	55.18	V	42
BH59	27.50	27.73	27.62	>100	>50	53.70	V	42
BH59	29.00	29.22	29.11	>100	>50	52.20	V	42
BH59	30.50	30.73	30.62	>100	>50	50.70	V	42
BH59	32.00	32.25	32.13	>100	>50	49.19	V	42
BH59	33.50	33.76	33.63	>100	>50	47.68	V	42
BH59	35.00	35.22	35.11	>100	>50	46.20	V	42
BH59	36.50	36.74	36.62	>100	>50	44.69	V	42
BH59	38.00	38.21	38.11	>100	>50	43.21	V	42
BH59	39.50	39.69	39.60	>100	>50	41.72	V	42
BH59	40.00	40.17	40.09	>100	>50	41.23	V	42
BH60	1.00	1.45	1.23	16	16	76.79	Fill	
BH60	3.00	3.45	3.23	54	39	74.79	III	39
BH60	4.00	4.45	4.23	61	40	73.79	III	40
BH60	5.00	5.45	5.23	75	45	72.79	III	41
BH60	6.50	6.95	6.73	60	35	71.29	III	38
BH60	8.00	8.45	8.23	28	28	69.79	II	

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH60	11.00	11.45	11.23	84	40	66.79	V	40
BH60	12.50	12.95	12.73	79	36	65.29	V	39
BH60	14.00	14.45	14.23	67	31	63.79	V	37
BH60	15.50	15.95	15.73	55	55	62.29	IV	
BH60	17.00	17.37	17.19	>100	>50	60.83	V	42
BH60	18.50	18.89	18.70	>100	>50	59.32	V	42
BH60	20.00	20.37	20.19	>100	>50	57.83	V	42
BH60	21.50	21.95	21.73	75	28	56.29	V	36
BH60	23.00	23.45	23.23	64	25	54.79	V	35
BH60	24.50	24.95	24.73	44	44	53.29	IV	
BH60	26.00	26.45	26.23	52	52	51.79	IV	
BH60	27.50	27.95	27.73	37	17	50.29	III	33
BH60	29.00	29.45	29.23	44	44	48.79	IV	
BH60	30.50	30.95	30.73	68	68	47.29	IV	
BH60	32.00	32.45	32.23	53	53	45.79	IV	
BH60	33.50	33.95	33.73	67	23	44.29	V	35
BH60	35.00	35.45	35.23	78	25	42.79	V	35
BH60	36.50	36.89	36.70	>100	>50	41.32	V	42
BH60	38.00	38.37	38.19	>100	>50	39.83	V	42
BH60	40.00	40.35	40.18	>100	>50	37.84	V	42
BH61	1.00	1.45	1.23	12	12	79.19	Fill	
BH61	3.00	3.45	3.23	17	17	77.19	Fill	
BH61	5.00	5.45	5.23	16	16	75.19	II	
BH61	7.00	7.45	7.23	35	23	73.19	III	35
BH61	8.00	8.45	8.23	54	31	72.19	III	37
BH61	11.00	11.45	11.23	83	39	69.19	III	40
BH61	14.00	14.37	14.19	>100	100	66.23	IV	
BH61	15.50	15.74	15.62	>100	100	64.79	IV	
BH61	17.00	17.38	17.19	>100	100	63.22	IV	
BH61	18.50	18.75	18.63	>100	100	61.79	IV	
BH61	20.00	20.23	20.12	>100	100	60.30	IV	
BH61	21.50	21.74	21.62	>100	100	58.79	IV	
BH61	23.00	23.45	23.23	90	90	57.19	IV	
BH61	24.50	24.89	24.70	>100	100	55.72	IV	
BH61	26.00	26.37	26.19	>100	100	54.23	IV	
BH61	27.50	27.85	27.68	>100	100	52.74	IV	
BH61	29.00	29.25	29.13	>100	100	51.29	IV	
BH61	30.50	30.88	30.69	>100	100	49.72	IV	
BH61	32.00	32.37	32.19	>100	>50	48.23	V	42
BH61	33.50	33.88	33.69	>100	>50	46.72	V	42
BH61	35.00	35.23	35.12	>100	>50	45.30	V	42
BH61	36.50	36.78	36.64	>100	>50	43.77	V	42
BH61	38.00	38.25	38.13	>100	>50	42.29	V	42

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH61	39.50	39.71	39.61	>100	>50	40.81	V	42
BH61	40.00	40.18	40.09	>100	>50	40.32	V	42
BH62	1.00	1.45	1.23	5	07	76.90	I	29
BH62	3.00	3.45	3.23	7	08	74.90	I	29
BH62	5.00	5.45	5.23	12	12	72.90	I	31
BH62	8.00	8.45	8.23	20	16	69.90	I	32
BH62	11.00	11.45	11.23	22	16	66.90	I	32
BH62	14.00	14.45	14.23	51	51	63.90	IV	
BH62	15.50	15.95	15.73	58	58	62.40	IV	
BH62	17.00	17.45	17.23	64	64	60.90	IV	
BH62	18.50	18.95	18.73	65	65	59.40	IV	
BH62	20.00	20.45	20.23	73	73	57.90	IV	
BH62	21.50	21.95	21.73	75	75	56.40	IV	
BH62	23.00	23.38	23.19	>100	>50	54.93	V	42
BH62	24.50	24.83	24.67	>100	>50	53.46	V	42
BH62	26.00	26.45	26.23	63	63	51.90	IV	
BH62	27.50	27.95	27.73	71	71	50.40	IV	
BH62	29.00	29.35	29.18	>100	>50	48.95	V	42
BH62	30.50	30.87	30.69	>100	>50	47.44	V	42
BH62	32.00	32.28	32.14	>100	>50	45.98	V	42
BH62	33.50	33.76	33.63	>100	>50	44.49	V	42
BH62	35.00	35.22	35.11	>100	>50	43.01	V	42
BH62	36.50	36.75	36.63	>100	>50	41.50	V	42
BH62	38.00	38.23	38.12	>100	>50	40.01	V	42
BH62	40.00	40.19	40.10	>100	>50	38.03	V	42
BH63	1.00	1.45	1.23	4	04	61.16	Fill	
BH63	3.00	3.45	3.23	7	08	59.16	I	29
BH63	5.00	5.45	5.23	13	13	57.16	II	
BH63	8.00	8.45	8.23	40	25	54.16	III	35
BH63	11.00	11.45	11.23	60	31	51.16	III	37
BH63	12.50	12.95	12.73	57	28	49.66	III	37
BH63	14.00	14.45	14.23	35	20	48.16	III	34
BH63	15.50	15.95	15.73	28	28	46.66	II	
BH63	17.00	17.45	17.23	87	37	45.16	V	39
BH63	18.50	18.95	18.73	40	40	43.66	IV	
BH63	20.30	20.75	20.53	51	24	41.86	V	35
BH63	21.50	21.95	21.73	82	33	40.66	V	38
BH63	23.00	23.45	23.23	93	36	39.16	V	39
BH63	24.50	24.87	24.69	>100	>50	37.70	V	42
BH63	26.00	26.39	26.20	>100	>50	36.19	V	42
BH63	27.50	27.84	27.67	>100	>50	34.72	V	42
BH63	29.00	29.27	29.14	>100	>50	33.25	V	42

CORRECTION FOR STANDARD PENETRATION TEST VALUES

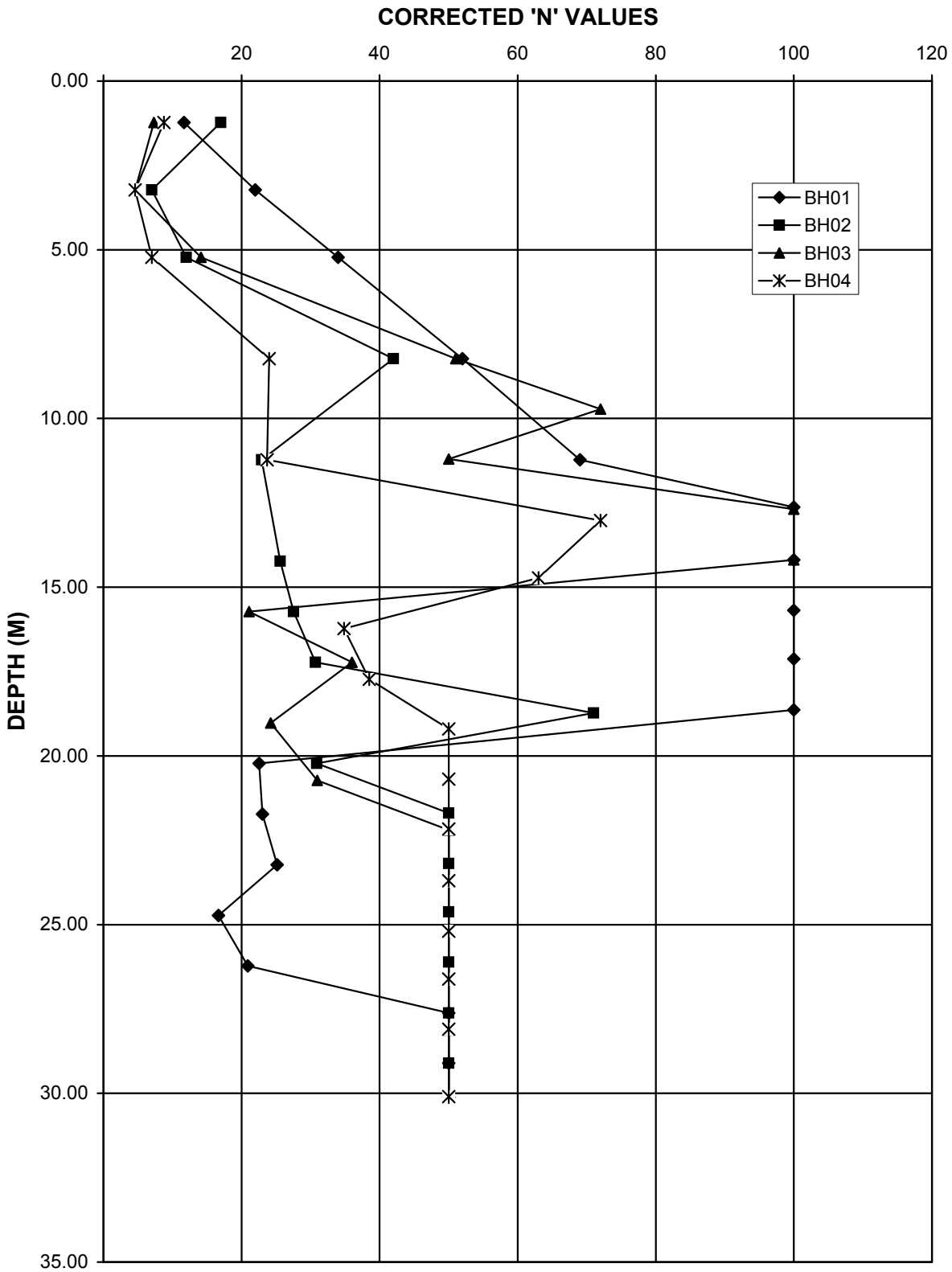
Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BH63	30.50	30.82	30.66	>100	>50	31.73	V	42
BH63	32.00	32.26	32.13	>100	>50	30.26	V	42
BH63	33.50	33.75	33.63	>100	>50	28.76	V	42
BH63	35.00	35.23	35.12	>100	>50	27.27	V	42
BH63	36.50	36.74	36.62	>100	>50	25.77	V	42
BH63	38.00	38.23	38.12	>100	>50	24.27	V	42
BH63	40.00	40.21	40.11	>100	>50	22.28	V	42
BH64	1.00	1.45	1.23	14	14	62.02	Fill	
BH64	3.00	3.45	3.23	8	09	60.02	I	30
BH64	5.00	5.45	5.23	16	16	58.02	I	32
BH64	8.00	8.45	8.23	28	28	55.02	II	
BH64	11.00	11.45	11.23	39	23	52.02	III	35
BH64	14.00	14.45	14.23	43	43	49.02	IV	
BH64	17.00	17.45	17.23	35	35	46.02	IV	
BH64	18.80	19.25	19.03	30	30	44.22	IV	
BH64	20.50	20.95	20.73	38	38	42.52	IV	
BH64	22.00	22.45	22.23	73	30	41.02	V	37
BH64	23.50	23.90	23.70	>100	>50	39.55	V	42
BH64	25.00	25.37	25.19	>100	>50	38.06	V	42
BH64	26.50	26.84	26.67	>100	>50	36.58	V	42
BH64	28.00	28.27	28.14	>100	>50	35.11	V	42
BH64	29.50	29.74	29.62	>100	>50	33.63	V	42
BH64	31.00	31.23	31.12	>100	>50	32.13	V	42
BH64	32.50	32.75	32.63	>100	>50	30.62	V	42
BH64	34.00	34.21	34.11	>100	>50	29.14	V	42
BH64	35.50	35.74	35.62	>100	>50	27.63	V	42
BH64	37.00	37.20	37.10	>100	>50	26.15	V	42
BH64	38.50	38.72	38.61	>100	>50	24.64	V	42
BH64	40.00	40.19	40.10	>100	>50	23.15	V	42
BHT1	1.00	1.45	1.23	5	07	77.72	I	29
BHT1	3.00	3.45	3.23	11	13	75.72	I	31
BHT1	5.00	5.45	5.23	26	21	73.72	I	34
BHT1	8.00	8.45	8.23	36	36	70.72	IV	
BHT1	11.00	11.37	11.19	>100	>50	67.76	III	42
BHT1	12.50	12.87	12.69	>100	>50	66.26	III	42
BHT1	14.00	14.45	14.23	76	34	64.72	III	38
BHT1	15.50	15.95	15.73	64	29	63.22	V	37
BHT1	17.00	17.45	17.23	70	30	61.72	V	37
BHT1	18.50	18.95	18.73	74	30	60.22	V	37
BHT1	20.00	20.45	20.23	78	30	58.72	V	37
BHT1	21.50	21.95	21.73	77	29	57.22	V	37
BHT1	23.00	23.45	23.23	22	12	55.72	V	31

CORRECTION FOR STANDARD PENETRATION TEST VALUES

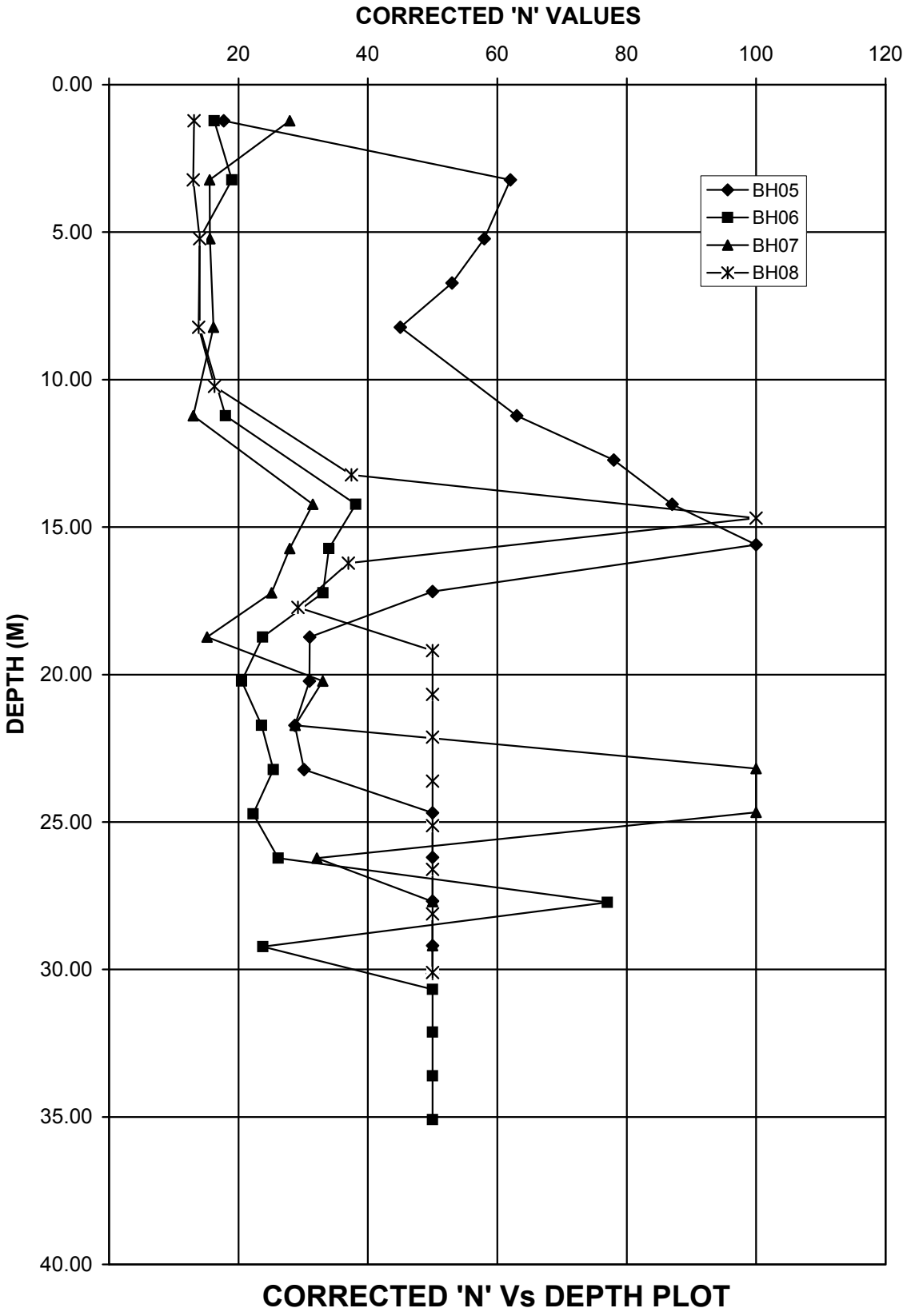
Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BHT1	24.50	24.95	24.73	68	25	54.22	V	35
BHT1	26.00	26.45	26.23	84	28	52.72	V	37
BHT1	27.50	27.89	27.70	>100	>50	51.25	V	42
BHT1	29.00	29.37	29.19	>100	>50	49.76	V	42
BHT1	30.50	30.95	30.73	59	59	48.22	IV	
BHT1	32.00	32.45	32.23	75	75	46.72	IV	
BHT1	33.50	33.95	33.73	82	82	45.22	IV	
BHT1	35.00	35.45	35.23	89	89	43.72	IV	
BHT1	36.50	36.95	36.73	97	97	42.22	IV	
BHT1	38.00	38.45	38.23	78	78	40.72	IV	
BHT1	39.50	39.95	39.73	70	70	39.22	IV	
BHT1	40.00	40.45	40.23	81	81	38.72	IV	
BHT2	1.00	1.45	1.23	8	12	77.86	I	31
BHT2	3.00	3.45	3.23	13	15	75.86	I	32
BHT2	5.00	5.45	5.23	22	19	73.86	I	33
BHT2	8.00	8.45	8.23	47	28	70.86	III	36
BHT2	9.63	10.08	9.86	53	53	69.23	IV	
BHT2	11.50	11.95	11.73	90	90	67.36	IV	
BHT2	13.00	13.40	13.20	>100	100	65.89	IV	
BHT2	14.50	14.88	14.69	>100	100	64.40	IV	
BHT2	16.00	16.24	16.12	>100	100	62.97	IV	
BHT2	17.50	17.73	17.62	>100	100	61.47	IV	
BHT2	19.00	19.23	19.12	>100	>50	59.97	V	42
BHT2	20.50	20.89	20.70	>100	>50	58.39	V	42
BHT2	22.00	22.41	22.21	>100	>50	56.88	V	42
BHT2	23.50	23.89	23.70	>100	>50	55.39	V	42
BHT2	25.00	25.38	25.19	>100	>50	53.90	V	42
BHT2	26.50	26.89	26.70	>100	>50	52.39	V	42
BHT2	28.00	28.45	28.23	80	80	50.86	IV	
BHT2	29.50	29.95	29.73	79	79	49.36	IV	
BHT2	31.00	31.45	31.23	87	87	47.86	IV	
BHT2	32.50	32.95	32.73	83	83	46.36	IV	
BHT2	34.00	34.45	34.23	89	89	44.86	IV	
BHT2	35.50	35.95	35.73	95	95	43.36	IV	
BHT2	37.00	37.45	37.23	87	87	41.86	IV	
BHT2	38.50	38.95	38.73	80	80	40.36	IV	
BHT2	40.00	40.45	40.23	78	78	38.86	IV	
BHT3	1.00	1.45	1.23	8	12	77.86	I	31
BHT3	3.00	3.45	3.23	16	17	75.86	I	33
BHT3	5.00	5.45	5.23	22	22	73.86	II	
BHT3	8.00	8.45	8.23	39	24	70.86	III	35
BHT3	11.00	11.45	11.23	60	31	67.86	V	37

CORRECTION FOR STANDARD PENETRATION TEST VALUES

Bore Hole No:	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Field 'N' Values	Cor. 'N' for Ovp. & Dilatancy (if reqd)	Reduced Level (M)	Stratum	Computed Phi in Degrees
BHT3	14.00	14.45	14.23	77	34	64.86	V	38
BHT3	15.50	15.87	15.69	>100	100	63.40	IV	
BHT3	17.00	17.39	17.20	>100	>50	61.89	V	42
BHT3	18.50	18.85	18.68	>100	>50	60.41	V	42
BHT3	20.00	20.36	20.18	>100	>50	58.91	V	42
BHT3	21.50	21.83	21.67	>100	>50	57.42	V	42
BHT3	23.00	23.35	23.18	>100	>50	55.91	V	42
BHT3	24.50	24.87	24.69	>100	>50	54.40	V	42
BHT3	26.00	26.35	26.18	>100	>50	52.91	V	42
BHT3	27.50	27.88	27.69	>100	>50	51.40	V	42
BHT3	29.00	29.45	29.23	64	64	49.86	IV	
BHT3	30.50	30.95	30.73	65	65	48.36	IV	
BHT3	32.00	32.45	32.23	99	30	46.86	V	37
BHT3	33.50	33.90	33.70	>100	29	45.39	V	37
BHT3	35.00	35.37	35.19	>100	29	43.90	V	37
BHT3	36.50	36.74	36.62	>100	29	42.47	V	37
BHT3	38.00	38.22	38.11	>100	29	40.98	V	37
BHT3	40.00	40.24	40.12	>100	29	38.97	V	37
BHT4	1.00	1.45	1.23	9	13	77.84	I	31
BHT4	3.00	3.45	3.23	22	20	75.84	I	34
BHT4	5.00	5.45	5.23	36	36	73.84	II	
BHT4	8.00	8.45	8.23	77	41	70.84	V	40
BHT4	9.50	9.95	9.73	83	41	69.34	V	40
BHT4	11.00	11.45	11.23	86	41	67.84	V	40
BHT4	12.50	12.95	12.73	89	89	66.34	IV	
BHT4	14.00	14.45	14.23	97	41	64.84	V	40
BHT4	15.50	15.95	15.73	93	38	63.34	V	39
BHT4	17.00	17.45	17.23	100	39	61.84	V	39
BHT4	18.50	18.87	18.69	>100	>50	60.38	V	42
BHT4	20.00	20.36	20.18	>100	>50	58.88	V	42
BHT4	21.50	21.89	21.70	>100	>50	57.37	V	42
BHT4	23.00	23.40	23.20	>100	>50	55.86	V	42
BHT4	24.50	24.75	24.63	>100	>50	54.44	V	42
BHT4	26.00	26.22	26.11	>100	>50	52.95	V	42
BHT4	27.50	27.95	27.73	71	71	51.34	IV	
BHT4	29.00	29.45	29.23	90	90	49.84	IV	
BHT4	30.50	30.95	30.73	86	86	48.34	IV	
BHT4	32.00	32.45	32.23	82	82	46.84	IV	
BHT4	33.50	33.95	33.73	88	88	45.34	IV	
BHT4	35.00	35.45	35.23	86	86	43.84	IV	
BHT4	36.50	36.95	36.73	85	85	42.34	IV	
BHT4	38.00	38.45	38.23	95	95	40.84	IV	
BHT4	40.00	40.45	40.23	>100	100	38.84	IV	



CORRECTED 'N' Vs DEPTH PLOT



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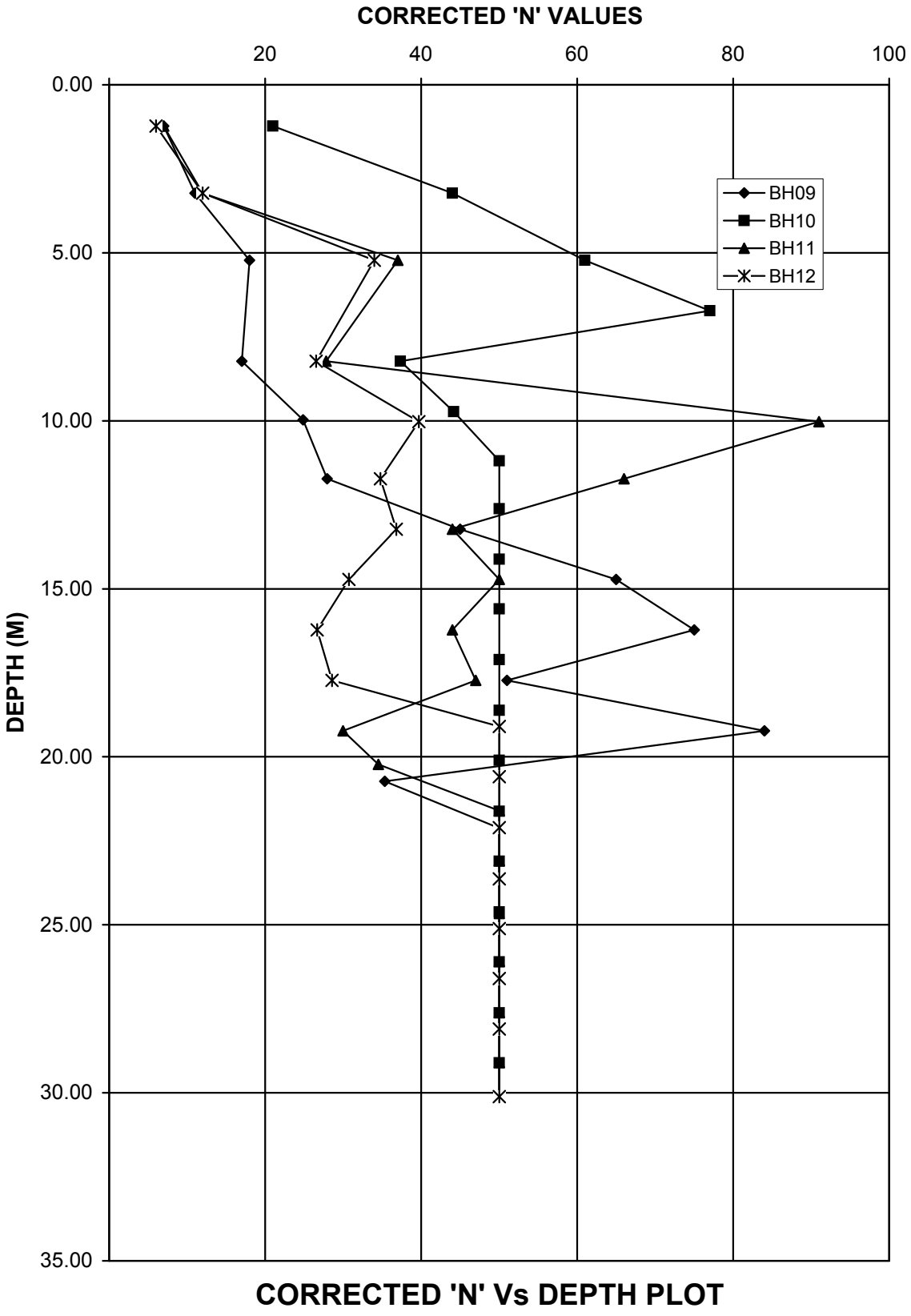

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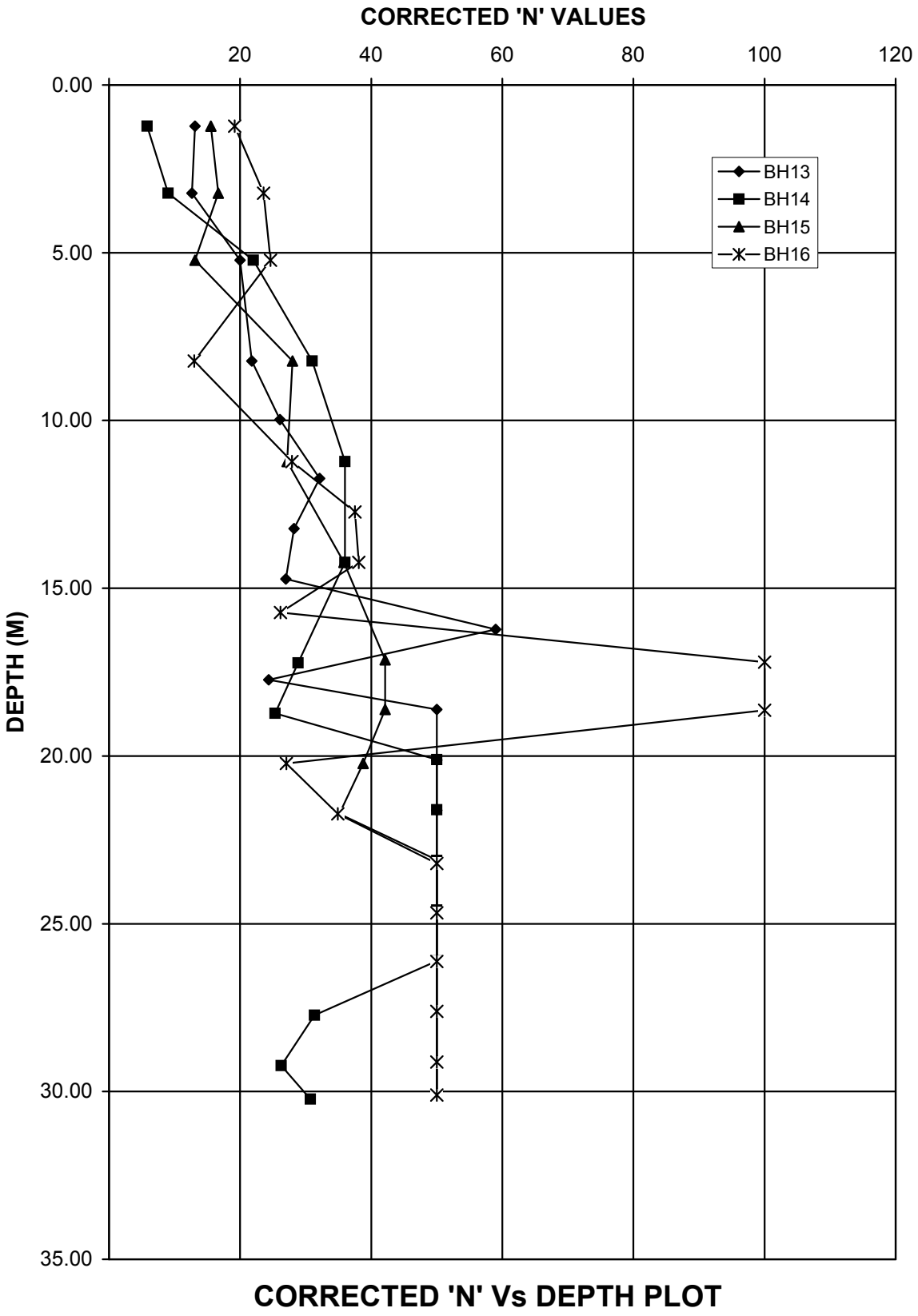

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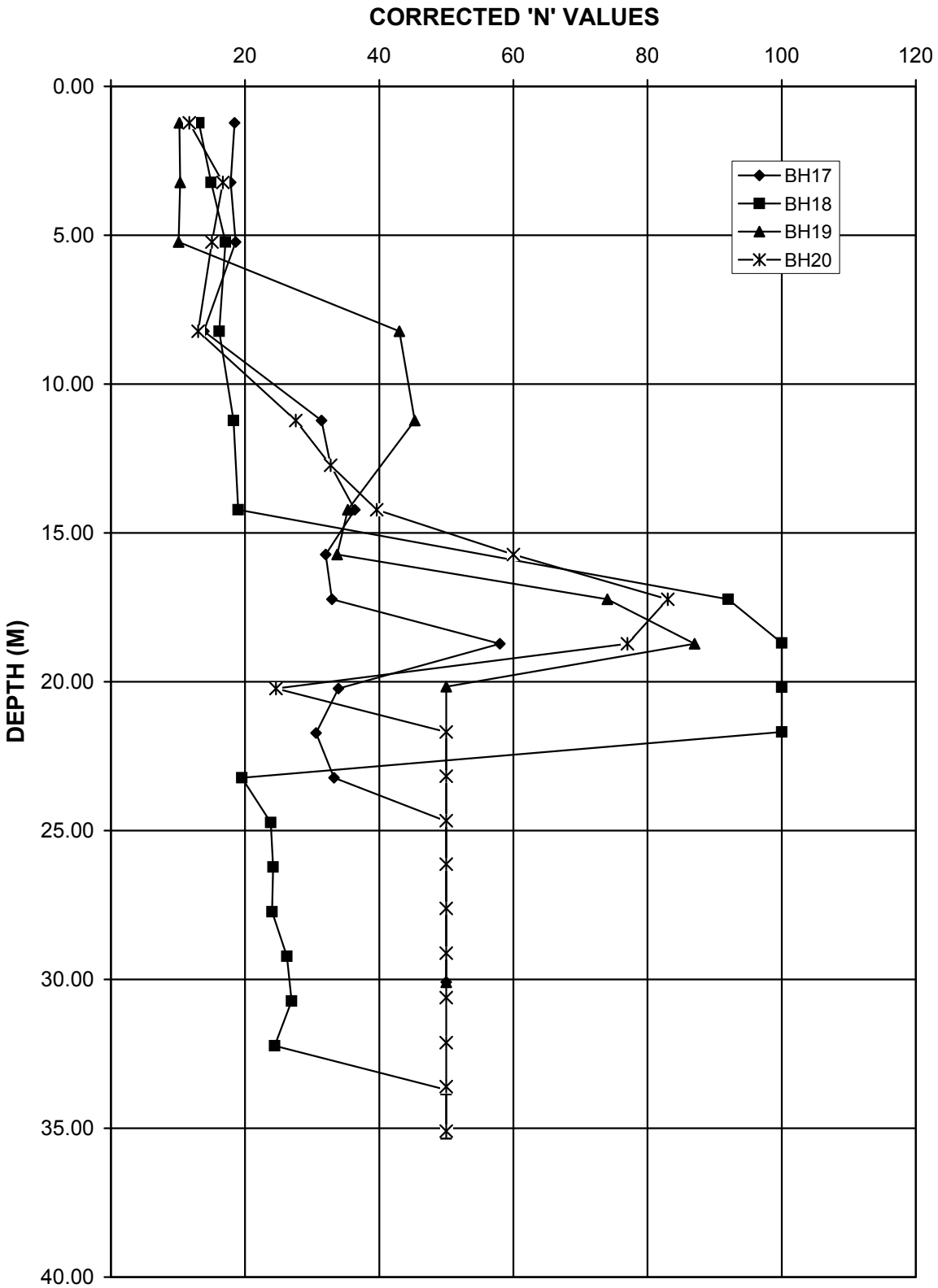

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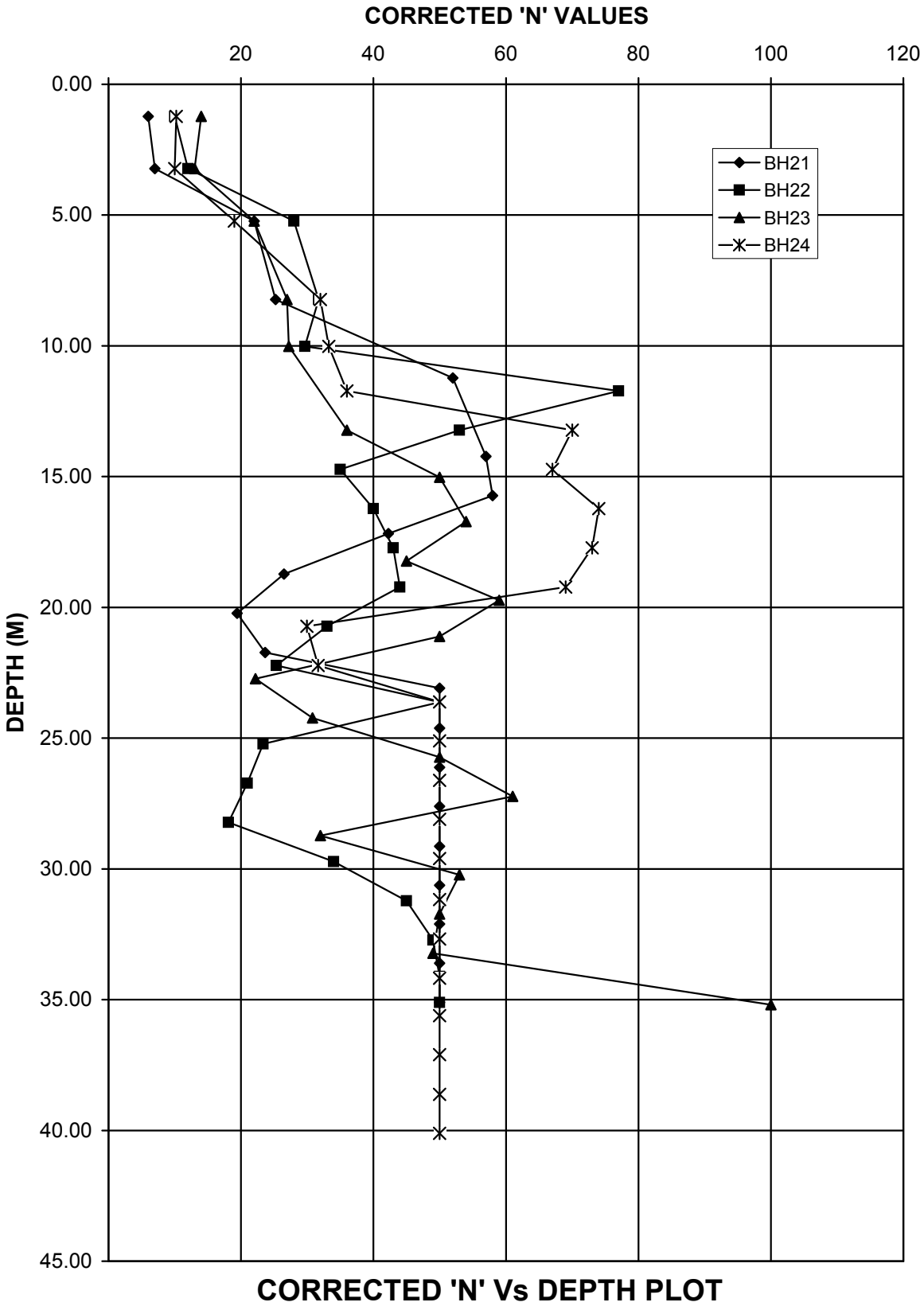

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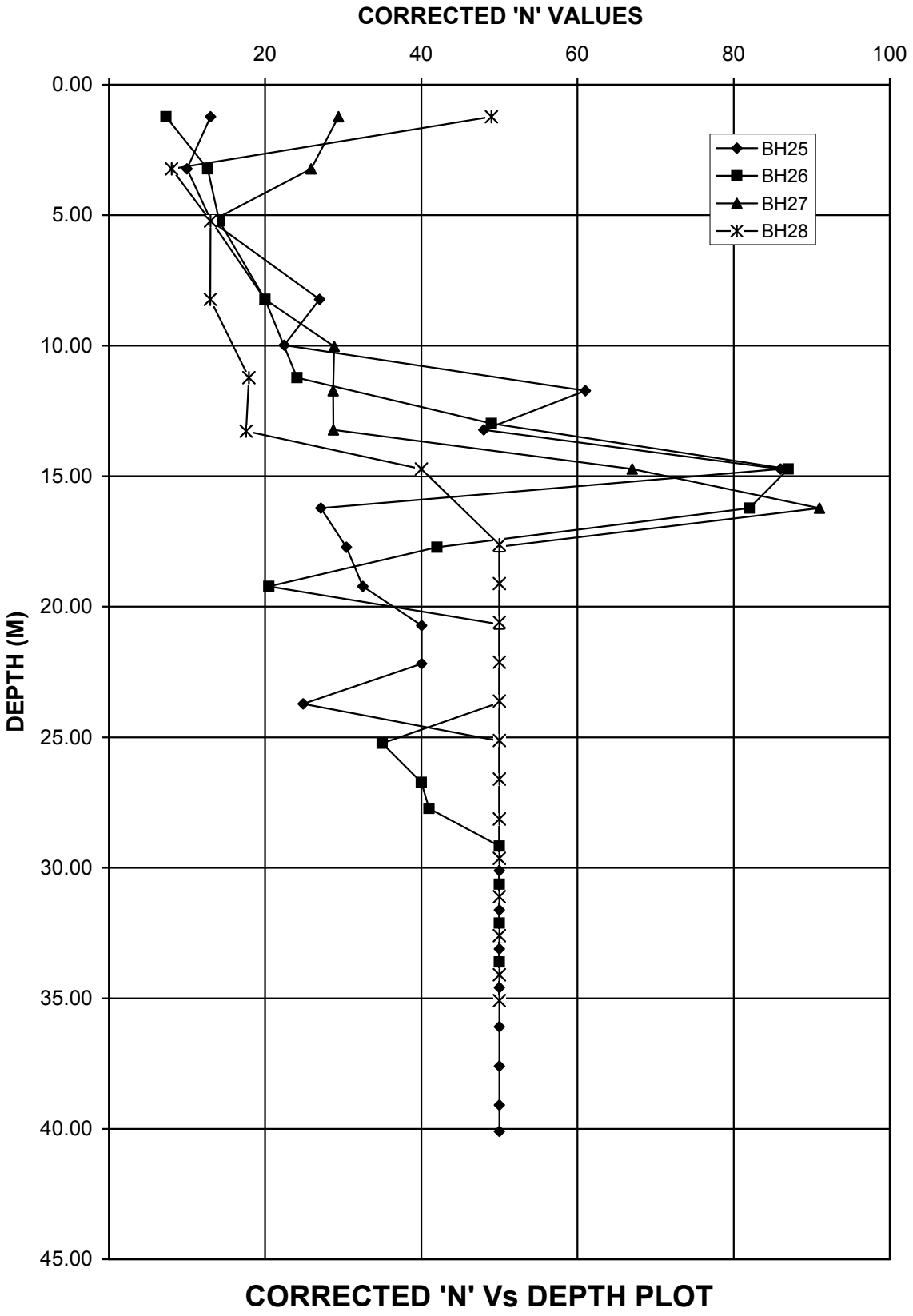

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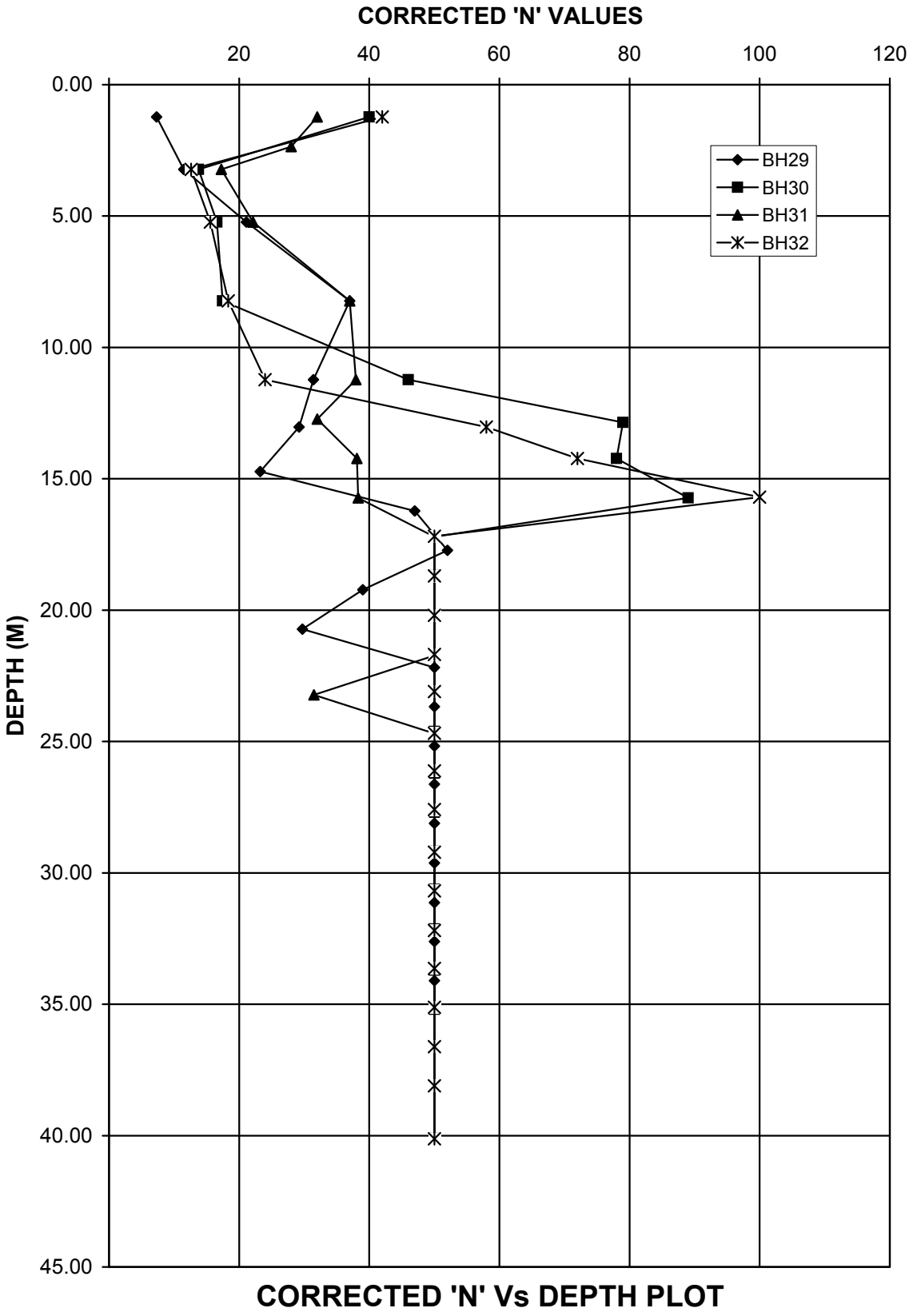

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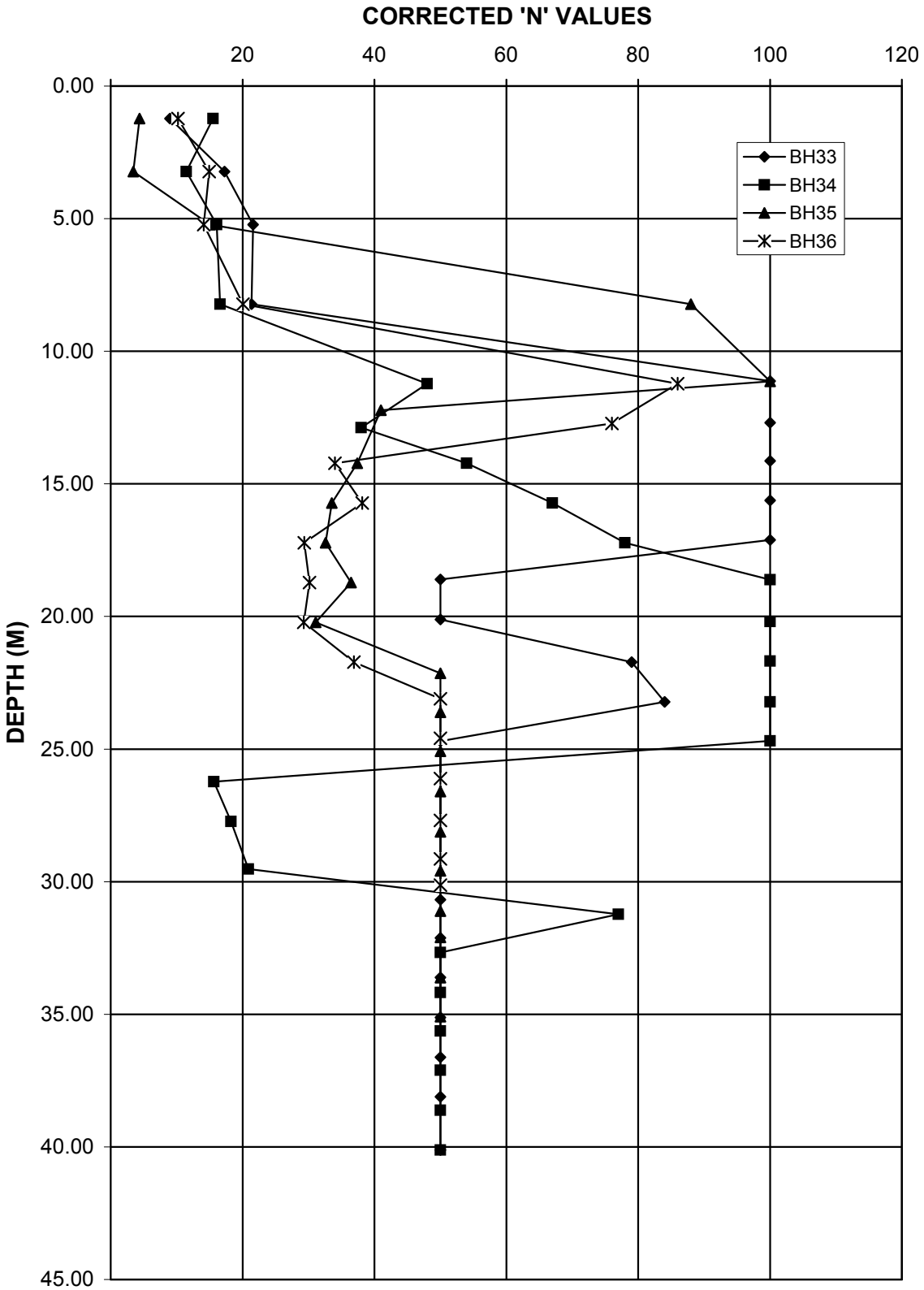

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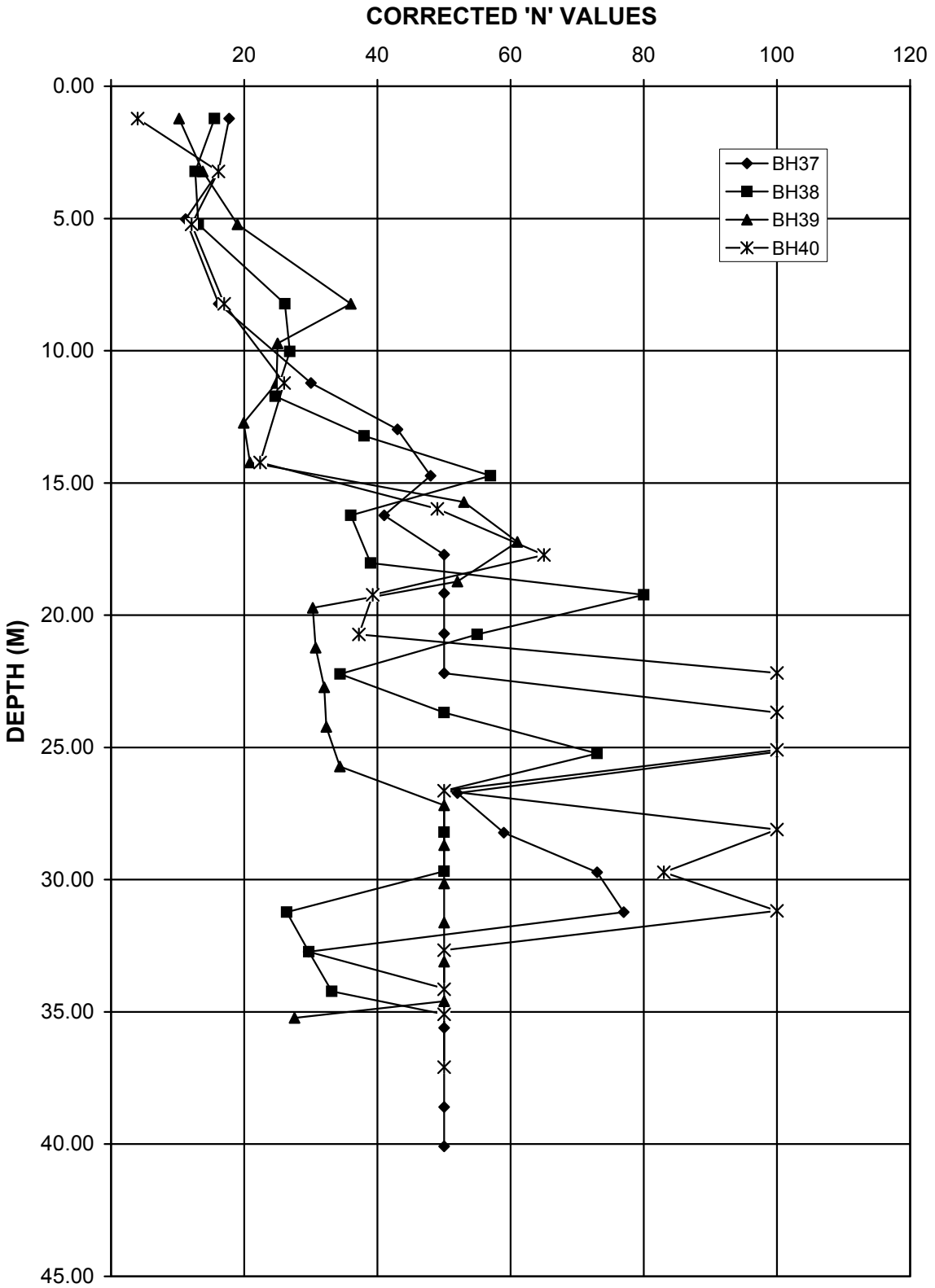

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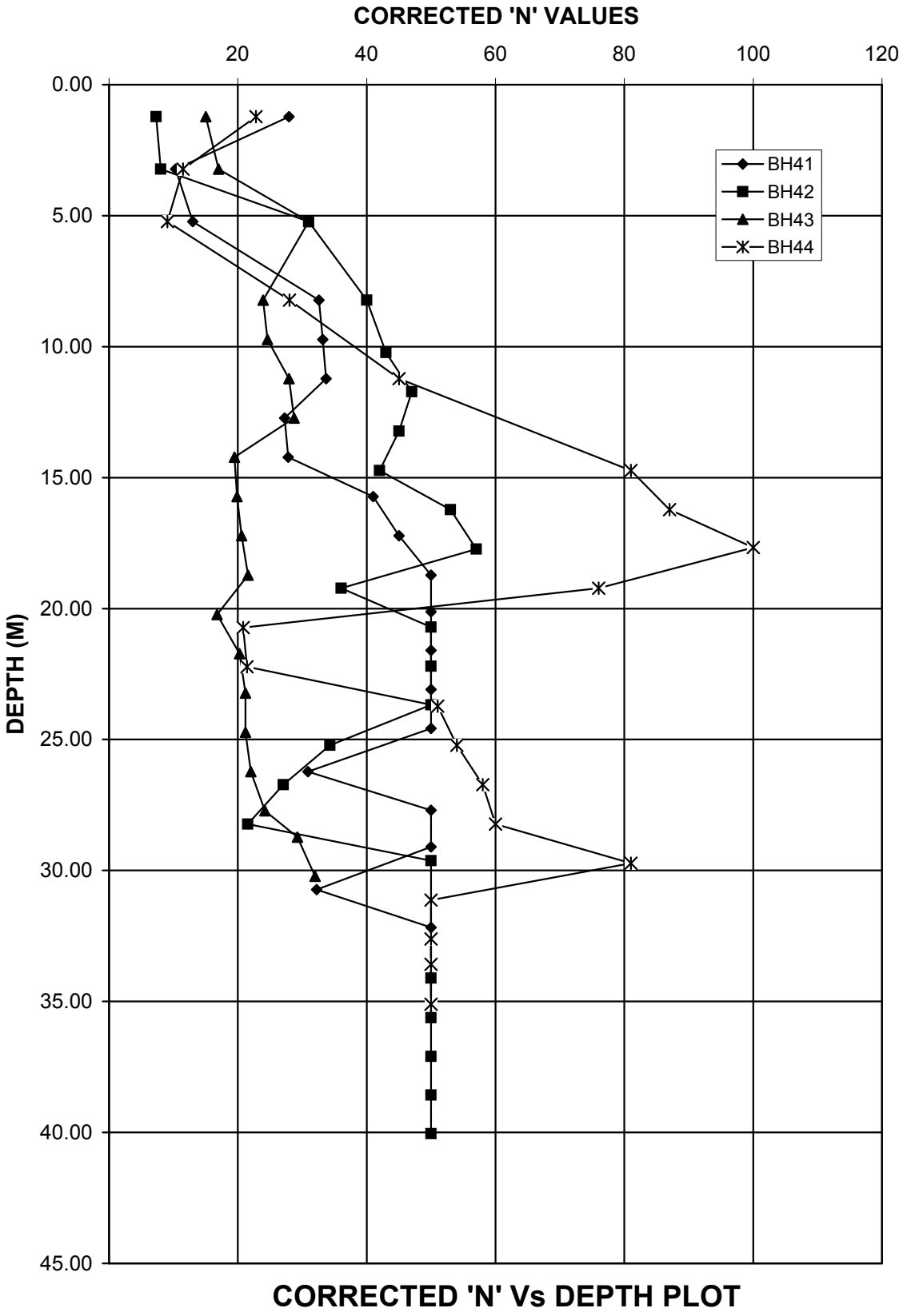

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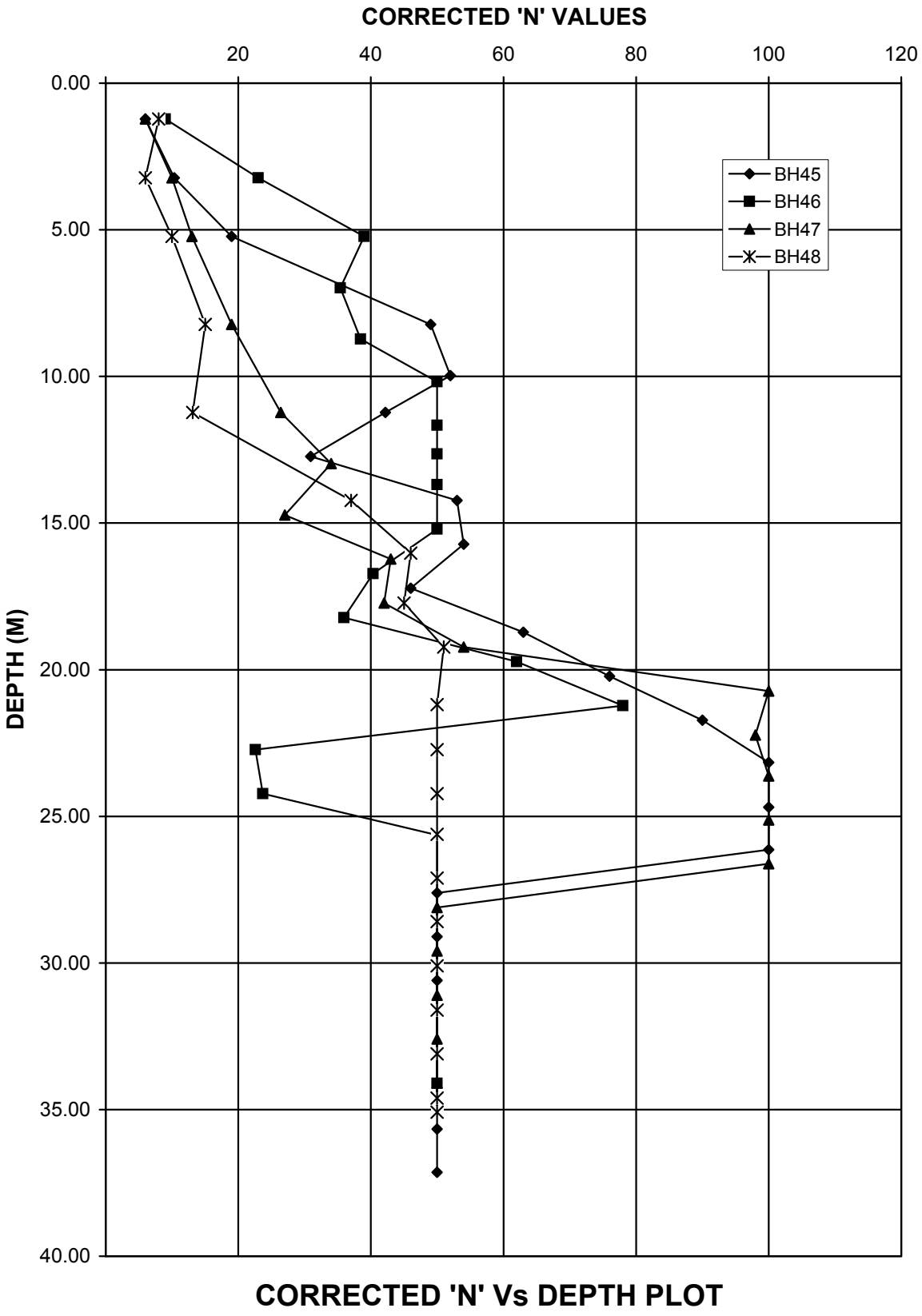

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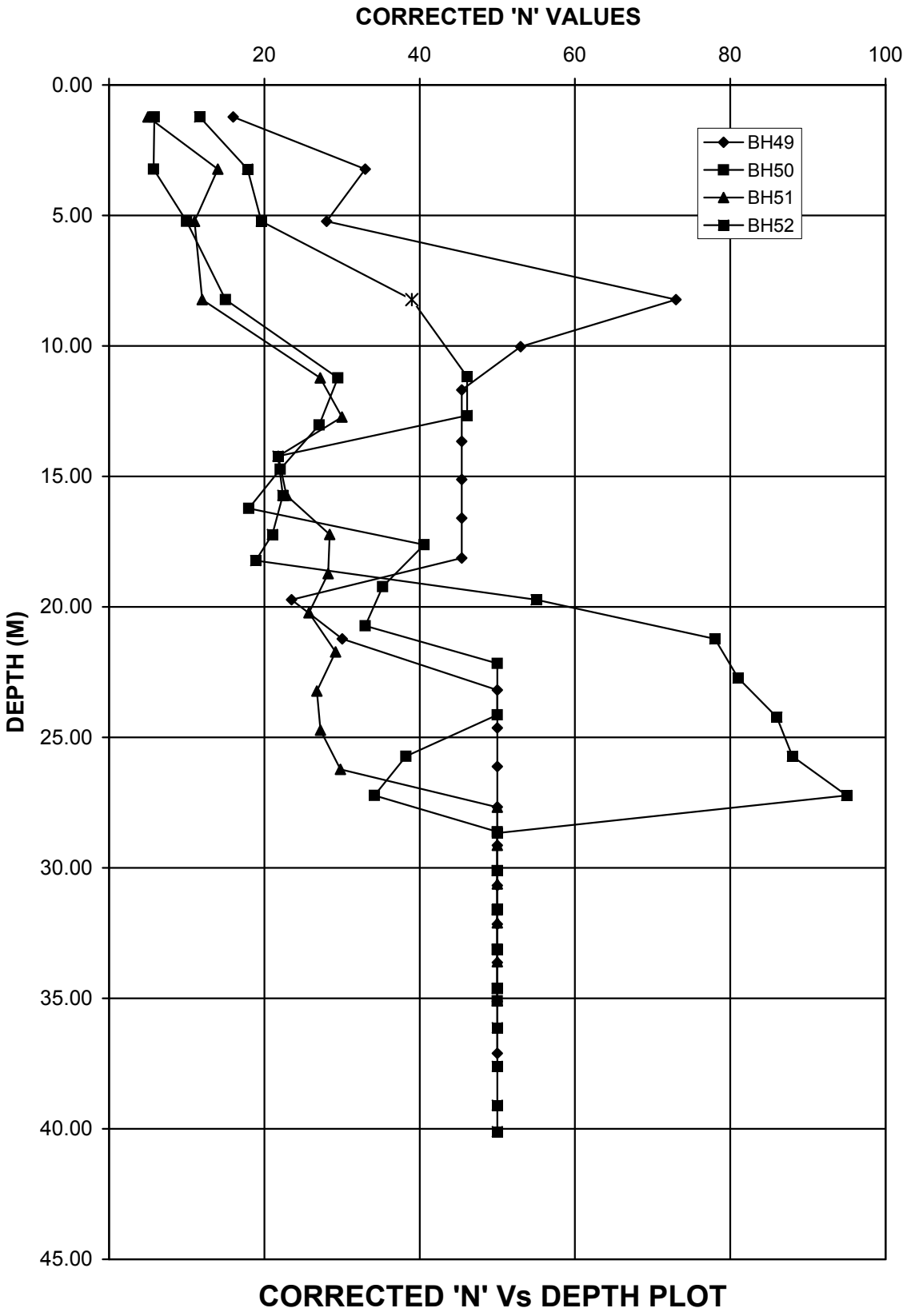

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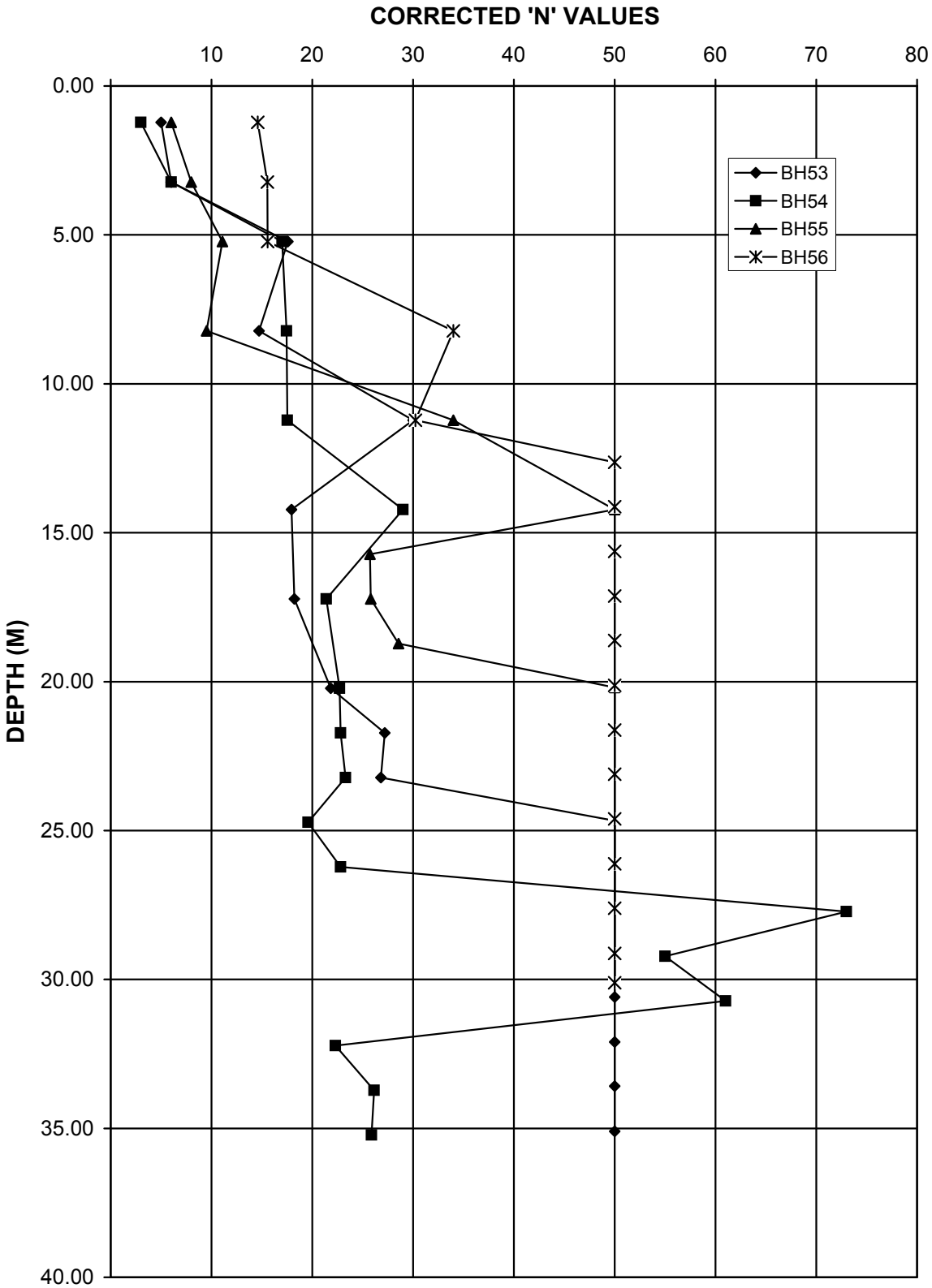

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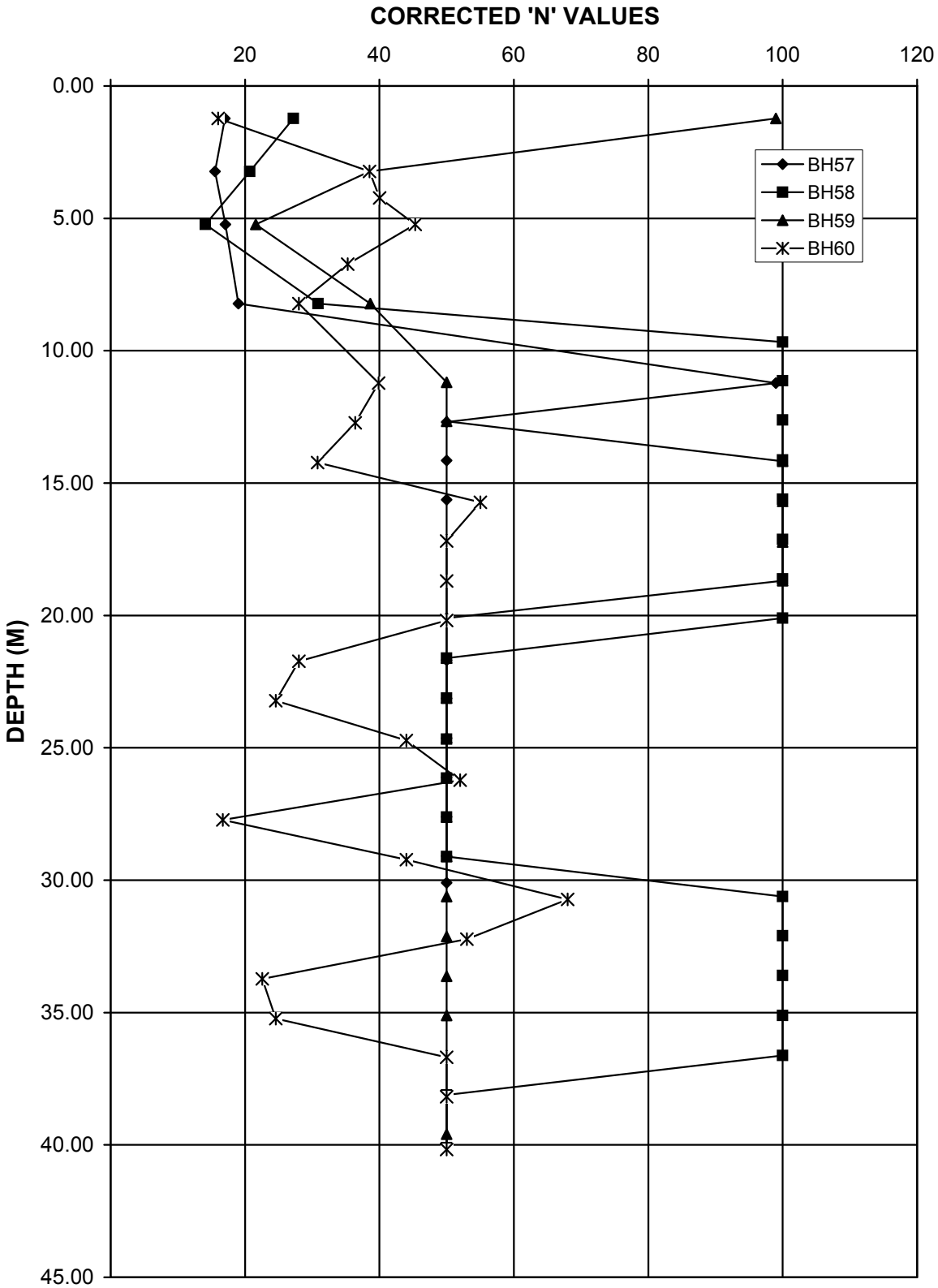

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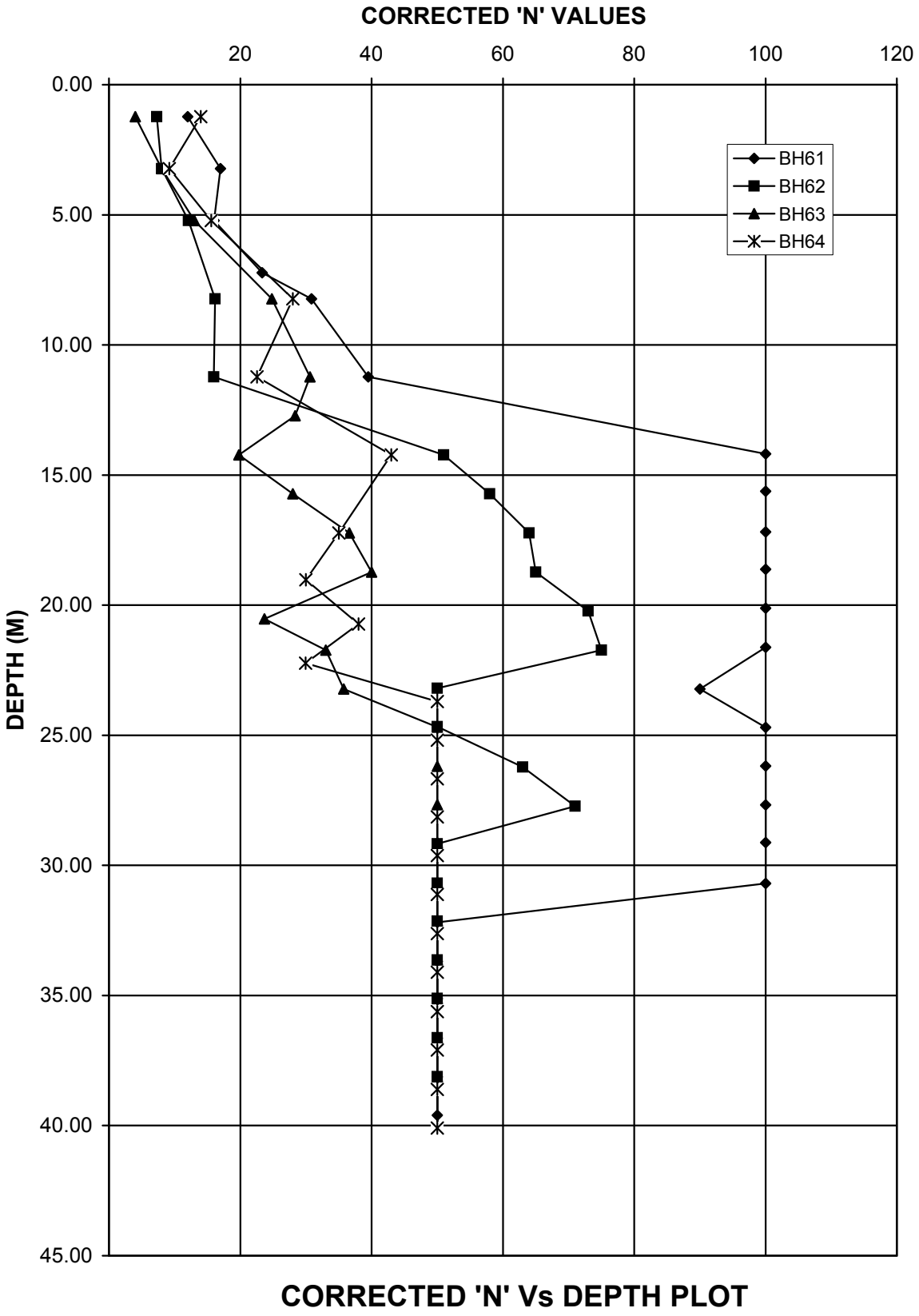
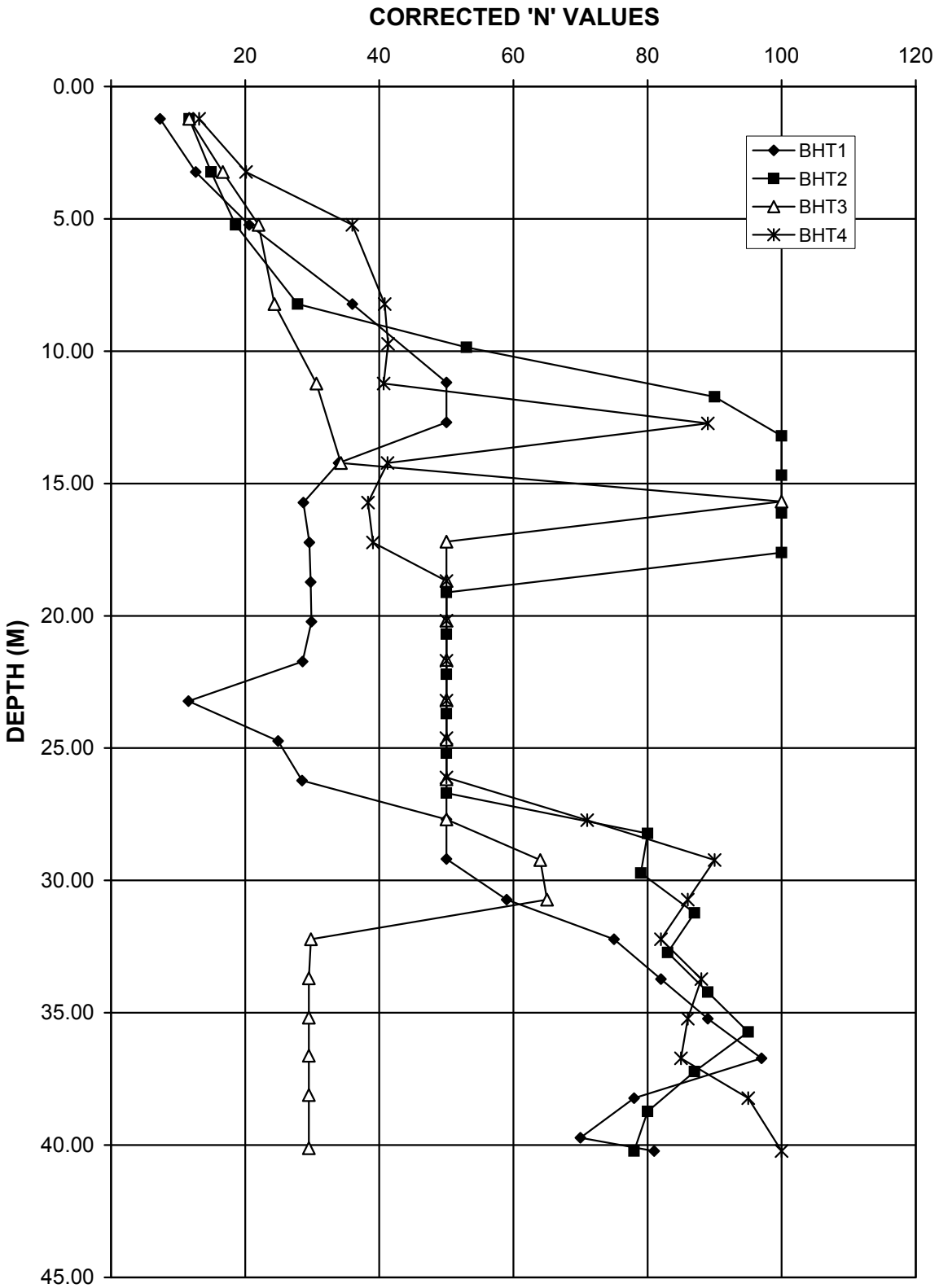


CORRECTED 'N' Vs DEPTH PLOT



CORRECTED 'N' Vs DEPTH PLOT

DYNAMIC CONE PENETRATION TEST RESULTS

DCPT No.	Co-Ordinates		R.L. of Ground (M)	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Nc Value
	Easting	Northinng					
DCPT-01	953.000	505.000	63.730	0.00	0.30	0.15	20
				0.30	0.60	0.45	17
				0.60	0.90	0.75	20
				0.90	1.20	1.05	22
				1.20	1.50	1.35	20
				1.50	1.80	1.65	20
				1.80	2.10	1.95	24
				2.10	2.40	2.25	28
				2.40	2.70	2.55	24
				2.70	3.00	2.85	30
				3.00	3.30	3.15	29
				3.30	3.60	3.45	58
				3.60	3.90	3.75	48
				3.90	4.20	4.05	51
				4.20	4.50	4.35	79
				4.50	4.80	4.65	87
				4.80	5.10	4.95	88
				5.10	5.40	5.25	54
				5.40	5.70	5.55	74
				5.70	6.00	5.85	84
				6.00	6.30	6.15	99
				6.30	6.60	6.45	114
				6.60	6.90	6.75	152
				6.90	7.20	7.05	393
					Extrapolated value		
DCPT-02	663.000	387.000	64.824	0.00	0.30	0.15	6
				0.30	0.60	0.45	41
				0.60	0.90	0.75	63
				0.90	1.20	1.05	52
				1.20	1.50	1.35	38
				1.50	1.80	1.65	19
				1.80	2.10	1.95	18
				2.10	2.40	2.25	23
				2.40	2.70	2.55	18
				2.70	3.00	2.85	13
				3.00	3.30	3.15	29
				3.30	3.60	3.45	38
				3.60	3.90	3.75	68
				3.90	4.20	4.05	71
				4.20	4.50	4.35	101
				4.50	4.80	4.65	107
				4.80	5.10	4.95	92
				5.10	5.40	5.25	92
				5.40	5.70	5.55	83
				5.70	6.00	5.85	86
				6.00	6.30	6.15	98
				6.30	6.60	6.45	106
				6.60	6.90	6.75	144
				6.90	7.20	7.05	197
				7.20	7.50	7.35	315
					Extrapolated value		

DYNAMIC CONE PENETRATION TEST RESULTS

DCPT No.	Co-Ordinates		R.L. of Ground (M)	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Nc Value
	Easting	Northinng					
DCPT-03	689.000	271.000	64.528	0.00	0.30	0.15	31
				0.30	0.60	0.45	55
				0.60	0.90	0.75	106
				0.90	1.20	1.05	102
				1.20	1.50	1.35	117
				1.50	1.80	1.65	29
				1.80	2.10	1.95	15
				2.10	2.40	2.25	21
				2.40	2.70	2.55	16
				2.70	3.00	2.85	16
				3.00	3.30	3.15	19
				3.30	3.60	3.45	25
				3.60	3.90	3.75	34
				3.90	4.20	4.05	38
				4.20	4.50	4.35	29
				4.50	4.80	4.65	31
				4.80	5.10	4.95	30
				5.10	5.40	5.25	34
				5.40	5.70	5.55	39
				5.70	6.00	5.85	51
				6.00	6.30	6.15	49
				6.30	6.60	6.45	97
				6.60	6.90	6.75	319
				6.90	7.20	7.05	600
					Extrapolated value		
DCPT-04	932.000	235.000	63.302	0.00	0.30	0.15	4
				0.30	0.60	0.45	11
				0.60	0.90	0.75	33
				0.90	1.20	1.05	59
				1.20	1.50	1.35	80
				1.50	1.80	1.65	67
				1.80	2.10	1.95	83
				2.10	2.40	2.25	135
				2.40	2.70	2.55	290
				2.70	3.00	2.85	378
					Extrapolated value		
DCPT-05	640.000	220.000	64.579	0.00	0.30	0.15	12
				0.30	0.60	0.45	25
				0.60	0.90	0.75	11
				0.90	1.20	1.05	20
				1.20	1.50	1.35	36
				1.50	1.80	1.65	27
				1.80	2.10	1.95	25
				2.10	2.40	2.25	30
				2.40	2.70	2.55	34
				2.70	3.00	2.85	30
				3.00	3.30	3.15	38
				3.30	3.60	3.45	31
				3.60	3.90	3.75	27
				3.90	4.20	4.05	19
				4.20	4.50	4.35	16
				4.50	4.80	4.65	16
				4.80	5.10	4.95	18
				5.10	5.40	5.25	20
				5.40	5.70	5.55	23
				5.70	6.00	5.85	19
				6.00	6.30	6.15	21
				6.30	6.60	6.45	29
				6.60	6.90	6.75	61
				6.90	7.20	7.05	98

DYNAMIC CONE PENETRATION TEST RESULTS

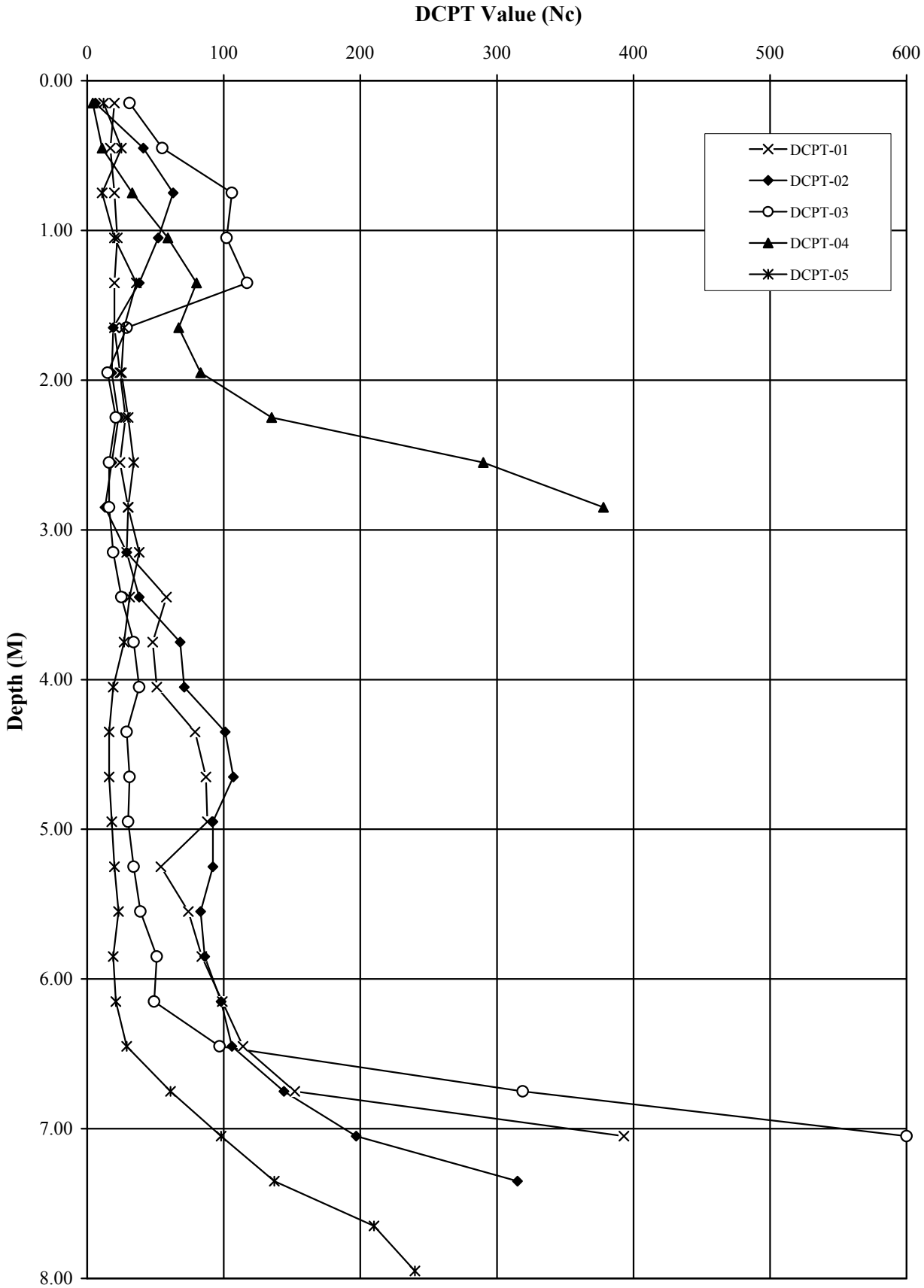
DCPT No.	Co-Ordinates		R.L. of Ground (M)	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Nc Value
	Easting	Northinng					
				7.20	7.50	7.35	137
				7.50	7.80	7.65	210
				7.80	8.10	7.95	240
						Extrapolated value	
DCPT-06	523.000	106.000	66.127	0.00	0.30	0.15	11
				0.30	0.60	0.45	14
				0.60	0.90	0.75	13
				0.90	1.20	1.05	21
				1.20	1.50	1.35	28
				1.50	1.80	1.65	19
				1.80	2.10	1.95	13
				2.10	2.40	2.25	31
				2.40	2.70	2.55	29
				2.70	3.00	2.85	31
				3.00	3.30	3.15	39
				3.30	3.60	3.45	26
				3.60	3.90	3.75	22
				3.90	4.20	4.05	12
				4.20	4.50	4.35	16
				4.50	4.80	4.65	14
				4.80	5.10	4.95	25
				5.10	5.40	5.25	35
				5.40	5.70	5.55	33
				5.70	6.00	5.85	33
				6.00	6.30	6.15	30
				6.30	6.60	6.45	25
				6.60	6.90	6.75	28
				6.90	7.20	7.05	22
				7.20	7.50	7.35	29
				7.50	7.80	7.65	41
				7.80	8.10	7.95	52
				8.10	8.40	8.25	91
				8.40	8.70	8.55	136
				8.70	9.00	8.85	167
				9.00	9.30	9.15	342
						Extrapolated value	
DCPT-07	190.000	-24.000	80.157	0.00	0.30	0.15	172
				0.30	0.60	0.45	136
				0.60	0.90	0.75	146
				0.90	1.20	1.05	157
				1.20	1.50	1.35	88
				1.50	1.80	1.65	68
				1.80	2.10	1.95	50
				2.10	2.40	2.25	40
				2.40	2.70	2.55	26
				2.70	3.00	2.85	19
				3.00	3.30	3.15	26
				3.30	3.60	3.45	34
				3.60	3.90	3.75	39
				3.90	4.20	4.05	43
				4.20	4.50	4.35	51
				4.50	4.80	4.65	51
				4.80	5.10	4.95	56
				5.10	5.40	5.25	60
				5.40	5.70	5.55	66
				5.70	6.00	5.85	84
				6.00	6.30	6.15	83
				6.30	6.60	6.45	44
				6.60	6.90	6.75	30
				6.90	7.20	7.05	42

DYNAMIC CONE PENETRATION TEST RESULTS

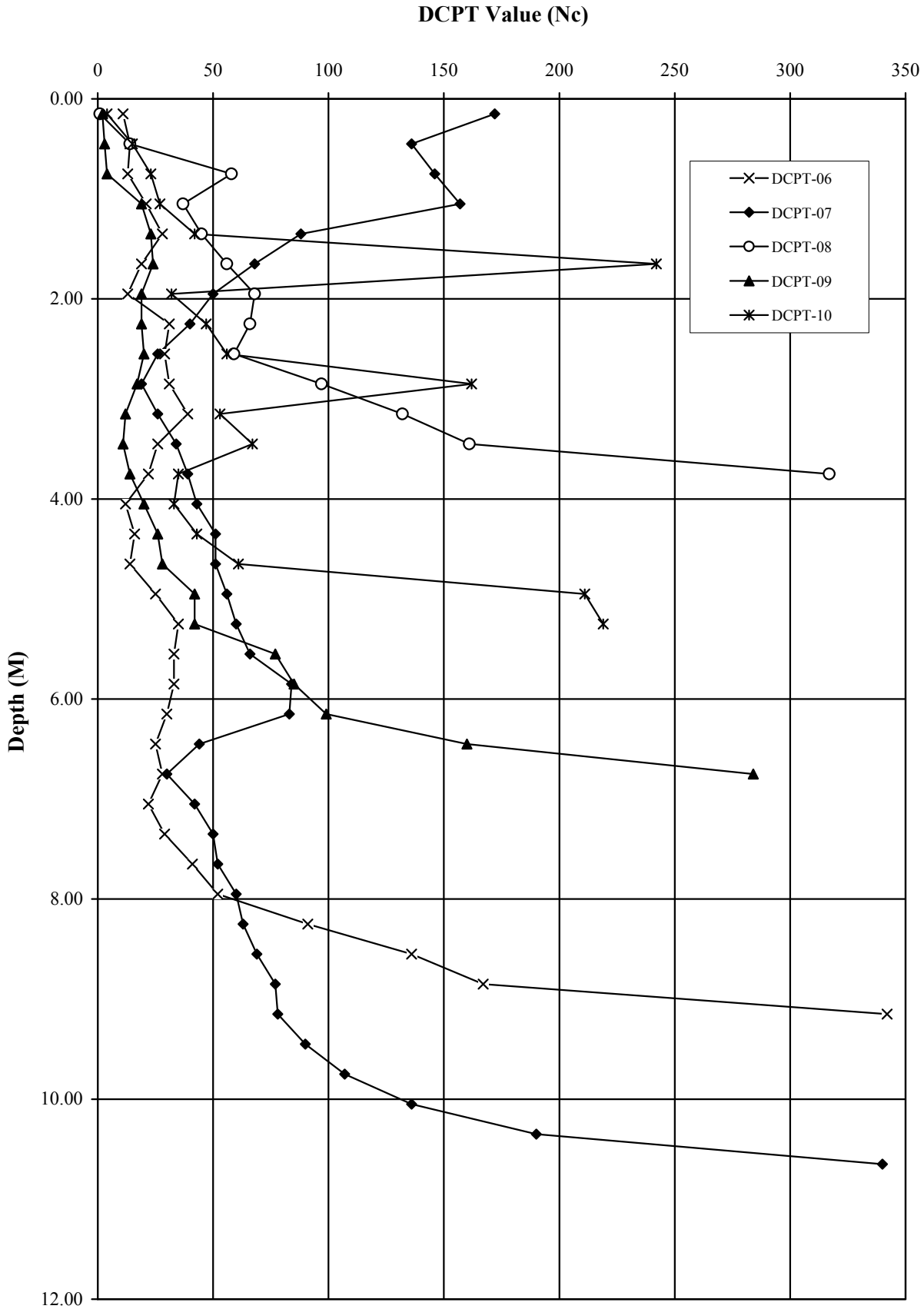
DCPT No.	Co-Ordinates		R.L. of Ground (M)	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Nc Value
	Easting	Northinng					
				7.20	7.50	7.35	50
				7.50	7.80	7.65	52
				7.80	8.10	7.95	60
				8.10	8.40	8.25	63
				8.40	8.70	8.55	69
				8.70	9.00	8.85	77
				9.00	9.30	9.15	78
				9.30	9.60	9.45	90
				9.60	9.90	9.75	107
				9.90	10.20	10.05	136
				10.20	10.50	10.35	190
				10.50	10.80	10.65	340
						Extrapolated value	
DCPT-08	-610.000	-24.000	78.092	0.00	0.30	0.15	1
				0.30	0.60	0.45	14
				0.60	0.90	0.75	58
				0.90	1.20	1.05	37
				1.20	1.50	1.35	45
				1.50	1.80	1.65	56
				1.80	2.10	1.95	68
				2.10	2.40	2.25	66
				2.40	2.70	2.55	59
				2.70	3.00	2.85	97
				3.00	3.30	3.15	132
				3.30	3.60	3.45	161
				3.60	3.90	3.75	317
						Extrapolated value	
DCPT-09	625.000	58.000	64.178	0.00	0.30	0.15	2
				0.30	0.60	0.45	3
				0.60	0.90	0.75	4
				0.90	1.20	1.05	19
				1.20	1.50	1.35	23
				1.50	1.80	1.65	24
				1.80	2.10	1.95	19
				2.10	2.40	2.25	19
				2.40	2.70	2.55	20
				2.70	3.00	2.85	17
				3.00	3.30	3.15	12
				3.30	3.60	3.45	11
				3.60	3.90	3.75	14
				3.90	4.20	4.05	20
				4.20	4.50	4.35	26
				4.50	4.80	4.65	28
				4.80	5.10	4.95	42
				5.10	5.40	5.25	42
				5.40	5.70	5.55	77
				5.70	6.00	5.85	85
				6.00	6.30	6.15	99
				6.30	6.60	6.45	160
				6.60	6.90	6.75	284
						Extrapolated value	
DCPT-10	871.000	-642.000	70.598	0.00	0.30	0.15	4
				0.30	0.60	0.45	15
				0.60	0.90	0.75	23
				0.90	1.20	1.05	27
				1.20	1.50	1.35	42
				1.50	1.80	1.65	242
				1.80	2.10	1.95	32

DYNAMIC CONE PENETRATION TEST RESULTS

DCPT No.	Co-Ordinates		R.L. of Ground (M)	Starting Depth (M)	Ending Depth (M)	Average Depth (M)	Nc Value
	Easting	Northinng					
				2.10	2.40	2.25	47
				2.40	2.70	2.55	56
				2.70	3.00	2.85	162
				3.00	3.30	3.15	53
				3.30	3.60	3.45	67
				3.60	3.90	3.75	35
				3.90	4.20	4.05	33
				4.20	4.50	4.35	43
				4.50	4.80	4.65	61
				4.80	5.10	4.95	211
				5.10	5.40	5.25	219



DCPT Value (Nc) vs. Depth Plot



DCPT Value (Nc) vs. Depth Plot

SCPT NO. - 1

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	96.0	176.0	98.6	178.6	9.9	0.714	7.2
0.4	236.0	262.0	238.6	264.6	23.9	0.237	1.0
0.6	308.0	314.0	310.6	316.6	31.1	0.060	0.2
0.8	350.0	410.0	352.6	412.6	35.3	0.537	1.5
1.0	368.0	406.0	372.1	410.1	37.2	0.343	0.9
1.2	170.0	290.0	174.1	294.1	17.4	1.068	6.1
1.4	204.0	284.0	208.1	288.1	20.8	0.714	3.4
1.6	238.0	304.0	242.1	308.1	24.2	0.591	2.4
1.8	188.0	256.0	192.1	260.1	19.2	0.608	3.2
2.0	192.0	282.0	197.6	287.6	19.8	0.803	4.1
2.2	170.0	318.0	175.6	323.6	17.6	1.316	7.5
2.4	132.0	336.0	137.6	341.6	13.8	1.812	13.2
2.6	156.0	386.0	161.6	391.6	16.2	2.042	12.6
2.8	210.0	414.0	215.6	419.6	21.6	1.812	8.4
3.0	222.0	456.0	229.1	463.1	22.9	2.077	9.1
3.2	232.0	468.0	239.1	475.1	23.9	2.095	8.8
3.4	251.0	474.0	258.1	481.1	25.8	1.980	7.7
3.6	208.0	414.0	215.1	421.1	21.5	1.830	8.5
3.8	376.0	612.0	383.1	619.1	38.3	2.095	5.5
4.0	298.0	418.0	306.6	426.6	30.7	1.068	3.5
4.2	480.0	672.0	488.6	680.6	48.9	1.706	3.5
4.4	482.0	670.0	490.6	678.6	49.1	1.670	3.4
4.6	666.0	1072.0	674.6	1080.6	67.5	3.599	5.3
4.8	612.0	1016.0	620.6	1024.6	62.1	3.582	5.8
5.0	610.0	1056.0	620.1	1066.1	62.0	3.953	6.4
5.2	560.0	995.0	570.1	1005.1	57.0	3.856	6.8
5.4	528.0	1062.0	538.1	1072.1	53.8	4.732	8.8
5.6	530.0	1092.0	540.1	1102.1	54.0	4.980	9.2
5.8	498.0	932.0	508.1	942.1	50.8	3.847	7.6
6.0	310.0	612.0	321.6	623.6	32.2	2.679	8.3
6.2	292.0	410.0	303.6	421.6	30.4	1.051	3.5
6.4	310.0	456.0	321.6	467.6	32.2	1.299	4.0
6.6	356.0	512.0	367.6	523.6	36.8	1.387	3.8
6.8	714.0	916.0	725.6	927.6	72.6	1.794	2.5
7.0	832.0	1092.0	845.1	1105.1	84.5	2.307	2.7
7.2	862.0	1136.0	875.1	1149.1	87.5	2.431	2.8
7.4	710.0	1032.0	723.1	1045.1	72.3	2.856	3.9
7.6	1352.0	1665.0	1365.1	1678.1	136.5	2.776	2.0
7.8	1492.0	1852.0	1505.1	1865.1	150.5	3.192	2.1
8.0	1132.0	1706.0	1146.6	1720.6	114.7	5.086	4.4
8.2	1610.0	2132.0	1624.6	2146.6	162.5	4.626	2.8
8.4	1612.0	2208.0	1626.6	2222.6	162.7	5.281	3.2
8.6	1702.0	2456.0	1716.6	2470.6	171.7	6.679	3.9

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
II	0	5.00	5.57	Clay	30.41	1.13kg/sqcm
I	5.00	8.60	4.58	Sandy silt	86.80	38°

SCPT NO. - 2

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	114.0	260.0	116.6	262.6	11.7	1.299	11.1
0.4	358.0	488.0	360.6	490.6	36.1	1.157	3.2
0.6	412.0	810.0	414.6	812.6	41.5	3.529	8.5
0.8	592.0	912.0	594.6	914.6	59.5	2.838	4.8
1.0	442.0	582.0	446.1	586.1	44.6	1.245	2.8
1.2	312.0	470.0	316.1	474.1	31.6	1.405	4.4
1.4	306.0	462.0	310.1	466.1	31.0	1.387	4.5
1.6	296.0	398.0	300.1	402.1	30.0	0.909	3.0
1.8	256.0	370.0	260.1	374.1	26.0	1.015	3.9
2.0	182.0	322.0	187.6	327.6	18.8	1.245	6.6
2.2	201.0	394.0	206.6	399.6	20.7	1.714	8.3
2.4	192.0	332.0	197.6	337.6	19.8	1.245	6.3
2.6	138.0	242.0	143.6	247.6	14.4	0.927	6.5
2.8	148.0	272.0	153.6	277.6	15.4	1.104	7.2
3.0	172.0	308.0	179.1	315.1	17.9	1.210	6.8
3.2	232.0	342.0	239.1	349.1	23.9	0.980	4.1
3.4	230.0	516.0	237.1	523.1	23.7	2.537	10.7
3.6	544.0	798.0	551.1	805.1	55.1	2.254	4.1
3.8	498.0	746.0	505.1	753.1	50.5	2.201	4.4
4.0	444.0	754.0	452.6	762.6	45.3	2.750	6.1
4.2	592.0	820.0	600.6	828.6	60.1	2.024	3.4
4.4	632.0	922.0	640.6	930.6	64.1	2.573	4.0
4.6	661.0	914.0	669.6	922.6	67.0	2.245	3.4
4.8	862.0	1154.0	870.6	1162.6	87.1	2.591	3.0
5.0	1310.0	1890.0	1320.1	1900.1	132.0	5.139	3.9
5.2	986.0	1730.0	996.1	1740.1	99.6	6.591	6.6
5.4	1092.0	1752.0	1102.1	1762.1	110.2	5.847	5.3
5.6	924.0	1586.0	934.1	1596.1	93.4	5.865	6.3
5.8	962.0	1502.0	972.1	1512.1	97.2	4.785	4.9
6.0	776.0	1476.0	787.6	1487.6	78.8	6.201	7.9
6.2	760.0	1472.0	771.6	1483.6	77.2	6.307	8.2
6.4	630.0	842.0	641.6	853.6	64.2	1.883	2.9
6.6	1196.0	1406.0	1207.6	1417.6	120.8	1.865	1.5
6.8	1310.0	2246.0	1321.6	2257.6	132.2	8.290	6.3
7.0	1072.0	1982.0	1085.1	1995.1	108.5	8.060	7.4
7.2	866.0	2010.0	879.1	2023.1	87.9	10.130	11.5
7.4	1292.0	2196.0	1305.1	2209.1	130.5	8.006	6.1
7.6	1366.0	2236.0	1379.1	2249.1	137.9	7.706	5.6

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
II	0.00	5.60	5.47	Clay	47.52	1.76kg/sqcm
I	5.60	7.60	4.60	Sandy silt	113.80	38°

SCPT NO. - 3

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	720.0	1132.0	722.6	1134.6	72.3	3.653	5.05
0.4	930.0	1660.0	932.6	1662.6	93.3	6.467	6.93
0.6	1630.0	1995.0	1632.6	1997.6	163.3	3.237	1.98
0.8	1890.0	2130.0	1892.6	2132.6	189.3	2.130	1.13
1.0	1273.0	1863.0	1277.1	1867.1	127.7	5.228	4.09
1.2	1891.0	2110.0	1895.1	2114.1	189.5	1.945	1.03
1.4	1645.0	2032.0	1649.1	2036.1	164.9	3.431	2.08
1.6	2192.0	2530.0	2196.1	2534.1	219.6	2.998	1.36
1.8	1870.0	2310.0	1874.1	2314.1	187.4	3.900	2.08
2.0	2243.0	2630.0	2248.6	2635.6	224.9	3.431	1.53
2.2	2110.0	2615.0	2115.6	2620.6	211.6	4.476	2.12
2.4	1870.0	1995.0	1875.6	2000.6	187.6	1.113	0.59
2.6	1395.0	1795.0	1400.6	1800.6	140.1	3.546	2.53
2.8	1012.0	1210.0	1017.6	1215.6	101.8	1.759	1.73
3.0	670.0	1074.0	677.1	1081.1	67.7	3.582	5.29
3.2	552.0	902.0	559.1	909.1	55.9	3.104	5.55
3.4	302.0	514.0	309.1	521.1	30.9	1.883	6.09
3.6	314.0	531.0	321.1	538.1	32.1	1.927	6.00
3.8	352.0	571.0	359.1	578.1	35.9	1.945	5.42
4.0	320.0	499.0	328.6	507.6	32.9	1.591	4.84
4.2	280.0	495.0	288.6	503.6	28.9	1.909	6.62
4.4	282.0	493.0	290.6	501.6	29.1	1.874	6.45
4.6	262.0	471.0	270.6	479.6	27.1	1.856	6.86
4.8	340.0	510.0	348.6	518.6	34.9	1.511	4.33
5.0	320.0	512.0	330.1	522.1	33.0	1.706	5.17
5.2	399.0	531.0	409.1	541.1	40.9	1.175	2.87
5.4	361.0	498.0	371.1	508.1	37.1	1.219	3.28
5.6	332.0	442.0	342.1	452.1	34.2	0.980	2.86
5.8	292.0	410.0	302.1	420.1	30.2	1.051	3.48
6.0	309.0	446.0	320.6	457.6	32.1	1.219	3.80
6.2	288.0	402.0	299.6	413.6	30.0	1.015	3.39
6.4	364.0	508.0	375.6	519.6	37.6	1.281	3.41
6.6	292.0	472.0	303.6	483.6	30.4	1.599	5.27
6.8	410.0	472.0	421.6	483.6	42.2	0.555	1.32
7.0	408.0	470.0	421.1	483.1	42.1	0.555	1.32
7.2	496.0	512.0	509.1	525.1	50.9	0.148	0.29
7.4	462.0	514.0	475.1	527.1	47.5	0.467	0.98
7.6	386.0	496.0	399.1	509.1	39.9	0.980	2.46
7.8	432.0	532.0	445.1	545.1	44.5	0.891	2.00
8.0	510.0	551.0	524.6	565.6	52.5	0.369	0.70
8.2	496.0	610.0	510.6	624.6	51.1	1.015	1.99
8.4	392.0	532.0	406.6	546.6	40.7	1.245	3.06
8.6	456.0	610.0	470.6	624.6	47.1	1.369	2.91
8.8	462.0	583.0	476.6	597.6	47.7	1.077	2.26
9.0	512.0	710.0	528.1	726.1	52.8	1.759	3.33
9.2	549.0	742.0	565.1	758.1	56.5	1.714	3.03
9.4	612.0	910.0	628.1	926.1	62.8	2.644	4.21
9.6	790.0	1010.0	806.1	1026.1	80.6	1.953	2.42
9.8	630.0	910.0	646.1	926.1	64.6	2.484	3.85
10.0	782.0	1053.0	799.6	1070.6	80.0	2.405	3.01
10.2	1053.0	1262.0	1070.6	1279.6	107.1	1.856	1.73
10.4	1392.0	1642.0	1409.6	1659.6	141.0	2.219	1.57
10.6	1111.0	1518.0	1128.6	1535.6	112.9	3.608	3.20
10.8	1492.0	1666.0	1509.6	1683.6	151.0	1.546	1.02
11.0	1515.0	1749.0	1534.1	1768.1	153.4	2.077	1.35
11.2	1810.0	1998.0	1829.1	2017.1	182.9	1.670	0.91

SCPT NO. - 3

Mass of cone(kg) = 1.1
Area of Cone (sqcm) = 10
Area of friction jacket (sqcm) = 113
Mass of each rod (kg) = 1.5
Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
11.4	1042.0	1612.0	1061.1	1631.1	106.1	5.051	4.76
11.6	1272.0	1865.0	1291.1	1884.1	129.1	5.254	4.07
11.8	1792.0	2142.0	1811.1	2161.1	181.1	3.104	1.71
12.0	1610.0	1978.0	1630.6	1998.6	163.1	3.263	2.00
12.2	1832.0	2242.0	1852.6	2262.6	185.3	3.635	1.96
12.4	1934.0	2302.0	1954.6	2322.6	195.5	3.263	1.67

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
I	0.00	7.50	3.49	Sandy silt	84.77	40°
III	7.50	12.40	2.45	Silty sand	101.16	36°

SCPT NO. - 4

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	1162.0	1250.0	1164.6	1252.6	116.5	0.785	0.67
0.4	672.0	810.0	674.6	812.6	67.5	1.228	1.82
0.6	1672.0	2232.0	1674.6	2234.6	167.5	4.962	2.96
0.8	448.0	656.0	450.6	658.6	45.1	1.847	4.10
1.0	510.0	720.0	514.1	724.1	51.4	1.865	3.63
1.2	444.0	716.0	448.1	720.1	44.8	2.414	5.39
1.4	450.0	684.0	454.1	688.1	45.4	2.077	4.57
1.6	318.0	574.0	322.1	578.1	32.2	2.272	7.05
1.8	480.0	642.0	484.1	646.1	48.4	1.440	2.97
2.0	92.0	166.0	97.6	171.6	9.8	0.661	6.78
2.2	202.0	348.0	207.6	353.6	20.8	1.299	6.25
2.4	175.0	324.0	180.6	329.6	18.1	1.325	7.34
2.6	160.0	334.0	165.6	339.6	16.6	1.546	9.34
2.8	116.0	188.0	121.6	193.6	12.2	0.644	5.29
3.0	74.0	160.0	81.1	167.1	8.1	0.768	9.46
3.2	112.0	192.0	119.1	199.1	11.9	0.714	6.00
3.4	160.0	234.0	167.1	241.1	16.7	0.661	3.96
3.6	480.0	642.0	487.1	649.1	48.7	1.440	2.96
3.8	254.0	532.0	261.1	539.1	26.1	2.467	9.45
4.0	136.0	372.0	144.6	380.6	14.5	2.095	14.49
4.2	216.0	394.0	224.6	402.6	22.5	1.582	7.04
4.4	272.0	458.0	280.6	466.6	28.1	1.653	5.89
4.6	102.0	248.0	110.6	256.6	11.1	1.299	11.74
4.8	250.0	428.0	258.6	436.6	25.9	1.582	6.12
5.0	215.0	420.0	225.1	430.1	22.5	1.821	8.09
5.2	334.0	540.0	344.1	550.1	34.4	1.830	5.32
5.4	266.0	520.0	276.1	530.1	27.6	2.254	8.16
5.6	456.0	666.0	466.1	676.1	46.6	1.865	4.00
5.8	330.0	548.0	340.1	558.1	34.0	1.936	5.69
6.0	252.0	578.0	263.6	589.6	26.4	2.891	10.97
6.2	396.0	611.0	407.6	622.6	40.8	1.909	4.68
6.4	301.0	516.0	312.6	527.6	31.3	1.909	6.11
6.6	228.0	424.0	239.6	435.6	24.0	1.741	7.27
6.8	234.0	536.0	245.6	547.6	24.6	2.679	10.91
7.0	258.0	568.0	271.1	581.1	27.1	2.750	10.14
7.2	256.0	556.0	269.1	569.1	26.9	2.661	9.89
7.4	302.0	612.0	315.1	625.1	31.5	2.750	8.73
7.6	356.0	646.0	369.1	659.1	36.9	2.573	6.97
7.8	378.0	710.0	391.1	723.1	39.1	2.945	7.53
8.0	388.0	732.0	402.6	746.6	40.3	3.051	7.58
8.2	272.0	602.0	286.6	616.6	28.7	2.927	10.21
8.4	252.0	482.0	266.6	496.6	26.7	2.042	7.66
8.6	270.0	604.0	284.6	618.6	28.5	2.962	10.41
8.8	310.0	813.0	324.6	827.6	32.5	4.458	13.73
9.0	422.0	742.0	438.1	758.1	43.8	2.838	6.48
9.2	362.0	760.0	378.1	776.1	37.8	3.529	9.33
9.4	494.0	808.0	510.1	824.1	51.0	2.785	5.46
9.6	811.0	1214.0	827.1	1230.1	82.7	3.573	4.32
9.8	116.0	1644.0	132.1	1660.1	13.2	13.529	102.41
10.0	790.0	1266.0	807.6	1283.6	80.8	4.219	5.22
10.2	1348.0	1994.0	1365.6	2011.6	136.6	5.723	4.19

SCPT NO. - 4

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
10.4	1470.0	2145.0	1487.6	2162.6	148.8	5.980	4.02
10.6	1520.0	2242.0	1537.6	2259.6	153.8	6.396	4.16

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
II	0.00	9.50	7.03	Clay	35.58	1.32kg/sqcm
III	9.50	10.60	4.38	Sandy silt	120.50	36°

SCPT NO. - 5

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	176.0	220.0	178.6	222.6	17.9	0.396	2.22
0.4	240.0	686.0	242.6	688.6	24.3	3.953	16.30
0.6	224.0	540.0	226.6	542.6	22.7	2.803	12.37
0.8	326.0	568.0	328.6	570.6	32.9	2.148	6.54
1.0	658.0	778.0	662.1	782.1	66.2	1.068	1.61
1.2	314.0	616.0	318.1	620.1	31.8	2.679	8.42
1.4	72.0	248.0	76.1	252.1	7.6	1.564	20.55
1.6	176.0	210.0	180.1	214.1	18.0	0.307	1.71
1.8	136.0	318.0	140.1	322.1	14.0	1.617	11.54
2.0	160.0	354.0	165.6	359.6	16.6	1.723	10.41
2.2	406.0	420.0	411.6	425.6	41.2	0.130	0.32
2.4	380.0	470.0	385.6	475.6	38.6	0.803	2.08
2.6	264.0	468.0	269.6	473.6	27.0	1.812	6.72
2.8	290.0	504.0	295.6	509.6	29.6	1.900	6.43
3.0	304.0	504.0	311.1	511.1	31.1	1.776	5.71
3.2	216.0	380.0	223.1	387.1	22.3	1.458	6.53
3.4	154.0	300.0	161.1	307.1	16.1	1.299	8.06
3.6	180.0	338.0	187.1	345.1	18.7	1.405	7.51
3.8	402.0	550.0	409.1	557.1	40.9	1.316	3.22
4.0	510.0	720.0	518.6	728.6	51.9	1.865	3.60
4.2	650.0	1090.0	658.6	1098.6	65.9	3.900	5.92
4.4	548.0	992.0	556.6	1000.6	55.7	3.936	7.07
4.6	562.0	1048.0	570.6	1056.6	57.1	4.307	7.55
4.8	582.0	1072.0	590.6	1080.6	59.1	4.343	7.35
5.0	610.0	1088.0	620.1	1098.1	62.0	4.237	6.83
5.2	700.0	1150.0	710.1	1160.1	71.0	3.989	5.62
5.4	782.0	1236.0	792.1	1246.1	79.2	4.024	5.08
5.6	764.0	1354.0	774.1	1364.1	77.4	5.228	6.75
5.8	664.0	1256.0	674.1	1266.1	67.4	5.245	7.78
6.0	506.0	782.0	517.6	793.6	51.8	2.449	4.73
6.2	570.0	968.0	581.6	979.6	58.2	3.529	6.07
6.4	822.0	1142.0	833.6	1153.6	83.4	2.838	3.40
6.6	922.0	1502.0	933.6	1513.6	93.4	5.139	5.50
6.8	1324.0	2024.0	1335.6	2035.6	133.6	6.201	4.64
7.0	1350.0	3032.0	1363.1	3045.1	136.3	14.891	10.92
7.2	696.0	1176.0	709.1	1189.1	70.9	4.254	6.00
7.4	810.0	1312.0	823.1	1325.1	82.3	4.449	5.41
7.6	1702.0	1914.0	1715.1	1927.1	171.5	1.883	1.10
7.8	854.0	1430.0	867.1	1443.1	86.7	5.104	5.89
8.0	912.0	1610.0	926.6	1624.6	92.7	6.183	6.67
8.2	2066.0	2422.0	2080.6	2436.6	208.1	3.157	1.52
8.4	2218.0	2636.0	2232.6	2650.6	223.3	3.706	1.66
8.6	1934.0	2440.0	1948.6	2454.6	194.9	4.484	2.30
8.8	1896.0	2018.0	1910.6	2032.6	191.1	1.086	0.57

SCPT NO. - 5

Mass of cone(kg) = 1.1
Area of Cone (sqcm) = 10
Area of friction jacket (sqcm) = 113
Mass of each rod (kg) = 1.5
Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
9.0	2024.0	2476.0	2040.1	2492.1	204.0	4.006	1.96
9.2	2310.0	3112.0	2326.1	3128.1	232.6	7.104	3.05

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
II	0.00	8.00	6.55	Clay	55.61	2.06kg/sqcm
III	8.00	9.20	1.84	Sand	208.98	40°

SCPT NO. - 6

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	170.0	318.0	172.6	320.6	17.3	1.316	7.63
0.4	230.0	624.0	232.6	626.6	23.3	3.493	15.02
0.6	496.0	512.0	498.6	514.6	49.9	0.148	0.30
0.8	470.0	614.0	472.6	616.6	47.3	1.281	2.71
1.0	496.0	670.0	500.1	674.1	50.0	1.546	3.09
1.2	512.0	734.0	516.1	738.1	51.6	1.971	3.82
1.4	510.0	772.0	514.1	776.1	51.4	2.325	4.52
1.6	606.0	852.0	610.1	856.1	61.0	2.183	3.58
1.8	936.0	1108.0	940.1	1112.1	94.0	1.529	1.63
2.0	604.0	828.0	609.6	833.6	61.0	1.989	3.26
2.2	740.0	1032.0	745.6	1037.6	74.6	2.591	3.47
2.4	830.0	1160.0	835.6	1165.6	83.6	2.927	3.50
2.6	796.0	1102.0	801.6	1107.6	80.2	2.714	3.39
2.8	1242.0	1710.0	1247.6	1715.6	124.8	4.148	3.32
3.0	1314.0	1556.0	1321.1	1563.1	132.1	2.148	1.63
3.2	1372.0	1980.0	1379.1	1987.1	137.9	5.387	3.91
3.4	1526.0	2096.0	1533.1	2103.1	153.3	5.051	3.29
3.6	1642.0	2362.0	1649.1	2369.1	164.9	6.378	3.87
3.8	1610.0	2340.0	1617.1	2347.1	161.7	6.467	4.00
4.0	1598.0	2306.0	1606.6	2314.6	160.7	6.272	3.90
4.2	1876.0	2510.0	1884.6	2518.6	188.5	5.617	2.98
4.4	1984.0	2592.0	1992.6	2600.6	199.3	5.387	2.70

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
III	0.00	4.40	3.89	Sandy silt	98.55	42°

SCPT NO. - 7

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	0.0	0.0	2.6	2.6	0.3	0.006	2.50
0.4	16.0	52.0	18.6	54.6	1.9	0.325	17.48
0.6	60.0	101.0	62.6	103.6	6.3	0.369	5.90
0.8	333.0	480.0	335.6	482.6	33.6	1.307	3.90
1.0	416.0	592.0	420.1	596.1	42.0	1.564	3.72
1.2	510.0	690.0	514.1	694.1	51.4	1.599	3.11
1.4	630.0	820.0	634.1	824.1	63.4	1.688	2.66
1.6	70.0	160.0	74.1	164.1	7.4	0.803	10.84
1.8	110.0	180.0	114.1	184.1	11.4	0.626	5.49
2.0	127.0	206.0	132.6	211.6	13.3	0.706	5.32
2.2	138.0	234.0	143.6	239.6	14.4	0.856	5.96
2.4	176.0	292.0	181.6	297.6	18.2	1.033	5.69
2.6	188.0	300.0	193.6	305.6	19.4	0.998	5.15
2.8	192.0	326.0	197.6	331.6	19.8	1.192	6.03
3.0	210.0	360.0	217.1	367.1	21.7	1.334	6.14
3.2	236.0	372.0	243.1	379.1	24.3	1.210	4.98
3.4	326.0	456.0	333.1	463.1	33.3	1.157	3.47
3.6	351.0	482.0	358.1	489.1	35.8	1.166	3.26
3.8	410.0	920.0	417.1	927.1	41.7	4.520	10.84
4.0	496.0	1028.0	504.6	1036.6	50.5	4.714	9.34
4.2	270.0	436.0	278.6	444.6	27.9	1.476	5.30
4.4	140.0	354.0	148.6	362.6	14.9	1.900	12.79
4.6	212.0	362.0	220.6	370.6	22.1	1.334	6.05
4.8	246.0	402.0	254.6	410.6	25.5	1.387	5.45
5.0	312.0	642.0	322.1	652.1	32.2	2.927	9.09
5.2	464.0	504.0	474.1	514.1	47.4	0.360	0.76
5.4	498.0	840.0	508.1	850.1	50.8	3.033	5.97
5.6	310.0	934.0	320.1	944.1	32.0	5.529	17.27
5.8	1042.0	1162.0	1052.1	1172.1	105.2	1.068	1.02
6.0	1192.0	1498.0	1203.6	1509.6	120.4	2.714	2.26
6.2	600.0	1106.0	611.6	1117.6	61.2	4.484	7.33
6.4	574.0	1062.0	585.6	1073.6	58.6	4.325	7.39
6.6	688.0	1186.0	699.6	1197.6	70.0	4.414	6.31
6.8	732.0	1210.0	743.6	1221.6	74.4	4.237	5.70
7.0	766.0	1260.0	779.1	1273.1	77.9	4.378	5.62
7.2	1218.0	1498.0	1231.1	1511.1	123.1	2.484	2.02
7.4	1610.0	2066.0	1623.1	2079.1	162.3	4.042	2.49
7.6	1540.0	2068.0	1553.1	2081.1	155.3	4.679	3.01
7.8	1201.0	1774.0	1214.1	1787.1	121.4	5.077	4.18
8.0	1199.0	1594.0	1213.6	1608.6	121.4	3.502	2.89
8.2	1210.0	1614.0	1224.6	1628.6	122.5	3.582	2.92
8.4	1230.0	1636.0	1244.6	1650.6	124.5	3.599	2.89
8.6	1296.0	1716.0	1310.6	1730.6	131.1	3.723	2.84
8.8	1356.0	1811.0	1370.6	1825.6	137.1	4.033	2.94
9.0	1401.0	1890.0	1417.1	1906.1	141.7	4.334	3.06
9.2	1532.0	2010.0	1548.1	2026.1	154.8	4.237	2.74
9.4	1591.0	2056.0	1607.1	2072.1	160.7	4.122	2.56
9.6	1651.0	2115.0	1667.1	2131.1	166.7	4.113	2.47
9.8	1590.0	2054.0	1606.1	2070.1	160.6	4.113	2.56
10.0	1710.0	2218.0	1727.6	2235.6	172.8	4.502	2.61
10.2	1856.0	2382.0	1873.6	2399.6	187.4	4.661	2.49
10.4	1891.0	2410.0	1908.6	2427.6	190.9	4.599	2.41
10.6	1940.0	2560.0	1957.6	2577.6	195.8	5.493	2.81
10.8	2021.0	2701.0	2038.6	2718.6	203.9	6.024	2.96

SCPT NO. - 7

Mass of cone(kg) = 1.1
Area of Cone (sqcm) = 10
Area of friction jacket (sqcm) = 113
Mass of each rod (kg) = 1.5
Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
11.0	2232.0	2916.0	2251.1	2935.1	225.1	6.060	2.69
11.2	2292.0	3104.0	2311.1	3123.1	231.1	7.192	3.11

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
II	0.00	6.30	6.29	Clay	33.85	1.25kg/sqcm
IV	6.30	10.50	3.43	Clay	134.04	4.96kg/sqcm
III	10.50	11.20	2.89	Silty sand	213.96	38°

SCPT NO. - 8

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	258.0	318.0	260.6	320.6	26.1	0.537	2.06
0.4	314.0	410.0	316.6	412.6	31.7	0.856	2.70
0.6	690.0	816.0	692.6	818.6	69.3	1.122	1.62
0.8	528.0	616.0	530.6	618.6	53.1	0.785	1.48
1.0	214.0	236.0	218.1	240.1	21.8	0.201	0.92
1.2	416.0	678.0	420.1	682.1	42.0	2.325	5.53
1.4	470.0	680.0	474.1	684.1	47.4	1.865	3.93
1.6	336.0	528.0	340.1	532.1	34.0	1.706	5.02
1.8	292.0	312.0	296.1	316.1	29.6	0.183	0.62
2.0	296.0	430.0	301.6	435.6	30.2	1.192	3.95
2.2	288.0	420.0	293.6	425.6	29.4	1.175	4.00
2.4	389.0	572.0	394.6	577.6	39.5	1.626	4.12
2.6	648.0	770.0	653.6	775.6	65.4	1.086	1.66
2.8	438.0	578.0	443.6	583.6	44.4	1.245	2.81
3.0	410.0	572.0	417.1	579.1	41.7	1.440	3.45
3.2	296.0	371.0	303.1	378.1	30.3	0.670	2.21
3.4	196.0	302.0	203.1	309.1	20.3	0.945	4.65
3.6	220.0	372.0	227.1	379.1	22.7	1.352	5.95
3.8	202.0	328.0	209.1	335.1	20.9	1.122	5.36
4.0	190.0	332.0	198.6	340.6	19.9	1.263	6.36
4.2	120.0	236.0	128.6	244.6	12.9	1.033	8.03
4.4	74.0	174.0	82.6	182.6	8.3	0.891	10.79
4.6	72.0	200.0	80.6	208.6	8.1	1.139	14.13
4.8	148.0	280.0	156.6	288.6	15.7	1.175	7.50
5.0	138.0	202.0	148.1	212.1	14.8	0.573	3.87
5.2	212.0	244.0	222.1	254.1	22.2	0.290	1.30
5.4	358.0	372.0	368.1	382.1	36.8	0.130	0.35
5.6	306.0	420.0	316.1	430.1	31.6	1.015	3.21
5.8	300.0	390.0	310.1	400.1	31.0	0.803	2.59
6.0	384.0	570.0	395.6	581.6	39.6	1.653	4.18
6.2	286.0	397.0	297.6	408.6	29.8	0.989	3.32
6.4	272.0	504.0	283.6	515.6	28.4	2.060	7.26
6.6	318.0	500.0	329.6	511.6	33.0	1.617	4.91
6.8	330.0	572.0	341.6	583.6	34.2	2.148	6.29
7.0	294.0	526.0	307.1	539.1	30.7	2.060	6.71
7.2	284.0	352.0	297.1	365.1	29.7	0.608	2.05
7.4	552.0	860.0	565.1	873.1	56.5	2.732	4.83
7.6	612.0	1032.0	625.1	1045.1	62.5	3.723	5.96
7.8	639.0	1104.0	652.1	1117.1	65.2	4.122	6.32
8.0	728.0	1258.0	742.6	1272.6	74.3	4.697	6.32
8.2	814.0	1354.0	828.6	1368.6	82.9	4.785	5.78
8.4	872.0	1502.0	886.6	1516.6	88.7	5.582	6.30
8.6	1040.0	1752.0	1054.6	1766.6	105.5	6.307	5.98
8.8	1110.0	1858.0	1124.6	1872.6	112.5	6.626	5.89
9.0	1072.0	1802.0	1088.1	1818.1	108.8	6.467	5.94

SCPT NO. - 8

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
9.2	1111.0	1962.0	1127.1	1978.1	112.7	7.537	6.69
9.4	1220.0	2134.0	1236.1	2150.1	123.6	8.095	6.55

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
II	0.00	9.40	4.71	Clayey silt / silty clay	45.08	1.67kg/sqcm

SCPT NO. - 9

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	176.0	240.0	178.6	242.6	17.9	0.573	3.21
0.4	294.0	326.0	296.6	328.6	29.7	0.290	0.98
0.6	158.0	206.0	160.6	208.6	16.1	0.431	2.69
0.8	42.0	144.0	44.6	146.6	4.5	0.909	20.38
1.0	61.0	194.0	65.1	198.1	6.5	1.183	18.18
1.2	248.0	322.0	252.1	326.1	25.2	0.661	2.62
1.4	150.0	210.0	154.1	214.1	15.4	0.537	3.49
1.6	126.0	222.0	130.1	226.1	13.0	0.856	6.58
1.8	160.0	210.0	164.1	214.1	16.4	0.449	2.74
2.0	170.0	236.0	175.6	241.6	17.6	0.591	3.36
2.2	244.0	246.0	249.6	251.6	25.0	0.024	0.10
2.4	278.0	302.0	283.6	307.6	28.4	0.219	0.77
2.6	404.0	498.0	409.6	503.6	41.0	0.838	2.05
2.8	458.0	501.0	463.6	506.6	46.4	0.387	0.83
3.0	460.0	510.0	467.1	517.1	46.7	0.449	0.96
3.2	360.0	564.0	367.1	571.1	36.7	1.812	4.94
3.4	440.0	506.0	447.1	513.1	44.7	0.591	1.32
3.6	480.0	708.0	487.1	715.1	48.7	2.024	4.16
3.8	712.0	852.0	719.1	859.1	71.9	1.245	1.73
4.0	186.0	410.0	194.6	418.6	19.5	1.989	10.22
4.2	446.0	701.0	454.6	709.6	45.5	2.263	4.98
4.4	270.0	420.0	278.6	428.6	27.9	1.334	4.79
4.6	224.0	420.0	232.6	428.6	23.3	1.741	7.48
4.8	172.0	322.0	180.6	330.6	18.1	1.334	7.39
5.0	214.0	312.0	224.1	322.1	22.4	0.874	3.90
5.2	132.0	186.0	142.1	196.1	14.2	0.484	3.41
5.4	168.0	220.0	178.1	230.1	17.8	0.467	2.62
5.6	292.0	352.0	302.1	362.1	30.2	0.537	1.78
5.8	304.0	410.0	314.1	420.1	31.4	0.945	3.01
6.0	376.0	400.0	387.6	411.6	38.8	0.219	0.56
6.2	920.0	1120.0	931.6	1131.6	93.2	1.776	1.91
6.4	1302.0	1634.0	1313.6	1645.6	131.4	2.945	2.24
6.6	690.0	1450.0	701.6	1461.6	70.2	6.732	9.60
6.8	478.0	1052.0	489.6	1063.6	49.0	5.086	10.39
7.0	572.0	940.0	585.1	953.1	58.5	3.263	5.58
7.2	472.0	896.0	485.1	909.1	48.5	3.759	7.75
7.4	448.0	710.0	461.1	723.1	46.1	2.325	5.04
7.6	534.0	772.0	547.1	785.1	54.7	2.113	3.86
7.8	298.0	644.0	311.1	657.1	31.1	3.068	9.86
8.0	434.0	786.0	448.6	800.6	44.9	3.122	6.96
8.2	624.0	912.0	638.6	926.6	63.9	2.555	4.00
8.4	115.0	1522.0	129.6	1536.6	13.0	12.458	96.13
8.6	1214.0	1864.0	1228.6	1878.6	122.9	5.759	4.69
8.8	1328.0	2426.0	1342.6	2440.6	134.3	9.723	7.24

SCPT NO. - 9

Mass of cone(kg) = 1.1
Area of Cone (sqcm) = 10
Area of friction jacket (sqcm) = 113
Mass of each rod (kg) = 1.5
Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
9.0	1112.0	2238.0	1128.1	2254.1	112.8	9.971	8.84
9.2	1162.0	2252.0	1178.1	2268.1	117.8	9.653	8.19

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
I	0.00	7.50	3.47	Sandy silt	38.10	36°
IV	7.50	9.20	6.71	Clay	85.30	3.16kg/sqcm

SCPT NO. - 10

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	206.0	474.0	208.6	476.6	20.9	2.378	11.40
0.4	394.0	526.0	396.6	528.6	39.7	1.175	2.96
0.6	224.0	272.0	226.6	274.6	22.7	0.431	1.90
0.8	152.0	362.0	154.6	364.6	15.5	1.865	12.06
1.0	242.0	378.0	246.1	382.1	24.6	1.210	4.92
1.2	146.0	242.0	150.1	246.1	15.0	0.856	5.70
1.4	126.0	204.0	130.1	208.1	13.0	0.697	5.36
1.6	146.0	310.0	150.1	314.1	15.0	1.458	9.71
1.8	44.0	94.0	48.1	98.1	4.8	0.449	9.33
2.0	28.0	62.0	33.6	67.6	3.4	0.307	9.15
2.2	70.0	120.0	75.6	125.6	7.6	0.449	5.94
2.4	110.0	170.0	115.6	175.6	11.6	0.537	4.65
2.6	84.0	130.0	89.6	135.6	9.0	0.414	4.62
2.8	86.0	158.0	91.6	163.6	9.2	0.644	7.03
3.0	192.0	306.0	199.1	313.1	19.9	1.015	5.10
3.2	394.0	496.0	401.1	503.1	40.1	0.909	2.27
3.4	491.0	632.0	498.1	639.1	49.8	1.254	2.52
3.6	308.0	560.0	315.1	567.1	31.5	2.237	7.10
3.8	174.0	364.0	181.1	371.1	18.1	1.688	9.32
4.0	166.0	300.0	174.6	308.6	17.5	1.192	6.83
4.2	236.0	436.0	244.6	444.6	24.5	1.776	7.26
4.4	252.0	526.0	260.6	534.6	26.1	2.431	9.33
4.6	168.0	236.0	176.6	244.6	17.7	0.608	3.44
4.8	118.0	202.0	126.6	210.6	12.7	0.750	5.92
5.0	130.0	212.0	140.1	222.1	14.0	0.732	5.23
5.2	108.0	204.0	118.1	214.1	11.8	0.856	7.25
5.4	210.0	412.0	220.1	422.1	22.0	1.794	8.15
5.6	236.0	426.0	246.1	436.1	24.6	1.688	6.86
5.8	352.0	436.0	362.1	446.1	36.2	0.750	2.07
6.0	174.0	224.0	185.6	235.6	18.6	0.449	2.42
6.2	236.0	420.0	247.6	431.6	24.8	1.635	6.60
6.4	222.0	410.0	233.6	421.6	23.4	1.670	7.15
6.6	142.0	210.0	153.6	221.6	15.4	0.608	3.96
6.8	134.0	208.0	145.6	219.6	14.6	0.661	4.54
7.0	166.0	232.0	179.1	245.1	17.9	0.591	3.30
7.2	176.0	272.0	189.1	285.1	18.9	0.856	4.53
7.4	164.0	264.0	177.1	277.1	17.7	0.891	5.03
7.6	290.0	486.0	303.1	499.1	30.3	1.741	5.74
7.8	152.0	216.0	165.1	229.1	16.5	0.573	3.47
8.0	142.0	210.0	156.6	224.6	15.7	0.608	3.88
8.2	138.0	264.0	152.6	278.6	15.3	1.122	7.35
8.4	144.0	226.0	158.6	240.6	15.9	0.732	4.62
8.6	118.0	200.0	132.6	214.6	13.3	0.732	5.52
8.8	104.0	198.0	118.6	212.6	11.9	0.838	7.07
9.0	120.0	174.0	136.1	190.1	13.6	0.484	3.56
9.2	126.0	186.0	142.1	202.1	14.2	0.537	3.78
9.4	106.0	224.0	122.1	240.1	12.2	1.051	8.61
9.6	130.0	208.0	146.1	224.1	14.6	0.697	4.77
9.8	92.0	162.0	108.1	178.1	10.8	0.626	5.79
10.0	50.0	142.0	67.6	159.6	6.8	0.821	12.14
10.2	78.0	176.0	95.6	193.6	9.6	0.874	9.14
10.4	112.0	244.0	129.6	261.6	13.0	1.175	9.06
10.6	444.0	586.0	461.6	603.6	46.2	1.263	2.74
10.8	428.0	616.0	445.6	633.6	44.6	1.670	3.75
11.0	546.0	978.0	563.6	995.6	56.4	3.830	6.79

SCPT NO. - 10

Mass of cone(kg) = 1.1
Area of Cone (sqcm) = 10
Area of friction jacket (sqcm) = 113
Mass of each rod (kg) = 1.5
Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
11.2	568.0	962.0	585.6	979.6	58.6	3.493	5.97
11.4	688.0	1242.0	705.6	1259.6	70.6	4.909	6.96
11.6	612.0	1258.0	629.6	1275.6	63.0	5.723	9.09
11.8	680.0	1270.0	697.6	1287.6	69.8	5.228	7.49
12.0	760.0	1320.0	777.6	1337.6	77.8	4.962	6.38
12.2	770.0	1210.0	787.6	1227.6	78.8	3.900	4.95
12.4	706.0	1110.0	723.6	1127.6	72.4	3.582	4.95
12.6	410.0	760.0	427.6	777.6	42.8	3.104	7.26
12.8	480.0	922.0	497.6	939.6	49.8	3.918	7.87
13.0	720.0	1132.0	737.6	1149.6	73.8	3.653	4.95
13.2	928.0	1322.0	945.6	1339.6	94.6	3.493	3.69
13.4	1632.0	2692.0	1649.6	2709.6	165.0	9.387	5.69

Layer No	Depth		Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
	From (M)	To (M)				
II	0.00	13.40	6.03	Clay	29.90	1.11kg/sqcm

SCPT NO. - 11

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	310.0	418.0	312.6	420.6	31.3	0.962	3.08
0.4	550.0	662.0	552.6	664.6	55.3	0.998	1.81
0.6	314.0	440.0	316.6	442.6	31.7	1.122	3.54
0.8	512.0	726.0	514.6	728.6	51.5	1.900	3.69
1.0	666.0	834.0	670.1	838.1	67.0	1.493	2.23
1.2	630.0	802.0	634.1	806.1	63.4	1.529	2.41
1.4	406.0	766.0	410.1	770.1	41.0	3.192	7.78
1.6	1210.0	1688.0	1214.1	1692.1	121.4	4.237	3.49
1.8	806.0	1218.0	810.1	1222.1	81.0	3.653	4.51
2.0	538.0	876.0	543.6	881.6	54.4	2.998	5.51
2.2	512.0	836.0	517.6	841.6	51.8	2.874	5.55
2.4	582.0	840.0	587.6	845.6	58.8	2.290	3.90
2.6	236.0	502.0	241.6	507.6	24.2	2.360	9.77
2.8	154.0	300.0	159.6	305.6	16.0	1.299	8.14
3.0	176.0	288.0	183.1	295.1	18.3	0.998	5.45
3.2	168.0	206.0	175.1	213.1	17.5	0.343	1.96
3.4	196.0	282.0	203.1	289.1	20.3	0.768	3.78
3.6	232.0	332.0	239.1	339.1	23.9	0.891	3.73
3.8	180.0	316.0	187.1	323.1	18.7	1.210	6.47
4.0	218.0	318.0	226.6	326.6	22.7	0.891	3.93
4.2	216.0	320.0	224.6	328.6	22.5	0.927	4.13
4.4	198.0	294.0	206.6	302.6	20.7	0.856	4.14
4.6	118.0	268.0	126.6	276.6	12.7	1.334	10.54
4.8	144.0	240.0	152.6	248.6	15.3	0.856	5.61
5.0	172.0	306.0	182.1	316.1	18.2	1.192	6.55
5.2	228.0	332.0	238.1	342.1	23.8	0.927	3.89
5.4	224.0	352.0	234.1	362.1	23.4	1.139	4.87
5.6	276.0	424.0	286.1	434.1	28.6	1.316	4.60
5.8	238.0	432.0	248.1	442.1	24.8	1.723	6.95
6.0	214.0	390.0	225.6	401.6	22.6	1.564	6.93
6.2	192.0	346.0	203.6	357.6	20.4	1.369	6.73
6.4	196.0	306.0	207.6	317.6	20.8	0.980	4.72
6.6	210.0	300.0	221.6	311.6	22.2	0.803	3.62
6.8	216.0	312.0	227.6	323.6	22.8	0.856	3.76
7.0	290.0	482.0	303.1	495.1	30.3	1.706	5.63
7.2	544.0	756.0	557.1	769.1	55.7	1.883	3.38
7.4	656.0	974.0	669.1	987.1	66.9	2.821	4.22
7.6	614.0	1120.0	627.1	1133.1	62.7	4.484	7.15
7.8	804.0	1252.0	817.1	1265.1	81.7	3.971	4.86
8.0	822.0	1470.0	836.6	1484.6	83.7	5.741	6.86
8.2	844.0	1456.0	858.6	1470.6	85.9	5.422	6.32
8.4	866.0	1510.0	880.6	1524.6	88.1	5.706	6.48
8.6	914.0	1522.0	928.6	1536.6	92.9	5.387	5.80
8.8	972.0	1734.0	986.6	1748.6	98.7	6.750	6.84
9.0	810.0	1512.0	826.1	1528.1	82.6	6.219	7.53
9.2	824.0	1144.0	840.1	1160.1	84.0	2.838	3.38
9.4	956.0	1572.0	972.1	1588.1	97.2	5.458	5.61
9.6	1602.0	2101.0	1618.1	2117.1	161.8	4.422	2.73
9.8	1896.0	2562.0	1912.1	2578.1	191.2	5.900	3.09

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
I	0.00	5.00	4.07	Sandy silt	41.20	36°
II	5.00	9.00	5.56	Clay	51.92	1.92kg/sqcm
III	9.00	9.80	3.70	Sandy silt	133.56	38°

SCPT NO. - 12

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	122.0	410.0	124.6	412.6	12.5	2.555	20.51
0.4	670.0	720.0	672.6	722.6	67.3	0.449	0.67
0.6	354.0	540.0	356.6	542.6	35.7	1.653	4.63
0.8	370.0	470.0	372.6	472.6	37.3	0.891	2.39
1.0	790.0	818.0	794.1	822.1	79.4	0.254	0.32
1.2	496.0	836.0	500.1	840.1	50.0	3.015	6.03
1.4	362.0	508.0	366.1	512.1	36.6	1.299	3.55
1.6	250.0	384.0	254.1	388.1	25.4	1.192	4.69
1.8	76.0	188.0	80.1	192.1	8.0	0.998	12.46
2.0	158.0	216.0	163.6	221.6	16.4	0.520	3.18
2.2	178.0	394.0	183.6	399.6	18.4	1.918	10.45
2.4	166.0	272.0	171.6	277.6	17.2	0.945	5.50
2.6	176.0	282.0	181.6	287.6	18.2	0.945	5.20
2.8	132.0	290.0	137.6	295.6	13.8	1.405	10.21
3.0	190.0	296.0	197.1	303.1	19.7	0.945	4.79
3.2	144.0	176.0	151.1	183.1	15.1	0.290	1.92
3.4	124.0	212.0	131.1	219.1	13.1	0.785	5.99
3.6	166.0	364.0	173.1	371.1	17.3	1.759	10.16
3.8	182.0	314.0	189.1	321.1	18.9	1.175	6.21
4.0	186.0	332.0	194.6	340.6	19.5	1.299	6.67
4.2	192.0	406.0	200.6	414.6	20.1	1.900	9.47
4.4	206.0	310.0	214.6	318.6	21.5	0.927	4.32
4.6	174.0	380.0	182.6	388.6	18.3	1.830	10.02
4.8	192.0	304.0	200.6	312.6	20.1	0.998	4.97
5.0	230.0	384.0	240.1	394.1	24.0	1.369	5.70
5.2	276.0	424.0	286.1	434.1	28.6	1.316	4.60
5.4	276.0	466.0	286.1	476.1	28.6	1.688	5.90
5.6	282.0	454.0	292.1	464.1	29.2	1.529	5.23
5.8	304.0	492.0	314.1	502.1	31.4	1.670	5.32
6.0	184.0	310.0	195.6	321.6	19.6	1.122	5.73
6.2	182.0	308.0	193.6	319.6	19.4	1.122	5.79
6.4	202.0	362.0	213.6	373.6	21.4	1.422	6.66
6.6	214.0	340.0	225.6	351.6	22.6	1.122	4.97
6.8	202.0	358.0	213.6	369.6	21.4	1.387	6.49
7.0	306.0	530.0	319.1	543.1	31.9	1.989	6.23
7.2	332.0	612.0	345.1	625.1	34.5	2.484	7.20
7.4	814.0	1046.0	827.1	1059.1	82.7	2.060	2.49
7.6	724.0	1042.0	737.1	1055.1	73.7	2.821	3.83
7.8	810.0	1286.0	823.1	1299.1	82.3	4.219	5.13
8.0	792.0	1402.0	806.6	1416.6	80.7	5.405	6.70
8.2	1350.0	1766.0	1364.6	1780.6	136.5	3.688	2.70
8.4	1502.0	2130.0	1516.6	2144.6	151.7	5.564	3.67
8.6	1320.0	2022.0	1334.6	2036.6	133.5	6.219	4.66
8.8	920.0	1560.0	934.6	1574.6	93.5	5.670	6.07
9.0	872.0	1482.0	888.1	1498.1	88.8	5.405	6.09
9.2	974.0	1362.0	990.1	1378.1	99.0	3.440	3.47
9.4	1478.0	1940.0	1494.1	1956.1	149.4	4.095	2.74
9.6	1132.0	1836.0	1148.1	1852.1	114.8	6.237	5.43
9.8	1146.0	1862.0	1162.1	1878.1	116.2	6.343	5.46
10.0	1176.0	1578.0	1193.6	1595.6	119.4	3.564	2.99

SCPT NO. - 12

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
10.2	1510.0	2340.0	1527.6	2357.6	152.8	7.352	4.81
10.4	1936.0	2580.0	1953.6	2597.6	195.4	5.706	2.92

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
I	0.00	3.00	3.72	Sandy silt	36.60	38°
II	3.00	7.50	6.00	Clay	25.41	0.94kg/sqcm
I	7.50	10.40	4.44	Sandy silt	119.16	36°

SCPT NO. - 13

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	812.0	1810.0	814.6	1812.6	81.5	8.838	10.85
0.4	470.0	2040.0	472.6	2042.6	47.3	13.900	29.41
0.6	870.0	1502.0	872.6	1504.6	87.3	5.599	6.42
0.8	992.0	1496.0	994.6	1498.6	99.5	4.467	4.49
1.0	1106.0	1444.0	1110.1	1448.1	111.0	2.998	2.70
1.2	1114.0	1652.0	1118.1	1656.1	111.8	4.768	4.26
1.4	1246.0	1904.0	1250.1	1908.1	125.0	5.830	4.66
1.6	1800.0	2342.0	1804.1	2346.1	180.4	4.803	2.66
1.8	1310.0	1614.0	1314.1	1618.1	131.4	2.697	2.05
2.0	1460.0	2274.0	1465.6	2279.6	146.6	7.210	4.92
2.2	1374.0	2194.0	1379.6	2199.6	138.0	7.263	5.26
2.4	2620.0	2980.0	2625.6	2985.6	262.6	3.192	1.22
2.6	1002.0	1976.0	1007.6	1981.6	100.8	8.626	8.56
2.8	662.0	1106.0	667.6	1111.6	66.8	3.936	5.90
3.0	409.0	812.0	416.1	819.1	41.6	3.573	8.59
3.2	302.0	512.0	309.1	519.1	30.9	1.865	6.03
3.4	299.0	472.0	306.1	479.1	30.6	1.537	5.02
3.6	264.0	390.0	271.1	397.1	27.1	1.122	4.14
3.8	312.0	468.0	319.1	475.1	31.9	1.387	4.35
4.0	280.0	380.0	288.6	388.6	28.9	0.891	3.09
4.2	310.0	420.0	318.6	428.6	31.9	0.980	3.08
4.4	338.0	512.0	346.6	520.6	34.7	1.546	4.46
4.6	304.0	454.0	312.6	462.6	31.3	1.334	4.27
4.8	282.0	412.0	290.6	420.6	29.1	1.157	3.98
5.0	292.0	438.0	302.1	448.1	30.2	1.299	4.30
5.2	296.0	444.0	306.1	454.1	30.6	1.316	4.30
5.4	244.0	370.0	254.1	380.1	25.4	1.122	4.41
5.6	284.0	440.0	294.1	450.1	29.4	1.387	4.72
5.8	356.0	478.0	366.1	488.1	36.6	1.086	2.97
6.0	292.0	478.0	303.6	489.6	30.4	1.653	5.44
6.2	318.0	426.0	329.6	437.6	33.0	0.962	2.92
6.4	364.0	504.0	375.6	515.6	37.6	1.245	3.32
6.6	292.0	402.0	303.6	413.6	30.4	0.980	3.23
6.8	390.0	484.0	401.6	495.6	40.2	0.838	2.09
7.0	372.0	486.0	385.1	499.1	38.5	1.015	2.64
7.2	340.0	508.0	353.1	521.1	35.3	1.493	4.23
7.4	334.0	484.0	347.1	497.1	34.7	1.334	3.84
7.6	368.0	416.0	381.1	429.1	38.1	0.431	1.13
7.8	436.0	560.0	449.1	573.1	44.9	1.104	2.46
8.0	390.0	540.0	404.6	554.6	40.5	1.334	3.30
8.2	410.0	582.0	424.6	596.6	42.5	1.529	3.60
8.4	498.0	617.0	512.6	631.6	51.3	1.060	2.07
8.6	530.0	692.0	544.6	706.6	54.5	1.440	2.64
8.8	612.0	734.0	626.6	748.6	62.7	1.086	1.73
9.0	707.0	899.0	723.1	915.1	72.3	1.706	2.36
9.2	910.0	1064.0	926.1	1080.1	92.6	1.369	1.48
9.4	1114.0	1362.0	1130.1	1378.1	113.0	2.201	1.95
9.6	1392.0	1668.0	1408.1	1684.1	140.8	2.449	1.74
9.8	1490.0	1760.0	1506.1	1776.1	150.6	2.396	1.59
10.0	1062.0	1340.0	1079.6	1357.6	108.0	2.467	2.28
10.2	1578.0	1880.0	1595.6	1897.6	159.6	2.679	1.68
10.4	1790.0	2035.0	1807.6	2052.6	180.8	2.175	1.20
10.6	2002.0	2242.0	2019.6	2259.6	202.0	2.130	1.05

SCPT NO. - 13

Mass of cone(kg) =	1.1	Area of friction jacket (sqcm) =	113
Area of Cone (sqcm) =	10	Mass of each rod (kg) =	1.5
		Mass of friction jacket(kg) =	0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
10.8	2146.0	2310.0	2163.6	2327.6	216.4	1.458	0.67
11.0	2252.0	2636.0	2271.1	2655.1	227.1	3.405	1.50

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
I	0.00	11.00	3.45	Sandy silt	81.29	38°

SCPT NO. - 14

Mass of cone(kg) = 1.1
Area of Cone (sqcm) = 10
Area of friction jacket (sqcm) = 113
Mass of each rod (kg) = 1.5
Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	340.0	376.0	342.6	378.6	34.3	0.325	0.95
0.4	310.0	338.0	312.6	340.6	31.3	0.254	0.81
0.6	222.0	270.0	224.6	272.6	22.5	0.431	1.92
0.8	176.0	280.0	178.6	282.6	17.9	0.927	5.19
1.0	314.0	370.0	318.1	374.1	31.8	0.502	1.58
1.2	710.0	836.0	714.1	840.1	71.4	1.122	1.57
1.4	630.0	782.0	634.1	786.1	63.4	1.352	2.13
1.6	166.0	366.0	170.1	370.1	17.0	1.776	10.44
1.8	440.0	552.0	444.1	556.1	44.4	0.998	2.25
2.0	244.0	510.0	249.6	515.6	25.0	2.360	9.46
2.2	160.0	294.0	165.6	299.6	16.6	1.192	7.20
2.4	75.0	236.0	80.6	241.6	8.1	1.431	17.76
2.6	88.0	196.0	93.6	201.6	9.4	0.962	10.28
2.8	112.0	218.0	117.6	223.6	11.8	0.945	8.03
3.0	208.0	250.0	215.1	257.1	21.5	0.378	1.76
3.2	266.0	406.0	273.1	413.1	27.3	1.245	4.56
3.4	630.0	988.0	637.1	995.1	63.7	3.175	4.98
3.6	1472.0	2002.0	1479.1	2009.1	147.9	4.697	3.18
3.8	1130.0	1878.0	1137.1	1885.1	113.7	6.626	5.83
4.0	792.0	1186.0	800.6	1194.6	80.1	3.493	4.36
4.2	604.0	1120.0	612.6	1128.6	61.3	4.573	7.46
4.4	554.0	1082.0	562.6	1090.6	56.3	4.679	8.32
4.6	534.0	882.0	542.6	890.6	54.3	3.086	5.69
4.8	698.0	1110.0	706.6	1118.6	70.7	3.653	5.17
5.0	198.0	406.0	208.1	416.1	20.8	1.847	8.88
5.2	172.0	372.0	182.1	382.1	18.2	1.776	9.76
5.4	154.0	332.0	164.1	342.1	16.4	1.582	9.64
5.6	184.0	314.0	194.1	324.1	19.4	1.157	5.96
5.8	194.0	324.0	204.1	334.1	20.4	1.157	5.67
6.0	222.0	358.0	233.6	369.6	23.4	1.210	5.18
6.2	224.0	354.0	235.6	365.6	23.6	1.157	4.91
6.4	252.0	386.0	263.6	397.6	26.4	1.192	4.52
6.6	306.0	466.0	317.6	477.6	31.8	1.422	4.48
6.8	682.0	714.0	693.6	725.6	69.4	0.290	0.42
7.0	850.0	1346.0	863.1	1359.1	86.3	4.396	5.09
7.2	852.0	1348.0	865.1	1361.1	86.5	4.396	5.08
7.4	792.0	1294.0	805.1	1307.1	80.5	4.449	5.53
7.6	768.0	1178.0	781.1	1191.1	78.1	3.635	4.65
7.8	742.0	1312.0	755.1	1325.1	75.5	5.051	6.69
8.0	736.0	1182.0	750.6	1196.6	75.1	3.953	5.27
8.2	886.0	1460.0	900.6	1474.6	90.1	5.086	5.65
8.4	844.0	1434.0	858.6	1448.6	85.9	5.228	6.09
8.6	1070.0	1504.0	1084.6	1518.6	108.5	3.847	3.55
8.8	1272.0	1752.0	1286.6	1766.6	128.7	4.254	3.31
9.0	974.0	1478.0	990.1	1494.1	99.0	4.467	4.51
9.2	930.0	1448.0	946.1	1464.1	94.6	4.591	4.85
9.4	922.0	1396.0	938.1	1412.1	93.8	4.201	4.48
9.6	792.0	1286.0	808.1	1302.1	80.8	4.378	5.42
9.8	858.0	1266.0	874.1	1282.1	87.4	3.617	4.14
10.0	794.0	1266.0	811.6	1283.6	81.2	4.183	5.15
10.2	852.0	1289.0	869.6	1306.6	87.0	3.874	4.45
10.4	948.0	1556.0	965.6	1573.6	96.6	5.387	5.58
10.6	1316.0	1814.0	1333.6	1831.6	133.4	4.414	3.31

SCPT NO. - 14

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
10.8	1304.0	2292.0	1321.6	2309.6	132.2	8.750	6.62
11.0	1434.0	2310.0	1453.1	2329.1	145.3	7.759	5.34

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
I	0.00	11.00	4.27	Sandy silt	71.30	36°

SCPT NO. - 15

Mass of cone(kg) = 1.1
Area of Cone (sqcm) = 10
Area of friction jacket (sqcm) = 113
Mass of each rod (kg) = 1.5
Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	700.0	1620.0	702.6	1622.6	70.3	8.148	11.60
0.4	1024.0	1560.0	1026.6	1562.6	102.7	4.750	4.63
0.6	306.0	562.0	308.6	564.6	30.9	2.272	7.36
0.8	366.0	496.0	368.6	498.6	36.9	1.157	3.14
1.0	280.0	462.0	284.1	466.1	28.4	1.617	5.69
1.2	300.0	382.0	304.1	386.1	30.4	0.732	2.41
1.4	382.0	542.0	386.1	546.1	38.6	1.422	3.68
1.6	370.0	544.0	374.1	548.1	37.4	1.546	4.13
1.8	436.0	692.0	440.1	696.1	44.0	2.272	5.16
2.0	406.0	654.0	411.6	659.6	41.2	2.201	5.35
2.2	388.0	620.0	393.6	625.6	39.4	2.060	5.23
2.4	345.0	594.0	350.6	599.6	35.1	2.210	6.30
2.6	508.0	766.0	513.6	771.6	51.4	2.290	4.46
2.8	626.0	922.0	631.6	927.6	63.2	2.626	4.16
3.0	624.0	890.0	631.1	897.1	63.1	2.360	3.74
3.2	724.0	1102.0	731.1	1109.1	73.1	3.352	4.58
3.4	510.0	1148.0	517.1	1155.1	51.7	5.653	10.93
3.6	536.0	756.0	543.1	763.1	54.3	1.953	3.60
3.8	422.0	790.0	429.1	797.1	42.9	3.263	7.60
4.0	488.0	862.0	496.6	870.6	49.7	3.316	6.68
4.2	512.0	1126.0	520.6	1134.6	52.1	5.440	10.45
4.4	1338.0	1512.0	1346.6	1520.6	134.7	1.546	1.15
4.6	742.0	1255.0	750.6	1263.6	75.1	4.546	6.06
4.8	632.0	1186.0	640.6	1194.6	64.1	4.909	7.66
5.0	934.0	1472.0	944.1	1482.1	94.4	4.768	5.05
5.2	996.0	1592.0	1006.1	1602.1	100.6	5.281	5.25
5.4	806.0	1310.0	816.1	1320.1	81.6	4.467	5.47
5.6	872.0	1482.0	882.1	1492.1	88.2	5.405	6.13
5.8	1012.0	1742.0	1022.1	1752.1	102.2	6.467	6.33
6.0	910.0	1582.0	921.6	1593.6	92.2	5.953	6.46
6.2	736.0	1292.0	747.6	1303.6	74.8	4.927	6.59
6.4	982.0	1486.0	993.6	1497.6	99.4	4.467	4.50
6.6	430.0	992.0	441.6	1003.6	44.2	4.980	11.28
6.8	406.0	708.0	417.6	719.6	41.8	2.679	6.42
7.0	562.0	912.0	575.1	925.1	57.5	3.104	5.40
7.2	601.0	1004.0	614.1	1017.1	61.4	3.573	5.82
7.4	628.0	1314.0	641.1	1327.1	64.1	6.077	9.48
7.6	872.0	1536.0	885.1	1549.1	88.5	5.883	6.65
7.8	976.0	1788.0	989.1	1801.1	98.9	7.192	7.27
8.0	1132.0	2106.0	1146.6	2120.6	114.7	8.626	7.52
8.2	1210.0	2246.0	1224.6	2260.6	122.5	9.175	7.49

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
I	0.00	6.00	4.40	Sandy silt	61.30	40°
II	6.00	8.20	7.04	Clay	70.10	2.60kg/sqcm

SCPT NO. - 16

Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	12.0	44.0	14.6	46.6	1.5	0.290	19.84
0.4	124.0	286.0	126.6	288.6	12.7	1.440	11.38
0.6	156.0	297.0	158.6	299.6	15.9	1.254	7.91
0.8	852.0	982.0	854.6	984.6	85.5	1.157	1.35
1.0	492.0	574.0	496.1	578.1	49.6	0.732	1.48
1.2	96.0	636.0	100.1	640.1	10.0	4.785	47.80
1.4	502.0	582.0	506.1	586.1	50.6	0.714	1.41
1.6	254.0	424.0	258.1	428.1	25.8	1.511	5.85
1.8	156.0	292.0	160.1	296.1	16.0	1.210	7.56
2.0	148.0	222.0	153.6	227.6	15.4	0.661	4.31
2.2	318.0	332.0	323.6	337.6	32.4	0.130	0.40
2.4	180.0	366.0	185.6	371.6	18.6	1.653	8.90
2.6	276.0	376.0	281.6	381.6	28.2	0.891	3.17
2.8	148.0	320.0	153.6	325.6	15.4	1.529	9.95
3.0	282.0	348.0	289.1	355.1	28.9	0.591	2.04
3.2	206.0	290.0	213.1	297.1	21.3	0.750	3.52
3.4	285.0	334.0	292.1	341.1	29.2	0.440	1.51
3.6	232.0	336.0	239.1	343.1	23.9	0.927	3.88
3.8	236.0	314.0	243.1	321.1	24.3	0.697	2.87
4.0	292.0	336.0	300.6	344.6	30.1	0.396	1.32
4.2	264.0	344.0	272.6	352.6	27.3	0.714	2.62
4.4	312.0	342.0	320.6	350.6	32.1	0.272	0.85
4.6	376.0	548.0	384.6	556.6	38.5	1.529	3.97
4.8	456.0	702.0	464.6	710.6	46.5	2.183	4.70
5.0	492.0	544.0	502.1	554.1	50.2	0.467	0.93
5.2	588.0	622.0	598.1	632.1	59.8	0.307	0.51
5.4	532.0	910.0	542.1	920.1	54.2	3.352	6.18
5.6	476.0	878.0	486.1	888.1	48.6	3.564	7.33
5.8	596.0	974.0	606.1	984.1	60.6	3.352	5.53
6.0	612.0	700.0	623.6	711.6	62.4	0.785	1.26
6.2	612.0	666.0	623.6	677.6	62.4	0.484	0.78
6.4	622.0	1032.0	633.6	1043.6	63.4	3.635	5.74
6.6	710.0	1022.0	721.6	1033.6	72.2	2.768	3.84
6.8	720.0	1236.0	731.6	1247.6	73.2	4.573	6.25
7.0	740.0	1176.0	753.1	1189.1	75.3	3.865	5.13
7.2	682.0	724.0	695.1	737.1	69.5	0.378	0.54
7.4	1082.0	1732.0	1095.1	1745.1	109.5	5.759	5.26
7.6	1872.0	1914.0	1885.1	1927.1	188.5	0.378	0.20
7.8	1910.0	2006.0	1923.1	2019.1	192.3	0.856	0.45
8.0	1066.0	2042.0	1080.6	2056.6	108.1	8.644	8.00
8.2	1822.0	2076.0	1836.6	2090.6	183.7	2.254	1.23
8.4	1650.0	2126.0	1664.6	2140.6	166.5	4.219	2.53
8.6	1616.0	2062.0	1630.6	2076.6	163.1	3.953	2.42
8.8	1974.0	2336.0	1988.6	2350.6	198.9	3.210	1.61
9.0	1999.0	2338.0	2015.1	2354.1	201.5	3.006	1.49
9.2	1850.0	2246.0	1866.1	2262.1	186.6	3.511	1.88
9.4	2068.0	2902.0	2084.1	2918.1	208.4	7.387	3.54
9.6	2156.0	3360.0	2172.1	3376.1	217.2	10.661	4.91

Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
II	0.00	4.00	7.32	Clay	26.80	0.99kg/sqcm
I	4.00	9.60	3.20	Sandy silt	107.90	38°

SCPT NO. - 17

Mass of cone(kg) = 1.1
Area of Cone (sqcm) = 10
Area of friction jacket (sqcm) = 113
Mass of each rod (kg) = 1.5
Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0.2	138.0	166.0	140.6	168.6	14.1	0.254	1.81
0.4	142.0	201.0	144.6	203.6	14.5	0.529	3.66
0.6	144.0	204.0	146.6	206.6	14.7	0.537	3.67
0.8	116.0	164.0	118.6	166.6	11.9	0.431	3.64
1.0	122.0	172.0	126.1	176.1	12.6	0.449	3.56
1.2	170.0	262.0	174.1	266.1	17.4	0.821	4.71
1.4	288.0	340.0	292.1	344.1	29.2	0.467	1.60
1.6	210.0	230.0	214.1	234.1	21.4	0.183	0.86
1.8	178.0	266.0	182.1	270.1	18.2	0.785	4.31
2.0	196.0	288.0	201.6	293.6	20.2	0.821	4.07
2.2	256.0	392.0	261.6	397.6	26.2	1.210	4.63
2.4	262.0	402.0	267.6	407.6	26.8	1.245	4.65
2.6	230.0	370.0	235.6	375.6	23.6	1.245	5.29
2.8	268.0	394.0	273.6	399.6	27.4	1.122	4.10
3.0	286.0	302.0	293.1	309.1	29.3	0.148	0.51
3.2	174.0	374.0	181.1	381.1	18.1	1.776	9.81
3.4	112.0	212.0	119.1	219.1	11.9	0.891	7.48
3.6	90.0	172.0	97.1	179.1	9.7	0.732	7.54
3.8	52.0	138.0	59.1	145.1	5.9	0.768	12.99
4.0	49.0	134.0	57.6	142.6	5.8	0.759	13.17
4.2	152.0	232.0	160.6	240.6	16.1	0.714	4.45
4.4	160.0	278.0	168.6	286.6	16.9	1.051	6.23
4.6	188.0	334.0	196.6	342.6	19.7	1.299	6.60
4.8	170.0	314.0	178.6	322.6	17.9	1.281	7.17
5.0	168.0	296.0	178.1	306.1	17.8	1.139	6.40
5.2	220.0	358.0	230.1	368.1	23.0	1.228	5.34
5.4	196.0	316.0	206.1	326.1	20.6	1.068	5.18
5.6	224.0	340.0	234.1	350.1	23.4	1.033	4.41
5.8	196.0	324.0	206.1	334.1	20.6	1.139	5.53
6.0	244.0	398.0	255.6	409.6	25.6	1.369	5.36
6.2	342.0	444.0	353.6	455.6	35.4	0.909	2.57
6.4	390.0	505.0	401.6	516.6	40.2	1.024	2.55
6.6	336.0	496.0	347.6	507.6	34.8	1.422	4.09
6.8	610.0	892.0	621.6	903.6	62.2	2.502	4.03
7.0	938.0	1610.0	951.1	1623.1	95.1	5.953	6.26
7.2	468.0	912.0	481.1	925.1	48.1	3.936	8.18
7.4	516.0	998.0	529.1	1011.1	52.9	4.272	8.07
7.6	628.0	1108.0	641.1	1121.1	64.1	4.254	6.64
7.8	726.0	1178.0	739.1	1191.1	73.9	4.006	5.42
8.0	656.0	1074.0	670.6	1088.6	67.1	3.706	5.53
8.2	690.0	1210.0	704.6	1224.6	70.5	4.608	6.54
8.4	622.0	1224.0	636.6	1238.6	63.7	5.334	8.38
8.6	790.0	1326.0	804.6	1340.6	80.5	4.750	5.90
8.8	612.0	1256.0	626.6	1270.6	62.7	5.706	9.11
9.0	699.0	1382.0	715.1	1398.1	71.5	6.051	8.46
9.2	1496.0	1792.0	1512.1	1808.1	151.2	2.626	1.74
9.4	1504.0	1864.0	1520.1	1880.1	152.0	3.192	2.10
9.6	1820.0	2410.0	1836.1	2426.1	183.6	5.228	2.85
9.8	2096.0	2638.0	2112.1	2654.1	211.2	4.803	2.27

SCPT NO. - 17

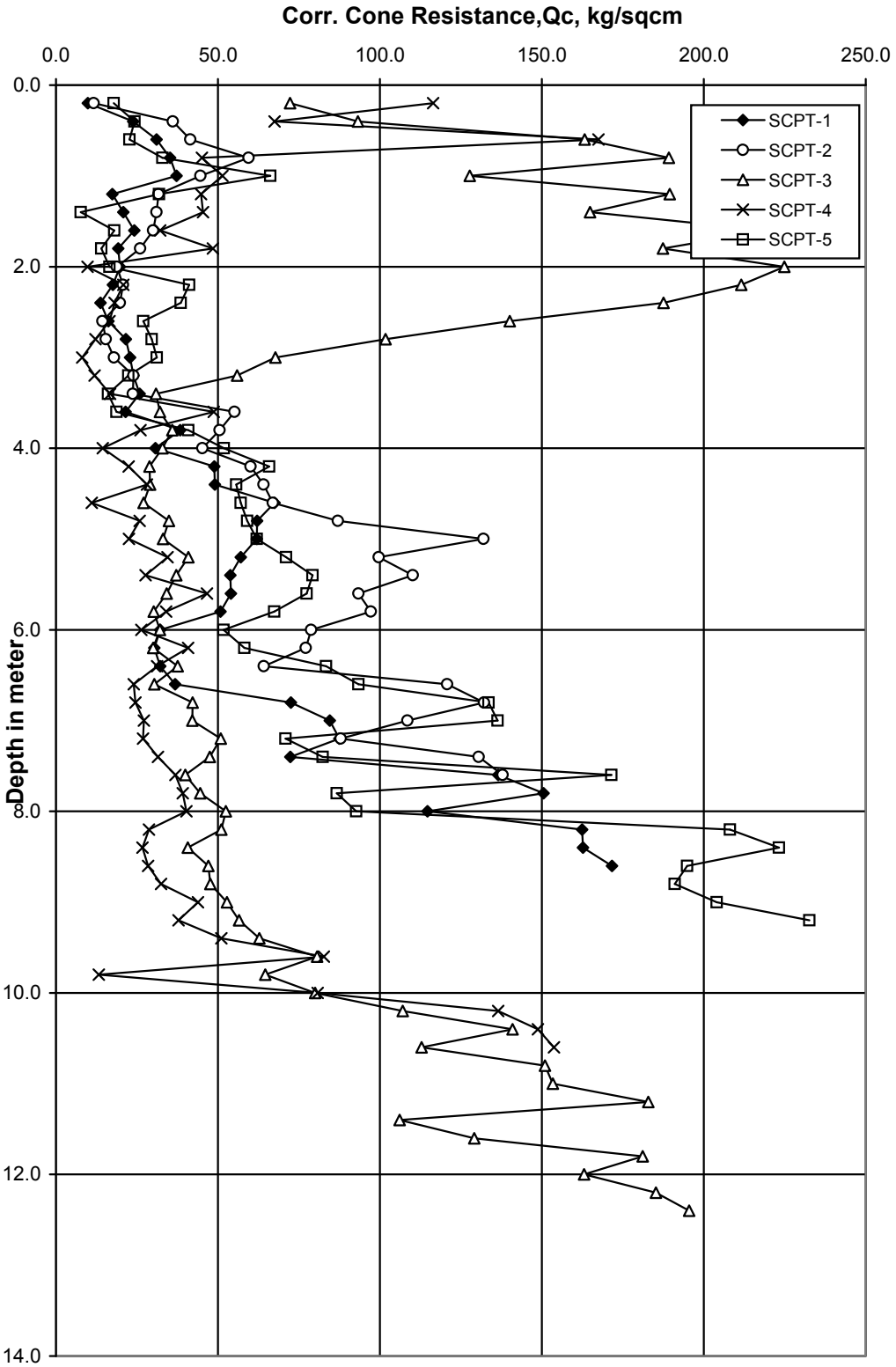
Mass of cone(kg) = 1.1 Area of friction jacket (sqcm) = 113

Area of Cone (sqcm) = 10 Mass of each rod (kg) = 1.5

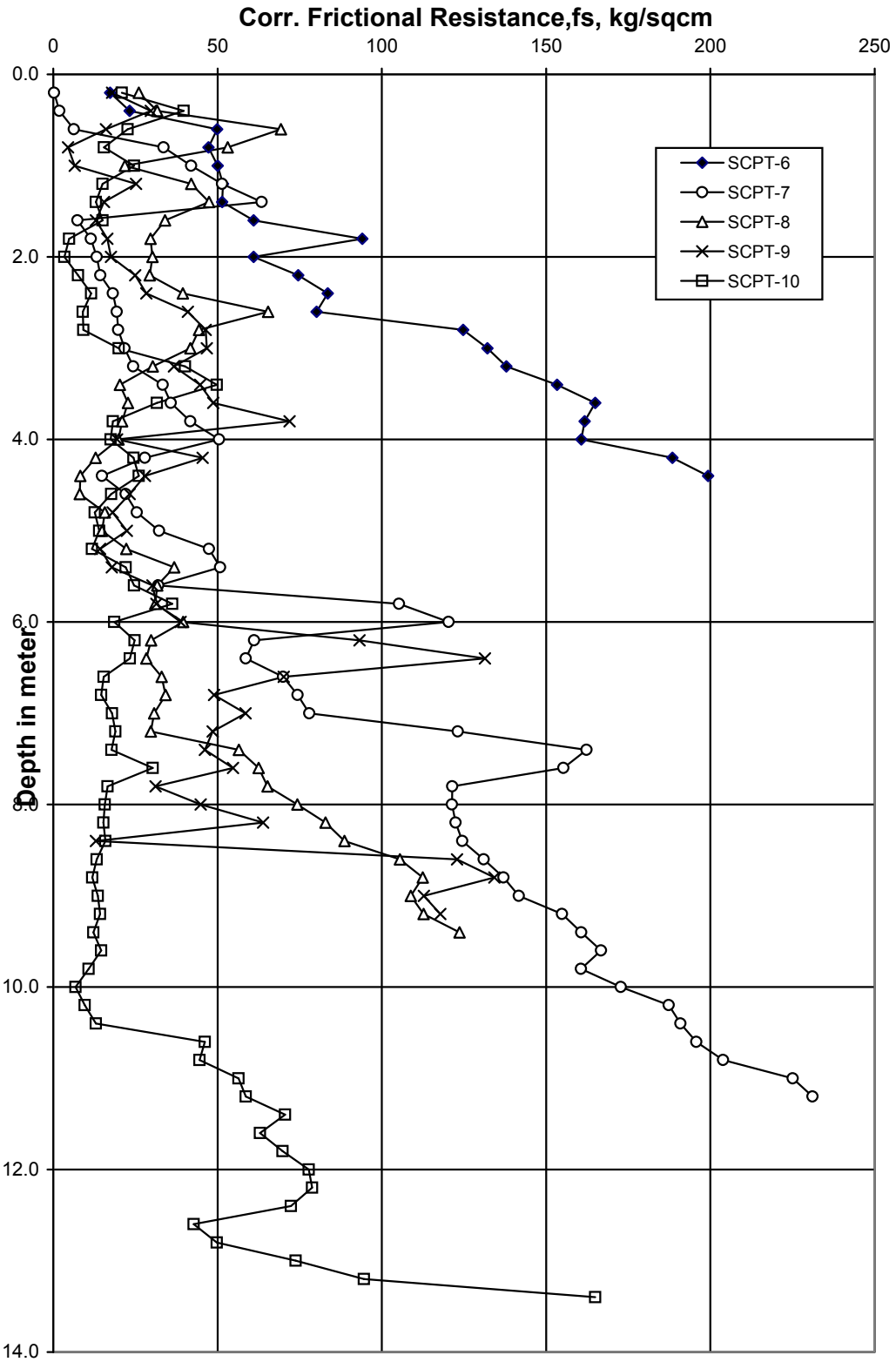
Mass of friction jacket(kg) = 0.734

Depth in m	Cone resi. In kg	Total resi. In kg	Correrected Cone resi. In kg	Corrected Total resi. In kg	Correrected Cone resi.Qc, kg/sqcm	Corrected Friction resi. fs, kg/sqcm	Friction Ratio in %
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
10.0	2052.0	2766.0	2069.6	2783.6	207.0	6.325	3.06
10.2	2022.0	2788.0	2039.6	2805.6	204.0	6.785	3.33

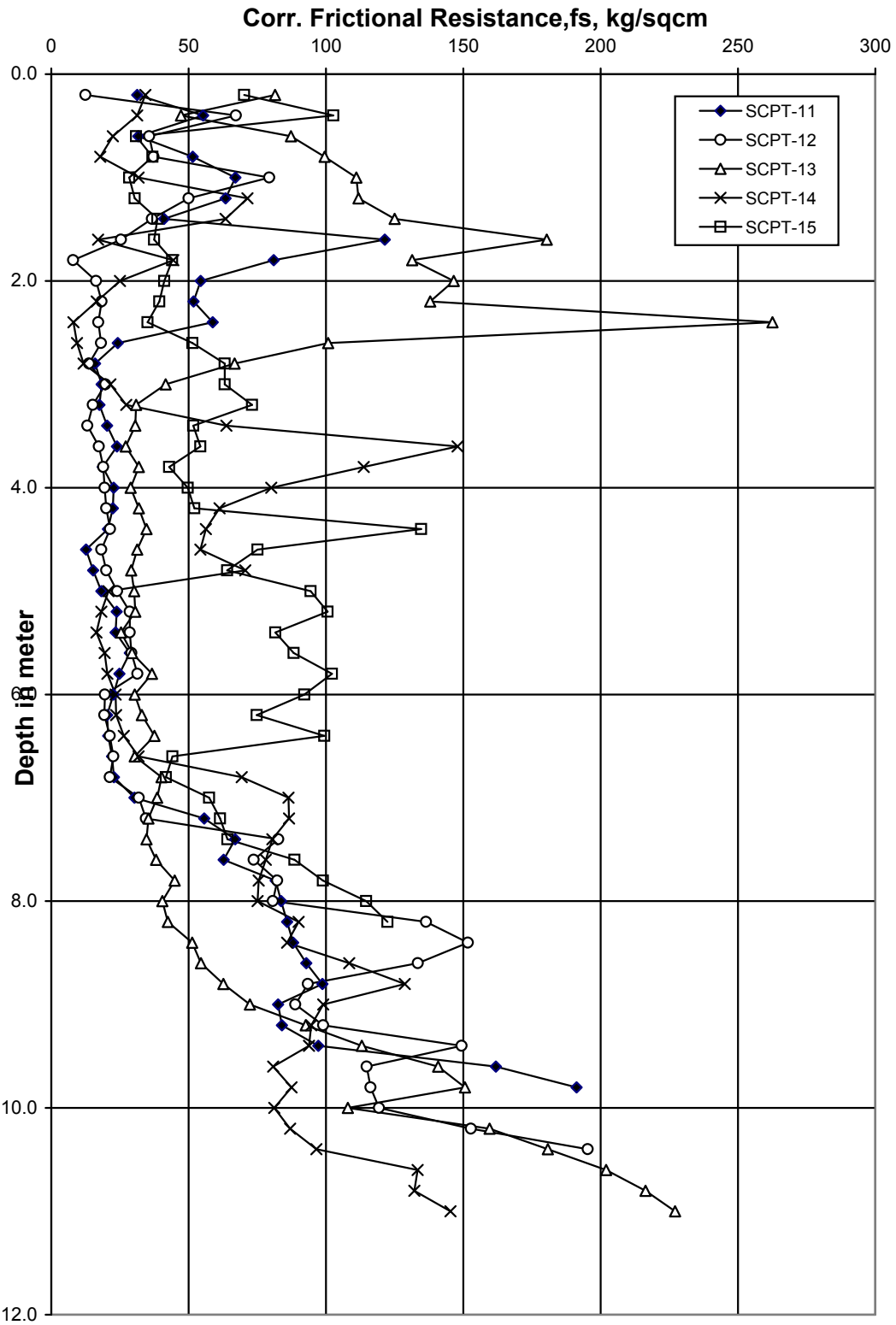
Layer No	Depth From (M)	Depth To (M)	Average Friction Ratio	Type of Soil	Average Qc kg/sqcm	Strength Parameters (c / f)
II	0.00	9.00	5.57	Clay	32.94	1.22kg/sqcm
III	9.00	10.20	2.56	Silty sand	184.83	38°



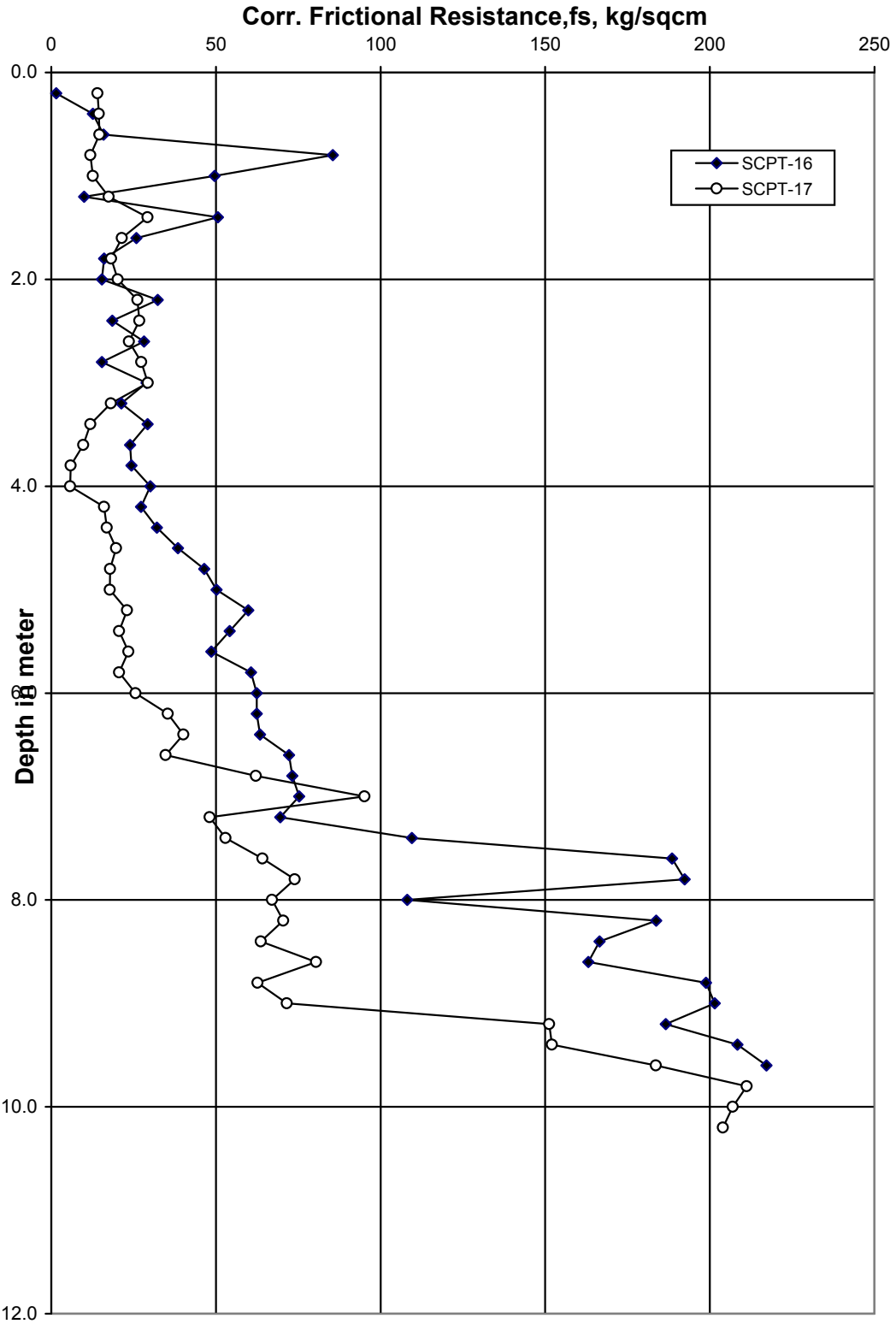
Corr. Cone Res vs depth plot



Corr. Frictional Resistance vs depth plot



Corr. Frictional Resistance vs depth plot



Corr. Frictional Resistance vs depth plot

Summarised Field CBR Test Results

Test Location	Depth of Test (M)	Field CBR (%)					
		Unsokaed			Soaked		
		For 2.5mm Pentn.	For 5.0mm Pentn.	Average FCBR	For 2.5mm Pentn.	For 5.0mm Pentn.	Average FCBR
FCBR-01	0.50	11.21	10.31		3.57	3.41	
		12.49	11.41	12.53	1.65	2.05	2.89
		13.89	11.71		3.46	3.06	
FCBR-02	0.50	4.42	3.54		2.04	2.04	
		8.79	7.55	7.11	4.06	3.54	4.02
		8.12	6.84		5.97	5.41	
FCBR-03	0.50	4.29	4.51		5.39	5.44	
		3.84	3.78	3.69	2.42	2.12	3.48
		2.70	2.77		2.63	2.73	
FCBR-04	0.50	10.55	10.19		3.60	3.36	
		11.64	10.90	11.38	3.36	3.04	3.71
		11.94	10.69		4.17	4.05	

FIELD PERMEABILITY TEST RESULTS:

Field permeability tests were conducted in four bore holes. The test results are presented below.

Test Locations	Type of Test	Depth of Test (M)	Permeability (cm/sec)
BH-02	Falling Head	1.40 – 2.00	7.737×10^{-6}
	Falling Head	2.80 – 3.50	1.172×10^{-6}
BH-10	Falling Head	1.45 – 2.00	5.401×10^{-6}
	Falling Head	2.90 – 3.50	5.132×10^{-6}
BH-31	Falling Head	1.30 – 2.00	2.588×10^{-5}
	Falling Head	2.80 – 3.50	7.311×10^{-6}
BH-53	Falling Head	1.40 – 2.00	4.079×10^{-4}
	Falling Head	2.90 – 3.50	3.414×10^{-4}

PART II: LABORATORY TEST RESULTS

TEST REPORT

TEST REPORT NO : 3369 DATE: 10/02/2015

Name and Address of Customer: Bharat Heavy Electricals Ltd.,
Power Sector, Western Region,
Shreemohini Complex, 345 Kingsway
Nagpur - 440 001.

Customer Reference No : BHE/PW/PUR/PWHQ-GEO/1317-LOI/3369

Customer Reference Date : 13/11/2014

Date of Sample Received at Lab : 17/11/2014

Date of Starting of Test : 18/11/2014

Date of Completion of Test : 03/02/2015

Sample ID Nos : 3369/BH01/UDS01 to 3369/CPLT02/DS02

Please refer the page nos. 254 of 469 to 297 of 469 of the Report for the following:

1. Sample Description
2. Test methods used
3. Test results

Further to note that the test parameters are mentioned at the header of test result table.

* The report related to the particular sample(s) tested under stated condition.
* All tests are based as per IS specifications
* Any discrepancy in this report should be brought to the notice within 15 (fifteen) days from the date of certificate
* Full/Partial use of this test results could not be done without the written permission of authorized signatory.

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH01	UDS01	2.00	Brownish grey, silty clay with sand mixture.	1.72	1.42	2.65	20 S		DRSH-CQ		0.34	30	40	21		CI		9	85	6	#See the Note
							22DR		0.5	0.632											
									1.0	0.933											
									1.5	1.215											
BH01	UDS03	6.50	Brownish grey, silty clay with sand mixture.										$			CI*		38	62 (Silt+Clay)		Do
BH01	SPT05	11.00	Brownish grey, silty clay with sand mixture.			2.69							$			CL*		22	75	3	Do
BH01	SPT10	18.50	Brownish grey, silty clay with sand mixture and silt stone.										$			CL*	2	34	64 (Silt+Clay)		Do
BH01	SPT15	26.00	Brownish grey, silty sand with traces of mica.										NP			SM-SP		94	06 (Silt+Clay)		Do
BH02	UDS01	2.00	Brownish grey, clayey silt with sand mixture.										$			MI*		44	56 (Silt+Clay)		Do
BH02	UDS03	6.50	Deep brownish grey, silty clay with sand mixtureand traces of silt.	1.75	1.40	2.67	23 S		DRSH-CQ		0.22	31	$			CI*		20	78	2	Do
							25DR		0.5	0.545											
									1.0	0.812											
									1.5	1.150											
BH02	UDS04	9.50	Brownish grey, silty clay with traces of sand mixture and mica.			2.67							33	21		CL		20	78	2	Do
BH02	UDS05	12.50	Brownish grey, silty sand with traces of mica.										NP			SM-SP		93	07 (Silt+Clay)		Do
BH02	SPT09	18.50	Brownish grey, silty clay with sand mixture.										42	23		CI		34	66 (Silt+Clay)		Do
BH02	SPT14	26.00	Brownish grey, gravelly sand.										NP			SW	47	50	3 (Silt+Clay)		Do

Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results				Atter. Limits			IS Classification	Grain Size				Test Method
									Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	LL %	PL %	SL %		Gravl %	Sand %	Silt %	Clay %	
BH03	UDS01	2.00	Greyish brown, silty sand with traces of clay binders.	2.08	1.73	2.62	19 S						NP			SM		50	49	1	Do
BH03	UDS03	6.50	Yellowish grey, silty clay with sand mixture.										$			CI*		24	76 (Silt+Clay)		Do
BH03	SPT06	11.00	Brownish grey, silty sand with traces of clay binders.			2.67							NP			SM		63	36	1	Do
BH03	SPT10	17.00	Brownish grey, silty clay with sand mixture and mica.										$			CI*		43	57 (Silt+Clay)		Do
BH03	SPT14	23.50	Brownish grey, silty sand with traces of gravels.										NP			SP	47	50	03 (Silt+Clay)		Do
BH04	UDS01	2.00	Brownish grey, silty sand with traces of mica.										NP			SM		77	23 (Silt+Clay)		Do
BH04	UDS03	6.50	Brownish grey, silty clay.	1.93	1.54	2.66	25 S	0.691	TRSH-UU		1.07	7	49	26	16	CI		12	85	3	Do
							25 T		3.0	1.609											
							25 C		2.0	1.476											
									1.0	1.345											
									UNCONFD		1.47	0									
									0.0	1.541											
									0.0	1.476											
									0.0	1.398											
									REMOULD		1.13	0									
									0.0	1.235											
									0.0	1.109											
									0.0	1.041											
BH04	UDS04	9.50	Greyish brown, silty sand with clay binders.	1.90	1.71	2.69	12 S						NP			SM		75	23	2	Do
BH04	SPT06	12.80	Brownish grey, silty clay with sand mixture and mica.										32	19		CL		18	82 (Silt+Clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH04	SPT12	22.00	Brownish grey, gravelly sand with traces of kankars.										NP			SP	20	76	04 (Silt+Clay)		Do
BH05	UDS01	2.00	Brownish grey, silty sand with clay binders.										NP			SM		54	46 (Silt+Clay)		Do
BH05	UDS02	4.00	Brownish grey, silty clay.	1.79	1.55	2.63	16 S		TRSH-UU		1.84	6	37	24	20	CI		10	78	12	Do
							15 T		3.0	2.412											
									2.0	2.271											
									1.0	2.154											
BH05	UDS03	9.50	Brownish grey, silty clay with sand mixture.	1.74	1.55		13 S						$			CL*		8	80	12	Do
BH05	SPT08	14.00	Yellowish grey, silty clay with traces of sand mixture.										32	25		ML					Do
BH05	SPT10	17.00	Brownish grey, silty sand with traces of clay binders.										NP			SM		64	36 (Silt+Clay)		Do
BH05	SPT17	27.50	Brownish grey, silty sand with traces of mica.										NP			SM-SP		88	12 (Silt+Clay)		Do
BH06	UDS01	1.00	Brownish grey, silty sand with traces of mica.										NP			SM		50	50		Do
BH06	UDS02	4.00	Brownish grey, silty clay with sand mixture.	2.06	1.77	2.64	17 S	0.456	TRSH-UU		1.22	11	37	17	17	CI		43	48	9	Do
							16 T		3.0	2.175											
							13 C		2.0	1.971											
									1.0	1.716											
									UNCONFD		1.61	0									
									0.0	1.557											
									0.0	1.593											
									0.0	1.667											
									REMOLED		1.25	0									
									0.0	1.217											
									0.0	1.265											
									0.0	1.279											

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH06	UDS03	6.00	greyish brown, silty clay with sand mixture.										41	23		CI		37	63 (Silt+Clay)		Do
BH06	UDS05	12.50	Brownish grey, silty sand with traces of clay binder and mica.	1.77	1.54		15DR		DRSH-CQ		0.07	37	NP			SM		71	29 (Silt+Clay)		Do
									0.5	0.432											
									1.0	0.833											
									1.5	1.195											
BH06	SPT10	20.00	Brownish grey, silty sand with traces of mica.										NP			SM		86	14 (Silt+Clay)		Do
BH06	SPT15	27.50	Brownish grey, silty clay with sand mixture.										$			CI*		42	58 (Silt+Clay)		Do
BH07	UDS01	2.00	Brownish grey, silty sand with traces of kankars.										NP			SM	2	80	18 (Silt+Clay)		Do
BH07	UDS03	6.50	Brownish grey, silty sand.	1.88	1.57		9 S						NP			SM-SP		91	09 (Silt+Clay)		Do
BH07	UDS05	12.50	Light brownish grey, silty sand.	1.76	1.59		9 S		DRSH-CQ		0.22	29	NP			SM-SP		88	12 (Silt+Clay)		Do
							11DR		0.5	0.455											
									1.0	0.808											
									1.5	1.030											
BH07	SPT09	18.50	Brownish grey, silty sand.										NP			SM-SP		94	06 (Silt+Clay)		Do
BH07	SPT12	23.00	Brownish grey, silty clay with sand mixture.										$			CL*		40	46	14	Do
BH08	UDS01	2.00	Greyish brown, silty sand with traces of kankars.										NP			SM-SP		91	09 (Silt+Clay)		Do
BH08	UDS02	4.00	Greyish brown, silty clay with traces of kankars.	2.03	1.64	2.61	24 S						49	26		CI		12	82	6	Do

Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	Atter. Limits LL %	PL %	SL %	IS Classification	Grain Size Gravl %	Sand %	Silt %	Clay %	Test Method
BH08	UDS05	11.50	Brownish grey, silty sand.	1.78	1.47		21 S		DRSH-CQ		0.21	27	NP			SM-SP		89	11 (Silt+Clay)		Do
							21DR		0.5	0.438											
									1.0	0.751											
									1.5	0.965											
BH08	SPT08	16.00	Yellowish grey, silty clay with sand mixture.										30	23		ML					Do
BH08	SPT13	23.50	Brownish grey, silty sand with gravels, traces of kankars and mica.										NP			SP	25	73	02 (Silt+Clay)		Do
BH09	UDS01	2.00	Brownish grey, silty clay.	2.09	1.75	2.67	20 S	0.499	TRSH-UU		1.11	0	29	20	22	CL		32	65	3	Do
							19 T		3.0	1.205											
							17 C		2.0	1.135											
									1.0	1.081											
									UNCONFD		1.13	0									
									0.0	1.150											
									0.0	1.094											
									0.0	1.143											
									REMOULD		0.89	0									
									0.0	0.900											
									0.0	0.844											
									0.0	0.939											
BH09	UDS03	6.50	brownish grey, silty clay with sand mixture.	1.76	1.49		19 S		DRSH-CQ		0.19	33	$			CI*		34	66 (Silt+Clay)		Do
							18DR		0.5	0.484											
									1.0	0.887											
									1.5	1.180											
BH09	SPT07	13.00	Brownish grey, silty clay with traces of sand mixture.										35	22		CI					Do
BH09	SPT12	20.50	Brownish grey, silty sand with traces of gravels.										NP			SP	13	85	02 (Silt+Clay)		Do
BH09	SPT17	28.00	Brownish grey, silty sand with gravels.										NP			SP	25	71	04 (Silt+Clay)		Do
BH10	UDS01	2.00	Brownish grey, silty clay with traces of fine sand mixture.			2.64	14 S						43	17	14	CI		13	45	42	Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH10	UDS02	4.00	Brownish grey, silty clay with sand mixture.	1.73	1.48		14 S		DRSH-CQ		0.20	33	34	20		CL*		38	62 (Silt+Clay)		Do
							17DR		0.5	0.551											
									1.0	0.812											
									1.5	1.175											
BH10	SPT07	11.00	Brownish grey, silty sand with traces if mica.										NP			SM-SP		93	07 (Silt+Clay)		Do
BH10	SPT12	18.50	Brownish grey, silty sand with traces of gravels and kankars.										NP			SP	20	76	04 (Silt+Clay)		Do
BH10	SPT18	27.50	Brownish grey, silty sand with gravels and traces of kankars.										NP			SM-SP	31	64	05 (Silt+Clay)		Do
BH11	UDS01	2.00	Greyish brown silty clay.	2.02	1.68	2.64	21 S	0.568	TRSH-UU		1.35	0	54	24		CH		26	58	16	Do
							20 T		3.0	1.429											
							22 C		2.0	1.361											
									1.0	1.265											
BH11	UDS02	4.00	Deep brown silty clay with fine sand mixture.	1.84	1.45		21 S		UNCONFD		0.19	0	33	23		CL		38	62(silt+clay)		Do
							26 T		0.0	0.232											
									0.0	0.160											
									0.0	0.192											
									REMOULD		0.13	0									
									0.0	0.184											
									0.0	0.089											
									0.0	0.128											
BH11	UDS03	6.50	Brownish grey clayey silt with sand mixture & mica.										35	25		MI		38	62(silt+clay)		Do
BH11	SPT05	9.80	Yellowish grey silty clay with sand mixture.			2.61							$			CL*		40	58	2	Do
BH11	SPT11	20.00	Brownish grey silty sand with gravels & mica.										NP			SM	33	50	17(silt+clay)		Do
BH11	SPT18	29.00	Brownish grey silty sand with traces of gravels & mica.										NP			SM	15	63	22(silt+clay)		Do
BH12	UDS01	2.00	Brownish grey silty clay.										40	25		CI		19	81(silt+clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH12	UDS02	4.00	Greyish brown clayey silt with traces of fine sand mixture.	1.87	1.54	2.59	20 S		TRSH-UU		0.68	28				MI*		20	78	2	Do
							22 T		3.0	3.790											
									2.0	2.993											
									1.0	1.975											
BH12	UDS03	6.50	Brownish grey silty clay with sand mixture.										$			CI*		18	82(silt+clay)		Do
BH12	SPT06	11.50	Brownish grey silty sand with traces of clay binders & mica.			2.74							NP			SM-SP		89	10	1	Do
BH12	SPT10	17.50	Brownish grey silty sand with traces of mica.										NP			SM-SP		92	8(silt+clay)		Do
BH13	UDS01	2.00	Brownish grey, silty sand with traces of mica.										NP			SM		81	19 (Silt+Clay)		Do
BH13	UDS02	4.00	Brownish grey, silty clay with traces of laminated sand.	2.08	1.75	2.62	20 S						46	16		CI		36	55	9	Do
BH13	SPT05	9.70	Brownish grey, silty sand with traces of gravels.										NP			SP	31	65	04 (Silt+Clay)		Do
BH13	SPT09	16.00	Brownish grey, silty clay with sand mixture.										$			CL*		44	56 (Silt+Clay)		Do
BH13	SPT14	23.00	Brownish grey, silty sand with traces of gravel.										NP			SP	26	71	03 (Silt+Clay)		Do
BH13	SPT19	30.00	Brownish grey, silty clay with traces of sand mixture.										$			CI*		6	94 (Silt+Clay)		Do
BH14	UDS01	2.00	Brownish grey, silty sand.										NP			SM		71	29 (Silt+Clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH14	UDS02	4.00	Brownish grey, silty clay with traces of sand mixture.	2.01	1.65	2.62	22 S		TRSH-UU		1.03	5	50	25		CH		15	76	9	Do
							22 T		3.0	1.462											
									2.0	1.291											
									1.0	1.260											
									UNCONFD		1.26	0									
									0.0	1.287											
									0.0	1.267											
									0.0	1.223											
									REMOULD		0.97	0									
									0.0	1.038											
									0.0	0.965											
									0.0	0.905											
BH14	UDS04	9.50	Brownish grey, silty clay with traces of sand mixture and calcereous nodules.										45	23		CI	4	31	65 (Silt+Clay)		Do
BH14	UDS06	15.50	Brownish grey, silty clay with sand mixture.										$			CI*		21	70	9	Do
BH14	SPT11	23.00	Brownish grey, silty sand with gravel and mica.										NP			SP	26	70	04 (Silt+Clay)		Do
BH15	UDS01	2.00	Brownish grey, silty sand with traces of clay binders.													SM		63	37 (Silt+Clay)		Do
BH15	UDS03	6.50	Brownish grey, silty clay with sand mixture.	2.06	1.72	2.64	17 S						28	20	21	CL-SC		56	42	2	Do
BH15	UDS05	12.50	Brownish grey, silty sand with traces of mica.										NP			SM-SP		94	06 (Silt+Clay)		Do
BH15	SPT07	17.00	Brownish grey, silty sand with traces of gravels.										NP			SP	30	66	04 (Silt+Clay)		Do
BH15	SPT12	24.50	Brownish grey, silty sand with gravels.										NP			SP	35	62	03 (Silt+Clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH16	UDS01	2.00	Brownish grey, silty sand with traces of mica.										NP			SM		83	17 (Silt+Clay)		Do
BH16	UDS03	6.50	Brownish grey, silty sand with traces of clay binders and mica.										NP			SM		69	31 (Silt+Clay)		Do
BH16	UDS04	9.50	Brownish grey, silty clay.	1.99	1.58	2.65	24 S		TRSH-UU		0.31	0	43	17		CI		30	59	11	Do
							26 T		3.0	0.378											
									2.0	0.288											
									1.0	0.254											
									UNCONFD		0.29	0									
									0.0	0.262											
									0.0	0.321											
									0.0	0.290											
									REMOULD		0.18	0									
									0.0	0.163											
									0.0	0.204											
									0.0	0.181											
BH16	SPT07	14.00	Brownish grey, silty sand with traces of gravel and kankars.										NP			SM-SP	12	79	09 (Silt+Clay)		Do
BH16	SPT10	18.50	Brownish grey, silty clay with traces of sand mixture.										35	22		CI					Do
BH16	SPT13	23.00	Brownish grey, silty sand with traces of gravel and kankars.										NP			SP	30	68	02 (Silt+Clay)		Do
BH17	UDS01	2.00	Brownish grey, silty sand with traces of mica.										NP			SM		84	16 (Silt+Clay)		Do
BH17	UDS04	9.50	Brownish grey, silty clay.	2.06	1.76	2.60	20 S		TRSH-UU		2.37	0	$			CI*		37	61	2	Do
							17 T		3.0	2.403											
									2.0	2.367											
									1.0	2.333											
BH17	SPT07	14.00	Brownish grey, silty sand with traces of kankars.										NP			SM-SP		93	07 (Silt+Clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH17	SPT10	18.50	Brownish grey, silty clay with traces of sand mixture.										31	21		CL					Do
BH17	SPT13	23.00	Brownish grey, silty sand with gravel.										NP			SP	47	52	01 (Silt+Clay)		Do
BH18	UDS01	2.00	Brownish grey, silty sand with traces of clay binder.										NP			SM		64	36 (Silt+Clay)		Do
BH18	UDS03	6.50	Greyish brown, silty sand with traces of clay binders.	1.65	1.55	2.67	6 S						NP			SM		83	17	0	Do
BH18	UDS05	12.50	Brownish grey, silty sand with traces of kankars.										NP			SM-SP		90	10 (Silt+Clay)		Do
BH18	SPT07	17.00	Brownish grey, clayey silt with sand mixture.										31	23		ML					Do
BH18	SPT11	23.00	Brownish grey, silty sand with traces of mica.										NP			SM		85	15 (Silt+Clay)		Do
BH18	SPT17	32.00	Brownish grey, silty sand with gravel and traces of kankars.										NP			SP	32	65	03 (Silt+Clay)		Do
BH19	UDS01	2.00	Brownish grey, silty sand with traces of mica.										NP			SM-SP		88	12 (Silt+Clay)		Do
BH19	UDS03	6.50	Brownish grey, silty clay.	2.08	1.77	2.62	16 S		TRSH-UU		1.52	0	34	20		CL		38	59	3	Do
							18 T		3.0	1.555											
									2.0	1.524											
									1.0	1.485											
BH19	UDS04	9.50	Brownish grey, silty sand with traces of clay binders.										NP			SM		69	31 (Silt+Clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH19	SPT08	17.00	Brownish grey, silty clay with sand mixture and traces of silt stone.										$			CL*	3	35	62 (Silt+Clay)		Do
BH20	UDS01	2.00	Brownish grey, silty sand with traces of clay binders.										NP			SM		71	29 (Silt+Clay)		Do
BH20	SPT04	8.00	Brownish grey, silty clay with sand mixture.										42	19		CI		13	78	9	Do
BH20	UDS04	9.50	Brownish grey, silty sand with traces of mica.										NP			SM-SP		94	06 (Silt+Clay)		Do
BH20	SPT08	15.50	Brownish grey, silty clay with traces of sand mixture.										27	21		CL-ML					
BH20	SPT13	23.00	Brownish grey, silty sand with gravel and traces of kankars.										NP			SM-SP	25	70	05 (Silt+Clay)		Do
BH21	UDS01	2.00	Greyish brown, clayey silt.	1.84	1.43	2.58	28 S						43	29		MI		18	66	16	Do
BH21	UDS03	6.50	Deep brown silty clay.										38	23		CI					Do
BH21	UDS04	9.50	Brownish grey silty sand with gravels & traces of mica.										NP			SM	40	31	29(silt+clay)		Do
BH21	SPT06	14.00	Brownish grey silty clay with traces of sand mixture.										31	21		CL					
BH21	DS06	12.00	Greyish brown silty clay with sand mixture.										$			CL*		14	86(silt+clay)		Do
BH21	SPT07	15.50	Greyish brown silty clay with sand mixture.										$			CL*		42	58(silt+clay)		Do

Project: Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.

Job No. : 3369

Sheet No.

CETEST

Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	Atter. Limits LL %	PL %	SL %	IS Classification	Grain Size Gravl %	Sand %	Silt %	Clay %	Test Method
BH21	SPT10	20.00	Brownish grey silty sand with traces of mica.										NP			SM-SP		93	7(silt+clay)		Do
BH21	SPT11	21.50	Brownish grey silty sand with traces of gravels & mica.										NP			SM	3	83	14(silt+clay)		Do
BH22	UDS01	2.00	Brownish grey, silty clay.	2.04	1.70	2.62	20 S	0.528	TRSH-UU		1.99	0	49	22		CI		20	76	4	Do
							20 T		3.0	2.014											
							20 C		2.0	1.992											
									1.0	1.960											
									UNCONFD		2.02	0									
									0.0	2.080											
									0.0	2.018											
									0.0	1.973											
									REMOULD		1.59	0									
									0.0	1.673											
									0.0	1.587											
									0.0	1.537											
BH22	UDS03	6.50	Brownish grey, silty clay with sand mixture.	1.86	1.44	2.70	31 S						39	25		CI		25	73	2	Do
BH22	SPT06	11.50	Brownish grey, silty clay with sand mixture and mica.										$			CL*		33	60	7	Do
BH22	SPT09	16.00	Brownish grey, silty clay with traces of sand mixture and calcereous nodules.										33	23		CL					Do
BH22	SPT14	23.50	Brownish grey, silty sand with gravels and traces of kankars.										NP			SM	14	50	36 (Silt+Clay)		Do
BH23	UDS01	2.00	Brownish grey silty clay with fine sand mixture.										55	22		CH		14	86(silt+clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH23	UDS02	4.00	Greyish brown, silty clay with sand mixture & kankars.	1.88	1.56	2.61	21 S		TRSH-UU		0.63	18	31	22		CL		32	66	2	Do
							20 T		3.0	2.241											
									2.0	1.780											
									1.0	1.330											
BH23	UDS03	6.50	Greyish brown clayey silt.	1.86	1.47		26 S		UNCONFD		0.64	0	38	25		MI		12	88(silt+clay)		Do
							27 T		0.0	0.604											
									0.0	0.638											
									0.0	0.670											
									REMOULD		0.43	0									
									0.0	0.414											
									0.0	0.436											
									0.0	0.447											
BH23	UDS05	11.50	Brownish grey silty clay with sand mixture & mica.										32	21		CL		30	70(silt+clay)		Do
BH23	SPT07	14.80	Brownish grey silty clay.										38	23		CI					
BH23	SPT12	22.50	Brownish grey silty sand with traces of mica.										NP			SM		83	17(silt+clay)		Do
BH23	SPT15	27.00	Brownish grey silty clay with traces of sand mixture.										30	22		CL					
BH23	SPT17	30.00	Greyish brown silty clay with sand mixture.										$			CL*		23	77(silt+clay)		Do
BH24	UDS01	2.00	Brownish grey silty clay with traces of sand mixture.										25	19		CL		62	38(silt+clay)		Do
BH24	UDS02	4.00	Brownish grey silty clay.										47	29		MI					
BH24	UDS03	6.50	Brownish grey clayey silt.	1.79	1.36		28 S		TRSH-UU		0.59	16	41	29		MI		16	84(silt+clay)		Do
							31 T		3.0	2.044											
									2.0	1.416											
									1.0	1.266											

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH24	SPT05	9.80	Brownish grey silty sand with traces of mica.										NP			SM-SP		94	6(silt+clay)		Do
BH24	SPT08	14.50	Greyish brown silty clay with traces of sand mixture.										29	20		CL					Do
BH24	SPT09	16.00	Greyish brown silty clay with sand mixture.			.							$			CL*		34	64	2	Do
BH24	SPT19	31.00	Brownish grey silty sand with gravels & mica.										NP			SM	21	51	28(silt+clay)		Do
BH25	UDS02	4.00	Deep brownish grey silty sand with traces of clay binders & mica.			2.70							NP			SM		86	12	2	Do
BH25	UDS03	6.50	Greyish brown silty sand.	1.78	1.66		8 S		DRSH-CQ		0.06	32	NP			SM-SP		89	11(silt+clay)		Do
							8DR		0.5	0.362											
									1.0	0.692											
									1.5	0.986											
BH25	SPT06	11.50	Brownish grey silty clay.										36	24		CI					Do
BH25	SPT07	13.00	Greyish brown silty clay with sand mixture.										33	18		CL		29	71(silt+clay)		Do
BH25	SPT10	17.50	Brownish grey silty sand with gravels & mica.										NP			SM	25	54	21(silt+clay)		Do
BH26	UDS01	2.00	Brownish grey silty sand with traces of mica.										NP			SM-SP		88	12(silt+clay)		Do
BH26	UDS02	4.00	Brownish grey silty sand with traces of mica.										NP			SM		81	19(silt+clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH26	UDS03	6.50	Brownish grey silty clay.	1.98	1.60	2.57	24 S	0.550	TRSH-UU		1.25	0	53	25		CH		26	51	23	Do
							24 T		3.0	1.361											
							24 C		2.0	1.213											
									1.0	1.181											
BH26	UDS04	9.50	Brownish grey silty sand with traces of mica.										NP			SM		87	13(silt+clay)		Do
BH26	SPT06	12.75	Brownish grey silty clay with traces of kankars.										33	22		CL					Do
BH26	SPT07	14.50	Greyish brown silty clay with sand mixture.										$			CL*		32	68(silt+clay)		Do
BH26	SPT12	22.00	Brownish grey silty sand with gravel pcs. & mica.										NP			SM	23	52	25(silt+clay)		Do
BH26	SPT14	25.00	Greyish brown silty clay with sand mixture.										$			CL*		37	63(silt+clay)		Do
BH26	SPT15	26.50	Deep brownish grey silty clay with traces of sand mixture.										33	20		CL					Do
BH27	UDS01	2.00	Reddish brown, silty sand with moorum and traces of kankars.										NP			SM-SP	5	84	11 (Silt+Clay)		Do
BH27	UDS03	6.50	Greyish brown, silty clay with traces of kankars.	2.10	1.76	2.58	20 T						44	20		CI		31	60	9	Do
BH27	SPT06	11.50	Brownish grey, silty sand with traces of mica.										NP			SM		87	13 (Silt+Clay)		Do
BH27	SPT08	14.50	Brownish grey, silty clay with sand mixture and calcereous nodules.										33	23		CL					Do

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Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH27	SPT12	20.50	Brownish grey, silty sand with gravels and traces of kankars.										NP			SM-SP	30	65	05 (Silt+Clay)		Do
BH27	SPT18	29.30	Brownish grey, silty sand with gravels and traces of kankars.										NP			SP	35	62	03 (Silt+Clay)		Do
BH28	UDS01	2.00	Brownish grey, silty sand with traces of clay binders and mica.										NP			SM		67	33 (Silt+Clay)		Do
BH28	UDS03	6.50	Brownish grey, silty clay with traces of sand mixture.	2.13	1.80	2.61	15 T						33	19		CL		41	51	8	Do
BH28	UDS04	9.50	Brownish grey, silty sand with traces of mica.										NP			SM-SP		94	06 (Silt+Clay)		Do
BH28	UDS06	16.00	Brownish grey, silty clay with sand mixture and traces of mica.										35	24		CI		32	63	5	Do
BH28	SPT12	23.50	Brownish grey, silty sand with traces of gravel and kankars.										NP			SP	73	24	03 (Silt+Clay)		Do
BH29	UDS01	2.00	Brownish grey, silty sand with traces of mica.										NP			SM-SP		91	09 (Silt+Clay)		Do
BH29	UDS03	6.50	Deep brownish grey, silty clay with traces of sand mixture.										$			CL*		17	83 (Silt+Clay)		Do
BH29	UDS04	9.50	Brownish grey, silty clay.	1.95	1.68	2.66	15 S	0.521	TRSH-UU		2.19	6	29	21		CL		33	64	3	Do
							16 T		3.0	2.794											
							19 C		2.0	2.662											
									1.0	2.541											
									UNCONFD		2.96	0									
									0.0	3.656											
									0.0	2.915											
									0.0	2.325											

Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	Atter. Limits LL %	PL %	SL %	IS Classification	Grain Size Gravl %	Sand %	Silt %	Clay %	Test Method
									REMOULD		2.52	0									
									0.0	3.020											
									0.0	2.585											
									0.0	1.956											
BH29	SPT06	12.80	Brownish grey, silty sand with traces of mica.										NP			SM-SP		95	05 (Silt+Clay)		Do
BH29	SPT09	17.50	Brownish grey, silty clay with traces of sand mixture.										31	22		CL					Do
BH29	SPT12	22.00	Brownish grey, silty sand with gravel and traces of kankars.										NP			SP	35	63	02 (Silt+Clay)		Do
BH29	SPT18	31.00	Brownish grey, silty sand with traces of gravels.										NP			SM-SP	17	78	05 (Silt+Clay)		Do
BH30	UDS02	4.00	Brownish grey, silty sand with traces of clay binders.										NP			SM		74	26 (Silt+Clay)		Do
BH30	UDS04	9.50	Brownish grey, silty sand.	1.73	1.61	2.62	8 S						NP			SM		79	20	1	Do
BH30	SPT08	15.50	Brownish grey, silty clay with sand mixture.										31	19		CL		39	61 (Silt+Clay)		Do
BH30	SPT15	26.00	Brownish grey, silty sandwith traces of mica.										NP			SM-SP		93	07 (Silt+Clay)		Do
BH31	UDS04	9.50	Brownish grey, silty clay with traces of sand mixture.	1.72	1.50	2.68	16 S		DRSH-CQ		0.15	34	$			CL*		22	74	4	Do
							15DR		0.5	0.529											
									1.0	0.768											
									1.5	1.170											
BH31	SPT12	20.00	Brownish grey, silty sand with traces of kankars and mica.										NP			SM-SP		92	08 (Silt+Clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH31	SPT16	26.00	Brownish grey, silty sand with traces of mica.										NP			SM		69	31 (Silt+Clay)		Do
BH32	UDS01	2.00	Brownish grey, silty clay/clayey silt with sand mixture and mica.															44	56 (Silt+Clay)		Do
BH32	UDS03	6.50	Brownish grey, silty sand with traces of mica.										NP			SM-SP		89	11 (Silt+Clay)		Do
BH32	UDS04	9.50	Brownish grey, clayey silt.	1.89	1.50	2.65	23 S		TRSH-UU		1.24	6	33	26	26	ML		30	69	1	Do
							26 T		3.0	1.734											
									2.0	1.617											
									1.0	1.501											
									UNCONFD		1.69	0									
									0.0	1.710											
									0.0	1.790											
									0.0	1.560											
									REMOULD		1.35	0									
									0.0	1.373											
									0.0	1.425											
									0.0	1.244											
BH32	SPT09	17.00	Brownish grey, silty clay.										$			CL*		35	59	6	Do
BH32	SPT15	26.00	Brownish grey, silty sand with traces of kankars and clay binders.										NP			SM	10	59	31 (Silt+Clay)		Do
BH33	UDS01	2.00	Brownish grey, silty sand with traces of sand stone and mica.										NP			SM	2	80	18 (Silt+Clay)		Do
BH33	UDS04	9.50	Brownish grey, silty clay with traces of sand.	1.84	1.58	2.67	8 S						37	24		CI		32	67	1	Do
BH33	SPT08	15.50	Brownish grey, silty clay with sand mixture.										$			CL*		38	62 (Silt+Clay)		Do
BH33	SPT12	21.50	Brownish grey, silty clay with traces of sand mixture.										34	23		CL					Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH33	SPT17	29.00	Brownish grey, silty sand with traces of gravels.										NP			SP	35	62	03 (Silt+Clay)		Do
BH34	UDS01	2.00	Brownish grey, silty sand with traces of mica.										NP			SM		86	14 (Silt+Clay)		Do
BH34	UDS03	6.50	Brownish grey, silty sand.	1.75	1.57	2.65	9 S						NP			SM		79	19	2	Do
BH34	SPT05	11.00	Brownish grey, silty clay with traces of sand mixture.										35	20		CI					Do
BH34	SPT12	21.50	Brownish grey, silty clay with tyraces of sand mixture.										35	22		CI					Do
BH34	SPT15	26.00	Brownish grey, silty sand with traces of kankars and mica.										NP			SM-SP		94	06 (Silt+Clay)		Do
BH34	SPT18	31.00	Brownish grey, silty clay with traces of sand mixture.										35	21		CI					Do
BH35	UDS01	2.00	Brownish grey, silty sand with traces of mica.										NP			SM		83	17 (Silt+Clay)		Do
BH35	UDS03	6.50	Greyish brown, silty clay with traces of sand mixture.	2.10	1.79	2.62	17 S		TRSH-UU		1.03	12	33	22		CL		54	44	2	Do
							18 T		3.0	2.077											
									2.0	1.898											
									1.0	1.545											
BH35	SPT08	15.50	Brownish grey, silty sand with traces of mica.										NP			SM-SP		92	08 (Silt+Clay)		Do
BH35	SPT14	25.00	Brownish grey, silty sand with gravel and kankars.										NP			SP	19	78	03 (Silt+Clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH36	UDS01	2.00	Brownish grey, silty sand with traces of clay binders.	1.68	1.55	2.62	10 S									SM		82	17	1	Do
BH36	UDS03	6.50	Brownish grey, silty sand with traces of kankars and mica.										NP			SM-SP		91	09 (Silt+Clay)		Do
BH36	SPT07	14.00	Brownish grey, silty clay with sand mixture.										34	18		CL		33	67 (Silt+Clay)		Do
BH36	SPT11	20.00	Brownish grey, silty sand with traces of gravels.										NP			SP	20	76	04 (Silt+Clay)		Do
BH36	SPT15	26.00	Brownish grey, silty clay with sand mixture and mica.										$			CI*		41	59 (Silt+Clay)		Do
BH37	UDS01	2.00	Brownish grey silty sand with traces of mica.										NP			SM-SP		89	11(silt+clay)		Do
BH37	UDS03	6.50	Deep grey silty sand / sandy silt.	1.79	1.63		10 S		DRSH-CQ		0.05	35				SM		76	24(silt+clay)		Do
							10DR		0.5	0.390											
									1.0	0.781											
									1.5	1.101											
BH37	UDS04	9.50	Brownish grey silty sand.	1.80	1.63		11 S						NP			SM-SP		93	7(silt+clay)		Do
BH37	SPT06	12.75	Yellowish grey silty clay with sand mixture.			2.61							$			CL*		30	67	3	Do
BH37	SPT10	19.00	Brownish grey silty sand with traces of mica										NP			SM-SP		91	9(silt+clay)		Do
BH37	SPT12	22.00	Brownish grey silty sand with traces of mica										NP			SM-SP		93	7(silt+clay)		Do
BH37	SPT13	23.50	Brownish grey silty clay with sand mixture.										$			CL*		23	74	3	Do

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Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	Atter. Limits LL %	PL %	SL %	IS Classification	Grain Size Gravl %	Sand %	Silt %	Clay %	Test Method
BH37	SPT14	25.00	Brownish grey silty sand with traces of clay binders & mica.										NP			SM		50	50(silt+clay)		Do
BH37	SPT16	28.00	Brownish grey silty clay with fine sand mixture.			.							31	21		CL					Do
BH37	SPT18	31.00	Brownish grey silty sand with traces of clay binders & mica.										NP			SM		51	49(silt+clay)		Do
BH38	UDS01	2.00	Brownish grey, silty sand.	1.78	1.69	2.68	5 S		DRSH-CQ		0.10	36	NP			SM		85	15	0	Do
							6DR		0.5	0.458											
									1.0	0.840											
									1.5	1.200											
BH38	UDS03	6.50	Brownish grey, silty clay with traces of sand mixture and silt stone.										$			CI*	2	19	79 (Silt+Clay)		Do
BH38	SPT05	9.80	Brownish grey, silty sand with traces of mica.										NP			SM-SP		95	05 (Silt+Clay)		Do
BH38	SPT09	16.00	Brownish grey, silty clay with traces of silt stone.										35	22		CI					Do
BH38	SPT13	22.00	Brownish grey, gravelly sand.										NP			SW	31	65	04 (Silt+Clay)		Do
BH38	SPT15	25.00	Brownish grey, silty clay with silt stone.										39	22		CI					Do
BH39	UDS01	2.00	Greyish brown silty clay with sand mixture.	1.99	1.68	2.65	18 S	0.504	TRSH-UU		0.72	11	28	21		SM-SC		67	29	4	Do
							18 T		3.0	1.642											
							12 C		2.0	1.311											
									1.0	1.154											

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Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
									UNCONFD		1.14	0									
									0.0	1.041											
									0.0	1.174											
									0.0	1.208											
									REMOULD		0.85	0									
									0.0	0.777											
									0.0	0.874											
									0.0	0.909											
BH39	UDS02	4.00	Greyish brown silty clay with traces of sand mixture.	1.72	1.21	2.62	31 S		TRSH-UU		0.48	0	39	25		CI		22	71	7	Do
							41 T		3.0	0.534											
									2.0	0.458											
									1.0	0.442											
BH39	UDS03	6.50	Brownish grey silty clay with traces of calcareous nodules.	1.74	1.38	2.63	22 S		TRSH-UU		1.12	11	43	25		CI		16	78	6	Do
							27 T		3.0	2.001											
									2.0	1.808											
									1.0	1.555											
BH39	SPT05	9.50	Brownish grey silty sand with traces of mica.										NP			SM		82	18(silt+clay)		Do
BH39	SPT09	15.50	Greyish brown silty clay with sand mixture.										$			CL*		48	45	7	Do
BH39	SPT13	21.00	Brownish grey silty sand with traces of kankars.										NP			SP	15	83	2(silt+clay)		Do
BH39	SPT18	28.50	Greyish brown silty clay with sand mixture & mica.										$			CL*		41	59(silt+clay)		Do
BH40	UDS01	2.00	Brownish grey silty sand with traces of mica.										NP			SM		83	17(silt+clay)		Do
BH40	UDS02	4.00	Brownish grey silty sand with traces of clay binders & mica.										NP			SM		74	26(silt+clay)		Do
BH40	UDS03	6.50	Greyish brwon clayey silt.	1.88	1.52	2.52	23 S						53	30		MH		8	88	4	Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH40	UDS04	9.50	Brownish grey silty clay.	1.76	1.50		17 S		UNCONFD		1.63	0	38	22		CI					Do
							17 T		0.0	2.109											
									0.0	1.682											
									0.0	1.092											
									REMOULD		1.23	0									
									0.0	1.631											
									0.0	1.269											
									0.0	0.800											
BH40	UDS05	12.50	Brownish grey silty sand with traces of clay binders & mica.										NP			SM		67	33(silt+clay)		Do
BH40	SPT07	15.75	Greyish brown silty clay with sand mixture.										31	19		CL					Do
BH40	SPT08	17.50	Brownish grey silty clay with sand mixture.										$			CL*		46	54(silt+clay)		Do
BH40	SPT10	20.50	Brownish grey silty sand with traces of clay binders & mica.										NP			SM		60	40(silt+clay)		Do
BH40	SPT11	22.00	Brownish grey silty clay with sand mixture.										$			CL*		25	62	13	Do
BH40	SPT12	23.50	Deep grey clayey silt.										35	29		MI					Do
BH40	SPT16	29.50	Brownish grey silty clay.										36	22		CI					Do
BH41	UDS01	2.00	Greyish brown silty sand.	1.78	1.59		12 S		DRSH-CQ		0.09	29	NP			SM		85	15(silt+clay)		Do
							12DR		0.5	0.369											
									1.0	0.637											
									1.5	0.928											
BH41	UDS02	4.00	Greyish brown silty clay with traces of fine sand	1.92	1.50	2.70	28 S	0.791	TRSH-UU		1.62	0	47	26		CI		6	85	9	Do
							28 T		3.0	1.665											
							26 C		2.0	1.607											
									1.0	1.601											

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH41	UDS03	6.50	Greyish brown silty clay with traces of sand mixture.	1.88	1.47	2.71	24 S		TRSH-UU		0.60	4	32	21		CL		38	57	5	Do
							28 T		3.0	0.883											
									2.0	0.815											
									1.0	0.726											
BH41	SPT04	8.00	Brownish grey silty sand with traces of mica.										NP			SM		86	14(silt+clay)		Do
BH41	SPT09	15.50	Greyish brown silty clay with sand mixture & mica.										32	17		CL		39	61(silt+clay)		Do
BH41	SPT13	21.50	Brownish grey silty sand with traces of kankars.										NP			SM-SP	28	66	6(silt+clay)		Do
BH41	SPT19	30.50	Brownish grey silty sand with traces of mica.										NP			SM		87	13(silt+clay)		Do
BH42	UDS01	2.00	Greyish brown silty sand with clay binders.	1.85	1.56		15 S		DRSH-CQ		0.12	35	NP			SM		86	14(silt+clay)		Do
							19DR		0.5	0.480											
									1.0	0.818											
									1.5	1.192											
BH42	UDS02	4.00	Greyish brwon clayey silt with traces of sand.	1.84	1.42	2.60	26 S	0.786	TRSH-UU		1.18	0	41	26		MI		18	74	8	Do
							30 T		3.0	1.212											
							27 C		2.0	1.189											
									1.0	1.142											
BH42	UDS03	6.50	Greyish brown silty sand.	1.78	1.61		11 S		DRSH-CQ		0.11	30	NP			SM-SP		90	10(silt+clay)		Do
							10DR		0.5	0.399											
									1.0	0.687											
									1.5	0.981											
BH42	UDS04	8.00	Brownish grey silty clay with traces of calcareous nodules & sand.	1.94	1.61	2.65	19 S		TRSH-UU		0.92	4	32	21		CL		6	87	7	Do
							21 T		3.0	1.213											
									2.0	1.174											
									1.0	1.063											
BH42	SPT05	10.00	Brownish grey silty clay with sand mixture & mica.										$			CL*		34	66(silt+clay)		Do
BH42	SPT08	14.50	Brownish grey silty clay with sand mixture & mica.										$			CL*		35	60	5	Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH42	SPT13	22.00	Brownish grey silty sand with traces of kankars.										NP			SP	21	75	4(silt+clay)		Do
BH42	SPT19	31.00	Brownish grey silty sand with traces of clay binders.										NP			SM	13	60	27(silt+clay)		Do
BH43	UDS01	2.00	Brownish grey silty clay.	1.98	1.65	2.67	20 S		TRSH-UU		1.33	0	43	23		CI		27	58	15	Do
							20 T		3.0	1.356											
									2.0	1.333											
									1.0	1.301											
BH43	UDS02	4.00	Brownish grey clayey silt with sand mixture.	1.71	1.41	2.65	22 S		TRSH-UU		2.08	17	37	28		MI		16	79	5	Do
							22 T		3.0	4.191											
									2.0	3.512											
									1.0	3.330											
BH43	UDS03	6.50	Brownish grey silty sand.	1.78	1.73		04 S		DRSH-CQ		0.20	27	NP			SM-SP		95	5(silt+clay)		Do
							03DR		0.5	0.463											
									1.0	0.713											
									1.5	0.983											
BH43	SPT06	11.00	Brownish grey silty sand with traces of mica.										NP			SM		87	13(silt+clay)		Do
BH43	SPT12	20.00	Brownish grey silty clay with sand mixture & mica.										$			CL*		17	83(silt+clay)		Do
BH43	SPT17	27.50	Brownish grey silty sand with traces of kankars & mica.										NP			SM-SP	20	75	5(silt+clay)		Do
BH44	UDS01	2.00	Greyish brown silty sand.	1.78	1.63		09 S		DRSH-CQ		0.07	29	NP			SM-SP		89	11(silt+clay)		Do
							9DR		0.5	0.357											
									1.0	0.621											
									1.5	0.914											
BH44	UDS02	4.00	Greyish brown silty sand.	1.78	1.49		20 S		DRSH-CQ		0.06	34	NP			SM		84	16(silt+clay)		Do
							19DR		0.5	0.405											
									1.0	0.706											
									1.5	1.076											

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Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH44	UDS03	6.50	Greyish brown clayey silt with traces of fine sand	1.79	1.29	2.66	35 S		TRSH-UU		0.51	0	42	26		MI		12	80	8	Do
							39 T		3.0	0.577											
									2.0	0.509											
									1.0	0.430											
BH44	UDS04	9.50	Brownish grey silty sand.	1.78	1.65		08 S		DRSH-CQ		0.08	33	NP			SM-SP		94	6(silt+clay)		Do
							8DR		0.5	0.401											
									1.0	0.713											
									1.5	1.043											
BH44	UDS05	13.00	Greyish brown silty clay with traces of sand.	1.86	1.39	2.65	28 S		TRSH-UU		0.89	0	43	25		CI		32	60	8	Do
							34 T		3.0	0.912											
									2.0	0.885											
									1.0	0.873											
BH44	SPT10	20.50	Brownish grey silty sand with tracres of kankars.										NP			SM-SP	18	73	9(silt+clay)		Do
BH44	SPT14	26.50	Brownish grey silty clay with traces of fine sand mixture.										33	19		CL		6	94(silt+clay)		Do
BH44	SPT18	32.50	Brownish grey silty sand with kankars & traces of mica.										NP			SM	25	61	14(silt+clay)		Do
BH45	UDS01	2.00	Deep brown silty sand.	1.78	1.66		7DR		DRSH-CQ		0.11	32	NP			SM		87	13(silt+clay)		Do
									0.5	0.388											
									1.0	0.796											
									1.5	1.008											
BH45	UDS02	4.00	Brownish grey silty clay with traces of calcareous nodules.	1.97	1.57	2.56	25 S		UNCONFD		1.00	0	61	27		CH		12	62	26	Do
							26 T		0.0	1.022											
									0.0	1.042											
									0.0	0.922											
									REMOULD		0.69	0									
									0.0	0.720											
									0.0	0.736											
									0.0	0.623											
BH45	UDS03	6.50	Brownish grey silty clay.				13 S						38	24		CI		28	67	5	Do
BH45	SPT06	11.00	Brownish grey silty sand with traces of mica.										NP			SM		85	15(silt+clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH45	SPT09	15.50	Brownish grey silty clay with traces of kankars.										35	23		CI					Do
BH45	SPT15	24.50	Brownish grey clayey silt with traces of sand mixture.										38	25		MI		36	64(silt+clay)		Do
BH45	SPT19	30.50	Brownish grey silty sand with gravels, traces of kankars & mica.										NP			SM	16	58	26(silt+clay)		Do
BH46	UDS01	2.00	Brownish grey, silty clay.	1.99	1.58	2.65	28 S	0.823	TRSH-UU		0.63	0	50	26	12	CH		22	75	3	Do
							26 T		3.0	0.661											
							31 C		2.0	0.630											
									1.0	0.591											
BH46	SPT07	11.50	Brownish grey, gravelly sand.										NP			SM-SW	41	50	09 (Silt+Clay)		Do
BH46	SPT13	19.50	Brownish grey, silty clay with traces of sand mixture.										35	22		CI					Do
BH46	SPT18	27.00	Brownish grey, silty sand with gravels and traces of kankars.										NP			SP	30	68	02 (Silt+Clay)		Do
BH47	UDS01	2.00	Deep brown silty clay with traces of sand mixture.										29	19		CL		18	82(silt+clay)		Do
BH47	UDS02	4.00	Greyish brown silty clay.	1.99	1.65	2.68	22 S	0.567	TRSH-UU		0.49	13	54	26		CH		8	87	5	Do
							21 T		3.0	1.497											
							21 C		2.0	1.185											
									1.0	0.864											
BH47	UDS03	6.50	Brownish grey clayey silt with traces of sand mixture.										41	29		MI					Do
BH47	UDS04	9.50	Greyish brown silty sand.	1.78	1.71		4 S		DRSH-CQ		0.15	36	NP			SM-SP		95	5(silt+clay)		Do
							5DR		0.5	0.519											
									1.0	0.841											
									1.5	1.239											

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH47	SPT06	12.75	Brownish grey silty clay with traces of sand mixture.										34	23		CL					Do
BH47	SPT11	20.50	Brownish grey silty sand with traces of clay binders & mica.										NP			SM		64	36(silt+clay)		Do
BH47	SPT17	29.50	Brownish grey silty sand with traces of gravel pcs. & mica.										NP			SM	17	63	20(silt+clay)		Do
BH48	UDS01	2.00	Greyish brown silty clay.										31	20		CL					Do
BH48	UDS02	4.00	Brownish grey silty clay with traces of calcareous nodules.	2.00	1.64		22 S		UNCONFD		1.76	0	52	25		CH		16	70	14	Do
							22 T		0.0	1.711											
									0.0	1.814											
									0.0	1.745											
									REMOULD		1.31	0									
									0.0	1.258											
									0.0	1.403											
									0.0	1.277											
BH48	UDS03	6.50	Greyish brown silty clay.	1.74	1.43	2.57	21 S						46	26		CI		9	91(silt+clay)		Do
BH48	UDS04	9.50	Brownish grey silty sand with traces of mica.										NP			SM-SP		90	10(silt+clay)		Do
BH48	UDS05	12.50	Brownish grey silty clay.										36	24		CI					Do
BH48	SPT07	14.00	Greyish brown silty clay with sand mixture.										$			CL*		19	81(silt+clay)		Do
BH48	SPT09	19.00	Brownish grey silty clay with traces of sand mixture.										32	23		CL					Do

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Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH48	SPT16	28.50	Brownish grey silty sand with gravels & traces of mica.										NP			SM	26	45	29(silt+clay)		Do
BH49	UDS01	2.00	Brownish grey silty clay with sand mixture & mica.													CI*		34	66(silt+clay)		Do
BH49	UDS02	4.00	Deep brownish grey silty clay.										49	25		CI					Do
BH49	UDS03	6.50	Deep brown silty sand.	1.78	1.65	2.66	8 S		DRSH-CQ		0.09	31	NP			SM		86	13	1	Do
							8DR		0.5	0.367											
									1.0	0.703											
									1.5	0.958											
BH49	SPT04	8.00	Brownish grey silty clay.										38	24		CI					Do
BH49	SPT05	9.80	Brownish grey silty clay with sand mixture & mica.										$			CL*		19	81(silt+clay)		Do
BH49	SPT10	18.00	Brownish grey silty sand with traces of kankars.										NP			SP		96	04(silt+clay)		Do
BH49	SPT18	30.50	Brownish grey silty sand with gravels & traces of mica.										NP			SM	20	59	21(silt+clay)		Do
BH50	UDS01	2.00	Brownish grey silty sand with traces of mica.										NP			SM		86	14(silt+clay)		Do
BH50	UDS02	4.00	Brownish grey silty clay with sand mixture.										42	21		CI		13	87(silt+clay)		Do
BH50	UDS03	6.50	Greyish brown silty clay.	1.86	1.46		26 S						$			CI*		12	88(silt+clay)		Do
							27 T														
BH50	UDS04	9.50	Brownish grey silty sand with traces of mica.										NP			SP		96	4(silt+clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH50	SPT11	20.50	Yellowish grey silty sand with clay binders & mica.			2.68							NP			SM		75	25	0	Do
BH51	UDS01	2.00	Greyish brown, silty clay.	2.04	1.63	2.64	23 S						37	20		CI		25	71	4	Do
BH51	UDS03	6.50	Brownish grey, silty clay with traces of sand mixture.										$			CI*		14	78	8	Do
BH51	SPT06	12.50	Brownish grey, silty clay with sand mixture and mica.										$			CI*		28	72 (Silt+Clay)		Do
BH51	SPT11	20.00	Brownish grey, silty sand										NP			SM		86	14 (Silt+Clay)		Do
BH51	SPT13	23.00	Brownish grey, silty sand with traces of gravels.										NP			SP	26	70	04 (Silt+Clay)		Do
BH51	SPT16	27.50	Brownish grey, silty sand										NP			SM-SP		90	10 (Silt+Clay)		Do
BH52	UDS01	2.00	Brownish grey silty sand with traces of mica.										NP			SM-SP		90	10(silt+clay)		Do
BH52	UDS03	6.50	Brownish grey silty clay.	1.81	1.41	2.55	27 S		UNCONFD		0.47	0	40	25		CI		20	71	9	Do
							29 T		0.0	0.376											
									0.0	0.463											
									0.0	0.581											
									REMOULD		0.30	0									
									0.0	0.232											
									0.0	0.292											
									0.0	0.369											
BH52	UDS04	9.50	Deep brown silty sand.	1.79	1.58		11 S		DRSH-CQ		0.25	29	NP			SM-SP		88	12(silt+clay)		Do
							13DR		0.5	0.539											
									1.0	0.773											
									1.5	1.087											

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Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH52	SPT11	19.50	Brownish grey silty clay with traces of sand mixture & calcareous nodules.										31	20		CL					Do
BH52	SPT17	28.50	Brownish grey silty sand with traces of mica.										NP			SM-SP		92	8(silt+clay)		Do
BH52	SPT20	31.50	Brownish grey silty sand with traces of mica.										NP			SM-SP		93	7(silt+clay)		Do
BH53	UDS02	4.00	Brownish grey, silty sand with traces of clay binders.	1.88	1.65	2.36	13 S									SM		55	43	2	Do
BH53	UDS05	12.50	Brownish grey, silty clay with sand mixture and mica.										45	23		CI		19	81 (Silt+Clay)		Do
BH53	UDS07	18.50	Brownish grey, silty sand with traces of kankars and mica.										NP			SM-SP	5	90	5 (Silt+Clay)		Do
BH53	SPT10	23.00	Brownish grey, silty sand with traces of sand mixture.										NP			SM-SP	17	78	05 (Silt+Clay)		Do
BH53	SPT14	29.00	Brownish grey, silty sand with traces of gravels.										NP			SP	10	86	04 (Silt+Clay)		Do
BH54	UDS03	6.50	Brownish grey, silty clay with sand mixture.										$			CI*		26	74 (Silt+Clay)		Do
BH54	UDS06	15.50	Brownish grey, silty sand.	1.53	1.49		3 S						NP			SM-SP		94	06 (Silt+Clay)		Do
BH54	SPT10	23.00	Brownish grey, silty sand with traces of gravels.										NP			SP	17	80	03 (Silt+Clay)		Do

Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	Atter. Limits LL %	PL %	SL %	IS Classification	Grain Size Gravl %	Sand %	Silt %	Clay %	Test Method
BH54	SPT14	29.00	Brownish grey, silty clay with sand mixture.										$			CL*		36	64 (Silt+Clay)		Do
BH55	UDS02	4.00	Yellowish brown, silty sand with traces of mica.	1.78	1.60	2.69	12 S		DRSH-CQ		0.28	30	NP			SM		68	31	1	Do
							12DR		0.5	0.492											
									1.0	0.959											
									1.5	1.142											
BH55	UDS05	12.50	Brownish grey, silty clay with sand mixture.										$			CL*		20	71	9	Do
BH55	SPT10	20.00	Brownish grey, silty sand with traces of gravels.										NP			SM-SP	24	65	11 (Silt+Clay)		Do
BH55	SPT12	23.00	Brownish grey, silty sand with gravel and traces of kankars.										NP			SP	30	68	02 (Silt+Clay)		Do
BH55	SPT15	27.50	Brownish grey, silty sand with gravels and kankars.										NP			SM-SP	38	53	09 (Silt+Clay)		Do
BH56	UDS01	2.00	Brownish grey, silty sand.	1.70	1.59	2.65	7 S						NP			SM		80	19	1	Do
BH56	UDS04	9.50	Brownish grey, silty clay with sand mixture.										33	18		CL		24	76 (Silt+Clay)		Do
BH56	SPT07	14.00	Brownish grey, silty sand with traces of kankars.										NP			SM-SP		92	08 (Silt+Clay)		Do
BH57	UDS01	2.00	Brownish grey, silty sand with traces of clay binder and mica.										NP			SM		68	32 (Silt+Clay)		Do
BH57	UDS04	9.50	Brownish grey, silty clay.	2.06	1.80	2.65	15 S		TRSH-UU		1.87	13	35	18	17	CI		45	52	3	Do
							15 T		3.0	3.232											
									2.0	2.913											
									1.0	2.653											

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH57	SPT06	12.50	Brownish grey, silty sand with traces of mica.										NP			SP		96	04 (Silt+Clay)		Do
BH57	SPT10	18.50	Brownish grey, silty sand with traces of mica.										NP			SM-SP		94	06 (Silt+Clay)		Do
BH57	SPT15	26.00	Brownish grey, gravelly sand.										NP			SW	25	71	4 (Silt+Clay)		Do
BH58	UDS01	2.00	Greyish brown, silty sand with sand mixture.	1.84	1.70	2.67	8 S						NP			SM		72	27	1	Do
BH58	UDS03	6.50	Brownish grey, silty sand with traces of mica.										NP			SM-SP		89	11 (Silt+Clay)		Do
BH58	SPT07	12.50	Brownish grey, clayey silt with sand mixture.										30	25		ML					Do
BH58	SPT12	20.00	Brownish grey, silty clay with sand mixture.										$			CL*		48	52 (Silt+Clay)		Do
BH58	SPT18	29.00	Brownish grey, silty sand with traces of kankars.										NP			SM		82	18 (Silt+Clay)		Do
BH59	UDS01	2.00	Greyish brown, silty sand with traces of clay binders and kankars.	1.80	1.44	2.45	22 S						NP			SM		62	37	1	Do
BH59	UDS04	9.50	Brownish grey, silty sand with traces of sand stone.										NP			SM	3	82	15 (Silt+Clay)		Do
BH59	SPT08	15.50	Brownish grey, silty clay with sand mixture and mica.										34	20		CL		43	57 (Silt+Clay)		Do
BH59	SPT12	21.50	Brownish grey, silty sand with traces of mica.										NP			SM		50	50 (Silt+Clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH59	SPT18	30.50	Brownish grey, silty sand with traces of mica.										NP			SM-SP		94	06 (Silt+Clay)		Do
BH60	UDS01	2.00	Brownish grey, silty sand with traces of mica.										NP			SM-SP		93	07 (Silt+Clay)		Do
BH60	UDS02	9.50	Brownish grey, silty clay with traces of sand mixture.	1.92	1.69	2.66	15 S						$			CI*		15	84	1	Do
BH60	SPT10	15.50	Brownish grey, silty clay with traces of sand mixture.										$			CI*		40	60 (Silt+Clay)		Do
BH60	SPT17	26.00	Brownish grey, silty clay with traces of sand mixture.										39	19		CI					Do
BH60	SPT20	30.50	Brownish grey, silty clay with calcareous nodules and sand mixture.										36	20		CI					Do
BH61	UDS02	4.00	Reddish brown, silty clay with traces of sand mixture.										$			CI*		14	81	5	Do
BH61	UDS04	9.50	Brownish grey, silty sand.	1.78	1.51	2.64	18 S		DRSH-CQ		0.08	38	NP			SM		78	21	1	Do
							18DR		0.5	0.469											
									1.0	0.848											
									1.5	1.237											
BH61	SPT08	15.50	Yellowish grey, clayey silt with sand mixture.										32	26		ML					Do
BH61	SPT12	21.50	Brownish grey, silty clay with traces of sand mixture.										34	17		CL		51	49 (Silt+Clay)		Do
BH61	SPT17	29.00	Brownish grey, silty clay with traces of sand nixture.										$			CL*		23	77 (Silt+Clay)		Do

Project: Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.

Job No. : 3369

Sheet No.

Bore Hole	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Spec. Grav.	Nat. Mois. %	Void Ratio	Strength Test Results Pc/Pn kg/sqcm	Shear kg/sqcm	Cohesn kg/sqcm	Frictn Deg.	Atter. Limits LL %	PL %	SL %	IS Classification	Grain Size Gravl %	Sand %	Silt %	Clay %	Test Method
BH62	UDS01	2.00	Brownish grey, silty sand with traces of kankars.										NP			SM-SP	3	86	11 (Silt+Clay)		Do
BH62	UDS04	9.50	Deep brown, silty sand.	1.57	1.50	2.67	5 S						NP			SM		80	20	0	Do
BH62	SPT07	15.50	Brownish grey, silty clay with sand mixture and mica.										$			CL*		40	60 (Silt+Clay)		Do
BH62	SPT14	26.00	Brownish grey, silty clay with traces of sand mixture.										36	22		CI					Do
BH62	SPT18	32.00	Brownish grey, silty sand with traces of gravels and mica.										NP			SM-SP	25	70	05 (Silt+Clay)		Do
BH63	UDS01	2.00	Brownish grey, silty sand with traces of mica.										NP			SM		78	22 (Silt+Clay)		Do
BH63	UDS03	6.50	Brownish grey, silty clay with sand mixture.	1.66	1.48	2.65	12 S						$			CI*		35	60	5	Do
BH63	SPT08	15.50	Brownish grey, silty clay with traces of sand mixture.										31	22		CL					Do
BH63	SPT10	18.50	Brownish grey, silty clay with traces of sand mixture.										31	20		CL					Do
BH63	SPT14	24.50	Brownish grey, silty sand with gravels and traces of clay binders.										NP			SM	19	50	31 (Silt+Clay)		Do
BH64	UDS01	2.00	Brownish grey, silty sand with traces of mica.										NP			SM-SP		88	12 (Silt+Clay)		Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BH64	UDS03	6.50	Brownish grey, clayey silt.	1.66	1.34	2.63	21 S	0.904	TRSH-UU		1.04	7	45	32		MI		20	76	4	Do
							24 T		3.0	1.599											
							21 C		2.0	1.442											
									1.0	1.294											
BH64	UDS04	9.50	Brownish grey, silty sand with traces of mica.										NP			SM		84	16 (Silt+Clay)		Do
BH64	UDS05	12.50	Brownish grey, silty clay with sand mixture and traces of mica.										35	24		CI		49	51 (Silt+Clay)		Do
BH64	SPT08	18.80	Brownish grey, silty clay with sand mixture.										31	22		CL					Do
BH64	SPT12	25.00	Brownish grey, silty sand with traces of gravel oieces.										NP			SP	47	50	03 (Silt+Clay)		Do
BHT1	UDS01	2.00	Brownish grey, silty sand with traces of mica.										NP			SM-SP		88	12 (Silt+Clay)		Do
BHT1	UDS04	9.50	Brownish grey, silty clay with sand mixture.	1.94	1.70	2.63	13 S						31	18		CL		15	80	5	Do
BHT1	SPT09	17.00	Brownish grey, silty sand with traces of mica.										NP			SM-SP		93	07 (Silt+Clay)		Do
BHT1	SPT13	23.00	Yellowish brown, silty sand with traces of rock dust and mica.										NP			SM-SP	4	90	06 (Silt+Clay)		Do
BHT1	SPT19	32.00	Brownish grey, silty clay with traces of sand mixture.										35	22		CI					Do
BHT2	UDS01	2.00	Brownish grey, silty sand with clay binder and mica.										NP			SM		59	41 (Silt+Clay)		Do
BHT2	UDS03	6.50	Brownish grey, silty sand.	1.61	1.53	2.66	5 S						NP			SM		75	24	1	Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BHT2	SPT05	9.63	Brownish grey, silty clay with traces of sand mixture.										35	20		CI					Do
BHT2	SPT10	17.50	Brownish grey, silty clay with sand mixture.										$			CL*		41	55	4	Do
BHT2	SPT14	23.50	Brownish grey, silty sand										NP			SM-SP		94	06 (Silt+Clay)		Do
BHT2	SPT20	32.50	Brownish grey, silty clay.										42	20		CI					Do
BHT3	UDS01	2.00	Brownish grey, silty clay/clayey silt with traces of mica.										NP			SM-SP		92	08 (Silt+Clay)		Do
BHT3	UDS03	6.50	Brownish grey, silty sand.	1.73	1.58	2.62	10 S		DRSH-CQ		0.20	34	NP			SM		54	42	4	Do
							10DR		0.0	0.493											
									1.0	0.927											
									1.5	1.200											
BHT3	SPT07	15.50	Brownish grey, silty clay with sand mixture.										$			CL*		36	64 (Silt+Clay)		Do
BHT3	SPT12	23.00	Brownish grey, silty sand with traces of gravel pieces.										NP			SM-SP	18	76	06 (Silt+Clay)		Do
BHT3	SPT16	29.00	Brownish grey, silty clay.										42	19		CI					Do
BHT4	UDS01	2.00	Brownish grey, silty sand with traces of calcereous nodules.										NP			SM	15	65	20 (Silt+Clay)		Do
BHT4	UDS03	6.50	Brownish grey, silty clay with traces of fine sand mixture.	1.90	1.74	2.65	9 S						$			CI*		41	58	1	Do

Bore	Sample	Depth	Sample Description	Bulk	Dry	Spec.	Nat.	Void	Strength Test Results				Atter. Limits			IS	Grain Size				Test Method
Hole	Number	M		Dens.	Dens.	Grav.	Mois.	Ratio	Pc/Pn	Shear	Cohesn	Frictn	LL	PL	SL	Classifi	Gravl	Sand	Silt	Clay	
				gms/cc	gms/cc		%		kg/sqcm	kg/sqcm	kg/sqcm	Deg.	%	%	%	cation	%	%	%	%	
BHT4	SPT07	12.50	Brownish grey, clayey silt with sand mixture.										32	25		ML					Do
BHT4	SPT14	23.00	Brownish grey, silty sand with gravels and traces of kankars.										NP			SM	25	60	15 (Silt+Clay)		Do
BHT4	SPT17	27.50	Brownish grey, silty clay with traces of silt stone and sand mixture.										39	22		CI					Do

*** Classification is based on average subsoil properties.**

$ Test could not be possible due to shortage of sample.

Density Test results of Trial Pit Samples

Trial Pit Location	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Nat. Mois. %
TP-01	UDS01	1.00	Brownish grey, sandy silt / silty sand.	1.57	1.46	7.53
TP-01	UDS02	2.00	Yellowish grey, silty sand.	1.51	1.43	5.59
TP-01	UDS03	3.00	Blackish grey, silty clay.	1.76	1.61	9.32
TP-01	UDS04	4.00	Blackish grey, silty clay.	1.72	1.59	8.18
TP-02	UDS01	1.00	Greyish brown, silty sand.	1.68	1.54	9.09
TP-02	UDS02	2.00	Greyish brown, silty sand.	1.76	1.54	14.01
TP-02	UDS03	3.00	Greyish brown, silty sand with silt stone & kankars.	1.70	1.54	10.39
TP-02	UDS04	4.00	Greyish brown, silty sand with silt stone & kankars.	2.00	1.71	16.38
TP-03	UDS01	1.00	Brownish grey, silty sand / sandy silt.	1.57	1.48	6.08
TP-03	UDS02	2.00	Brownish grey, silty sand.	1.47	1.40	5.00
TP-03	UDS03	3.00	Brownish grey, silty sand.	1.61	1.54	4.55
TP-03	UDS04	4.00	Brownish grey, silty sand.	1.54	1.45	6.21
TP-04	UDS01	1.00	Blackish grey, silty clay.	1.62	1.52	6.58
TP-04	UDS02	2.00	Brownish grey, clayey silt / silty clay.	1.63	1.55	5.16
TP-04	UDS03	3.00	Brownish grey, clayey silt / silty clay.	1.72	1.60	7.50
TP-04	UDS04	4.00	Brownish grey, clayey silt / silty clay.	1.70	1.58	7.59
TP-05	UDS01	1.00	Greyish brown, silty sand.	1.55	1.47	5.44
TP-05	UDS02	2.00	Greyish brown, silty sand.	1.57	1.48	6.08
TP-05	UDS03	3.00	Greyish brown, silty sand.	1.53	1.46	5.00
TP-05	UDS04	4.00	Greyish brown, silty sand.	1.54	1.49	3.44
TP-06	UDS01	1.00	Greyish brown, silty sand.	1.52	1.44	5.39
TP-06	UDS02	2.00	Greyish brown, silty sand.	1.56	1.47	6.12
TP-06	UDS03	3.00	Greyish brown, silty sand.	1.52	1.44	5.61
TP-06	UDS04	4.00	Greyish brown, silty sand.	1.55	1.47	5.44
TP-07	UDS01	1.00	Blackish grey / grey, ash.	1.21	1.15	5.22
TP-07	UDS02	2.00	Blackish grey / grey, ash.	1.24	1.18	5.08

Trial Pit Location	Sample Number	Depth M	Sample Description	Bulk Dens. gms/cc	Dry Dens. gms/cc	Nat. Mois. %
TP-07	UDS03	3.00	Blackish grey / grey, ash.	1.27	1.21	4.96
TP-07	UDS04	4.00	Blackish grey / grey, ash.	1.25	1.2	4.17
TP-08	UDS01	1.00	Blackish grey, silty clay.	1.62	1.54	5.19
TP-08	UDS02	2.00	Blackish grey, silty clay.	1.67	1.58	5.70
TP-08	UDS03	3.00	Blackish grey, silty clay.	1.72	1.61	6.83
TP-08	UDS04	4.00	Brownish grey, silty clay / clayey silt.	1.74	1.63	6.75
TP-09	UDS01	1.00	Yellowish grey, silty sand.	1.52	1.46	4.11
TP-09	UDS02	2.00	Blackish grey, silty clay.	1.58	1.49	6.04
TP-09	UDS03	3.00	Brownish grey, silty clay.	1.66	1.51	9.93
TP-09	UDS04	4.00	Brownish grey, silty clay.	1.73	1.55	11.61
TTP-01	UDS01	1.00	Greyish brown, silty sand with traces of silt stone.	1.46	1.39	5.22
TTP-01	UDS02	2.00	Brownish grey, silty sand.	1.64	1.56	5.22
TTP-01	UDS03	3.00	Brownish grey, silty sand.	1.53	1.47	4.25
TTP-01	UDS04	4.00	Greyish brown, silty sand with traces of silt stone.	1.66	1.57	5.73

SWELLING TEST RESULTS

Borehole No.	Sample No.	Depth (M)	Description	Free Swell Index, (%)	Swelling Pressure (kg/cm^2)	Moisture Content (%)	Test Method
BH-4	UDS-03	6.50	Brownish grey, silty clay/clayey silt.	15.56	0.12	25	#See the Note
BH-5	UDS-02	4.00	Brownish grey, silty clay/clayey silt.	10.20	--	16	Do
BH-6	UDS-02	4.00	Brownish grey, silty clay with sand mixture.	13.89	0.04	17	Do
BH-7	UDS-05	12.50	Light brownish grey, silty sand.	0.00	--	10	Do
BH-9	UDS-01	2.00	Brownish grey, silty clay/clayey silt.	9.09	0.05	20	Do
BH-10	UDS-01	2.00	Brownish grey, silty clay/clayey silt with traces of fine sand mixture.	15.91	--	14	Do
BH-11	UDS-01	2.00	Greyish brown silty clay.	21.74	0.86	22	Do
BH-23	UDS-02	4.00	Greyish brown, silty clay/clayey silt with sand mixture & kankars.	13.51	0.35	29	Do
BH-26	UDS-03	6.50	Brownish grey silty clay/clayey silt.	26.67	1.33	23	Do
BH-29	UDS-04	9.50	Brownish grey, silty clay/clayey silt.	0.00	0.00	16	Do
BH-32	UDS-04	9.50	Brownish grey, silty clay/clayey silt.	0.00	--	25	Do
BH-39	UDS-02	4.00	Greyish brown silty clay / clayey silt with traces of sand mixture.	4.17	0.00	27	Do
BH-44	UDS-03	6.50	Greyish brown silty clay / clayey silt with traces of fine sand.	4.00	0.00	29	Do
BH-45	UDS-02	4.00	Brownish grey clayey silt/silty clay with traces of calcareous nodules.	45.45	--	26	Do
BH-46	UDS-01	2.00	Brownish grey, clayey silt / silty clay.	30.00	0.00	27	Do
BH-47	UDS-02	4.00	Greyish brown silty clay/clayey silt.	28.26	1.89	24	Do

SWELLING TEST RESULTS

Borehole No.	Sample No.	Depth (M)	Description	Free Swell Index, (%)	Swelling Pressure (kg/cm^2)	Moisture Content (%)	Test Method
BH-49	UDS-03	6.50	Deep brown silty sand.	0.00	0.00	9	Do
BH-57	UDS-04	9.50	Brownish grey, silty clay/clayey silt.	23.68	--	15	Do
BH-64	UDS-03	6.50	Brownish grey, silty clay/clayey silt.	15.91	0.24	23	Do

SUMMERISED LABORATORY COMPACTION & CBR TEST RESULTS

SL No.	Sample No.	Depth (M)	Description	Standard Proctor Compaction Test			Modified Proctor Compaction Test			Test Method
				OMC (%)	MDD (gm/cc)	Soaked CBR (%)	OMC (%)	MDD (gm/cc)	Soaked CBR (%)	
1	TP-01 / DS01	1.00	Light grey, silty sand with traces of mica & clay binders.	14.00	1.770	9	--	--	--	# See the Note
1	TP-01 / DS02	2.00	Yellowish grey, silty sand with traces of clay binders.	--	--	--	12.00	1.950	--	Do
2	TP-02 / DS02	2.00	Yellowish brown sandy silt with clay binders.	14.75	1.836	8	--	--	--	Do
3	TP-03 / DS01	1.00	Greyish brown silty sand.	14.26	1.701	--	--	--	--	Do
3	TP-03 / DS02	2.00	Greyish brown silty sand.	--	--	--	13.30	1.827	21	Do
4	TP-07 / DS01	1.00	Deep grey fly ash.	--	--	--	26.50	1.205	15	Do
5	TP-08 / DS01	1.00	Brownish grey, clayey silty sand.	15.20	1.863	10	--	--	--	Do
6	TP-09 / DS01	1.00	Yellowish grey, silty sand.	--	--	--	12.74	1.851	--	Do
6	TP-09 / DS03	3.00	Brownish grey silty clay	16.10	1.773	6	--	--	--	Do
7	TTP-01 / DS02	2.00	Yellowihs grey sandy silt / silty sand with clay binders.	--	--	--	14.55	1.83	14	Do
8	PLT03 / DS02	2.00	Greyish brown, clayey silty sand / clayey sandy silt.	14.00	1.801	7	--	--	--	Do
9	PLT05 / DS01	1.00	Brownish grey clayey silty sand.	--	--	--	12.90	1.961	16	Do
9	PLT05 / DS02	2.00	Blackish / deep grey, silty clay.	14.25	1.749	--	--	--	--	Do
10	CPLT01 / DS01	1.00	Brownish grey clayey silt with traces of sand mixture.	15.32	1.822	8	--	--	--	Do

SUMMERISED LABORATORY COMPACTION & CBR TEST RESULTS

SL No.	Sample No.	Depth (M)	Description	Standard Proctor Compaction Test			Modified Proctor Compaction Test			Test Method
				OMC (%)	MDD (gm/cc)	Soaked CBR (%)	OMC (%)	MDD (gm/cc)	Soaked CBR (%)	
11	CPLT01 / DS01	1.00	Yellowish grey, clayey silt with fine sand mixture.	13.85	1.777	--	--	--	--	Do
11	CPLT02 / DS02	2.00	Greyish brown clayey silty sand.	--	--	--	12.20	1.954	19	Do

 # Note: Test Methods

Bulk Density & Dry Density: Ref. CET/SOP/01, Issue No. 01-(Page 27 & 39 of 40)
Natural Moisture Content: IS 2720 (Part 2)
Specific Gravity: IS 2720 (Part 3).
Grain size analysis: IS 2720 (Part 4)
Lquid Limit & Plastic Limit: IS 2720 (Part 5)
Standard Proctor Compaction Test (Light Compaction): IS 2720 (Part 7)
Modified Proctor Compaction Test (Heavy Compaction): IS 2720 (Part 8)
Unconfined Compressive Strength Test: IS 2720 (Part 10)
Triaxial Test (TRSH-UU): IS 2720 (Part 11)
Direct Shear Test (DRSH-CQ): IS 2720 (Part 13)
Consolidation Properties (Void Ratio): IS 2720 (Part 15)
California Bearing Ratio (CBR) Test: IS 2720 (Part 16)
Free Swell Index: IS 2720 (Part 40)
Swelling Pressure: IS 2720 (Part 41)

C.E.Testing Company Pvt. Ltd.

Prepared By
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(Name)
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Checked / Approved By
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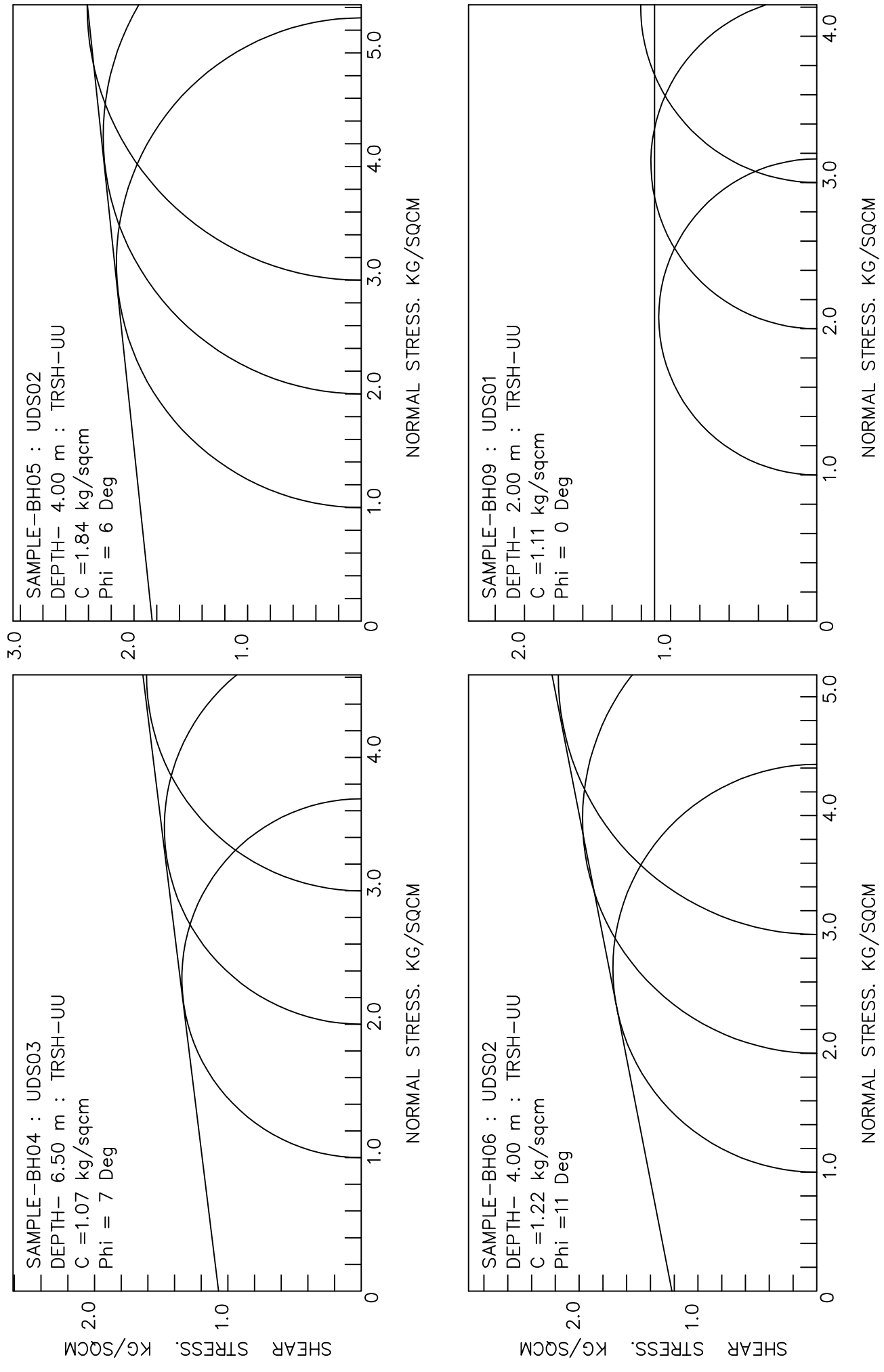
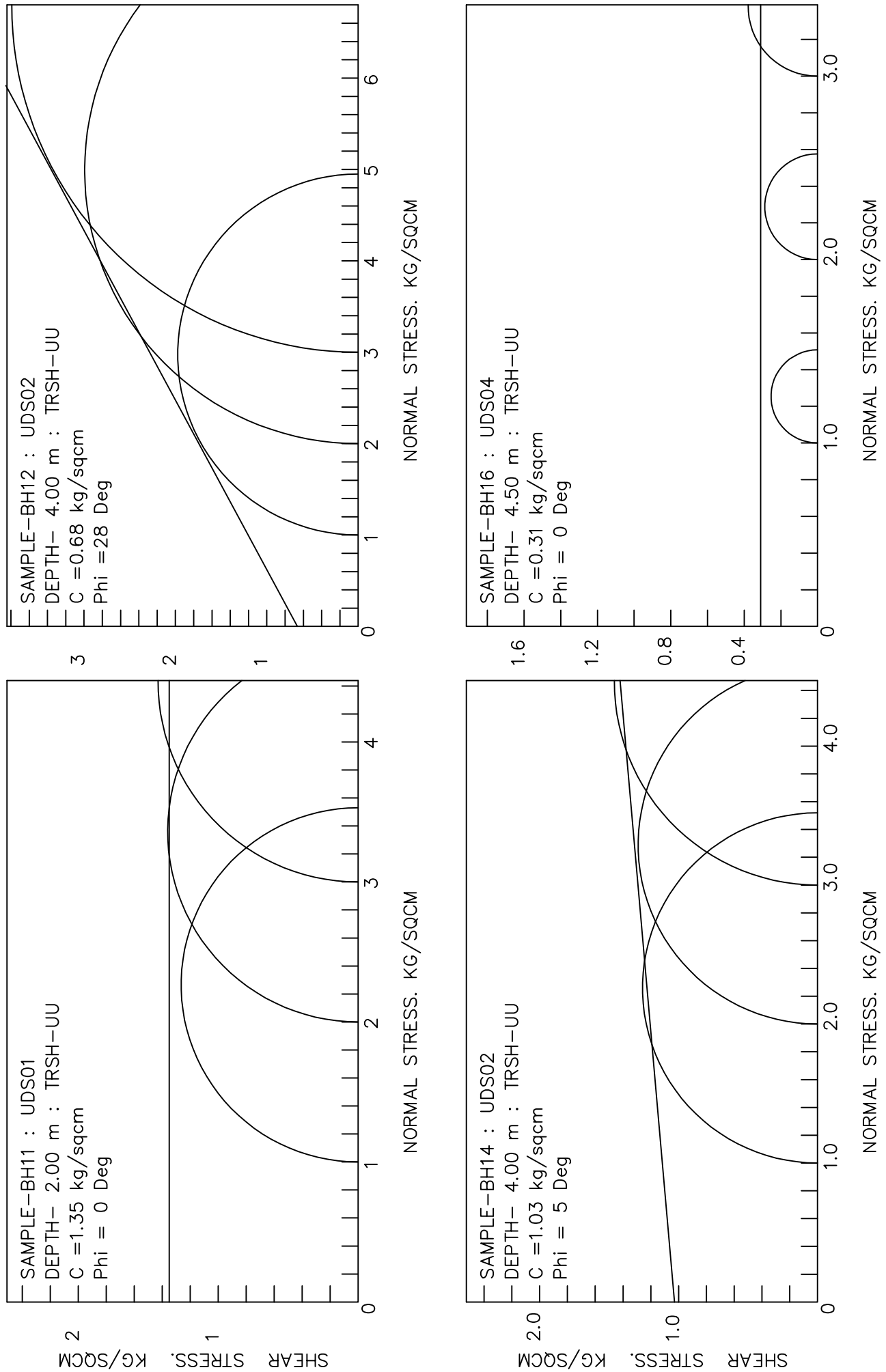
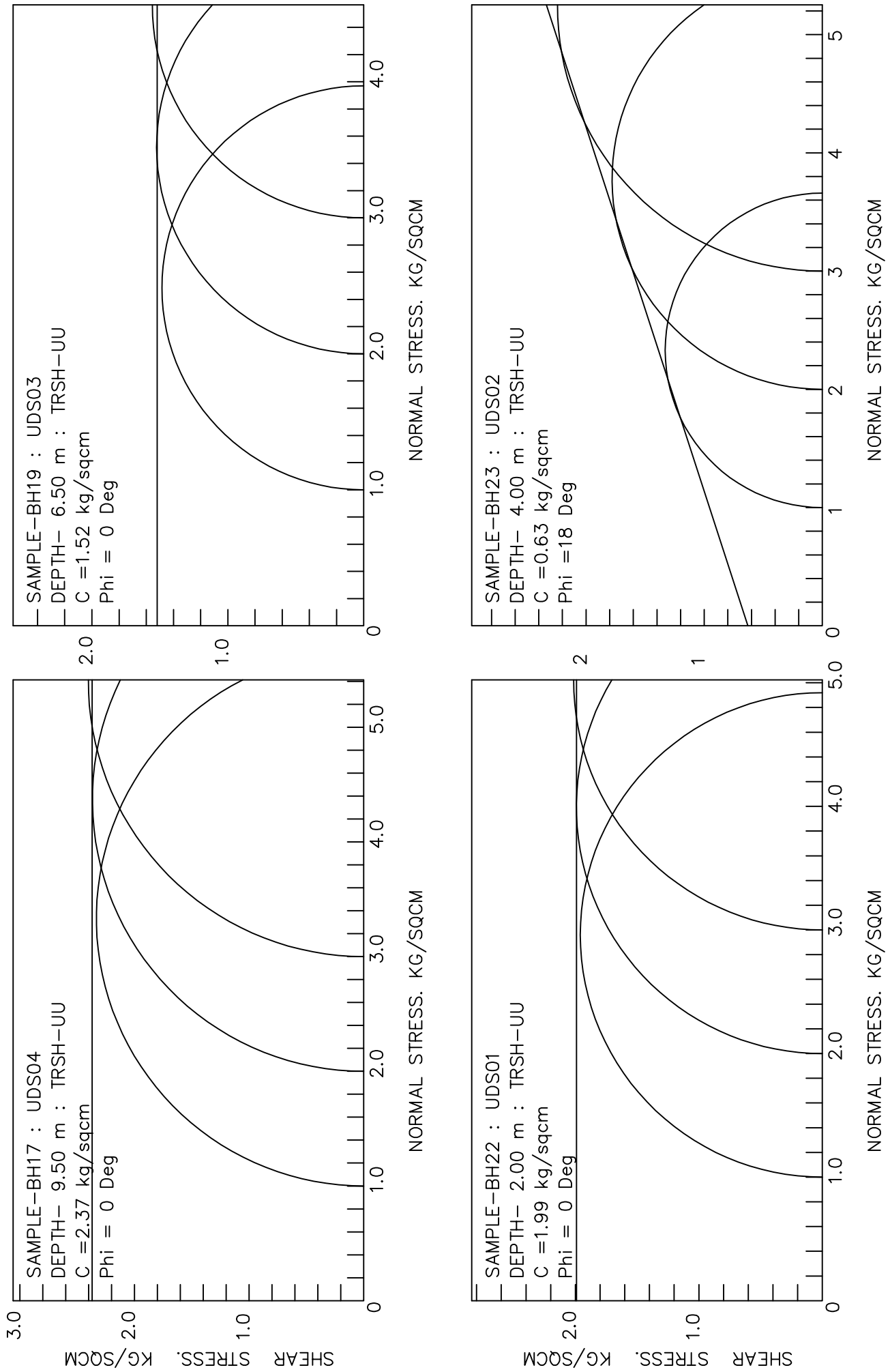
S. Nath
Technical Manager

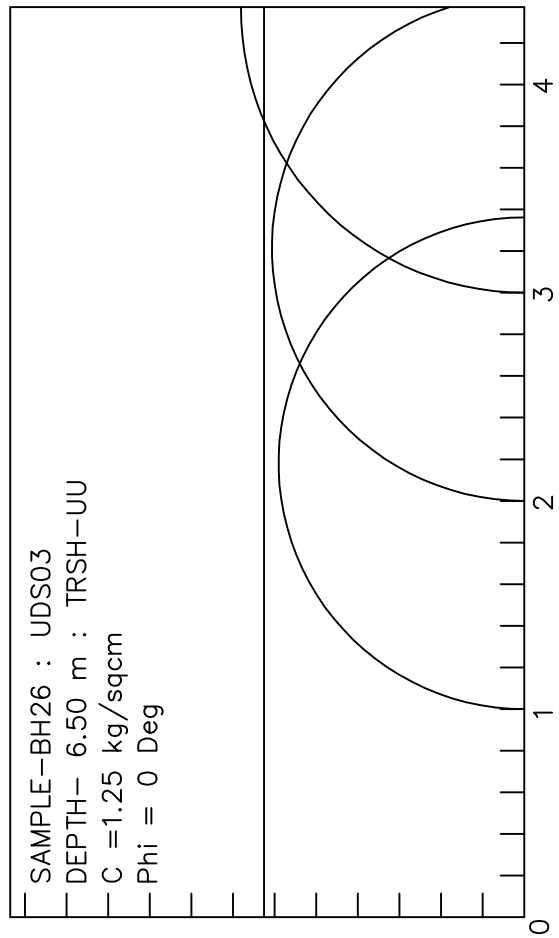
**** End of Report****

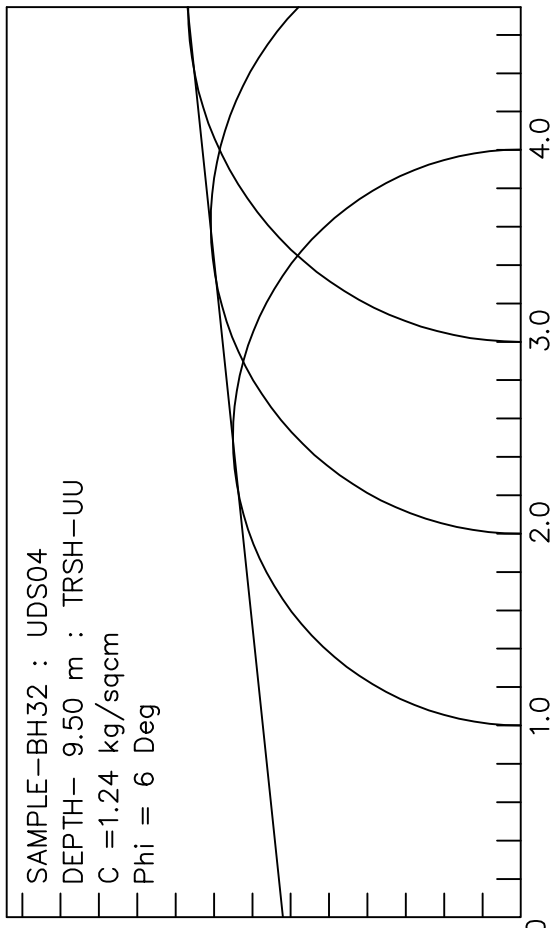
PART III: CHARTS & GRAPHS

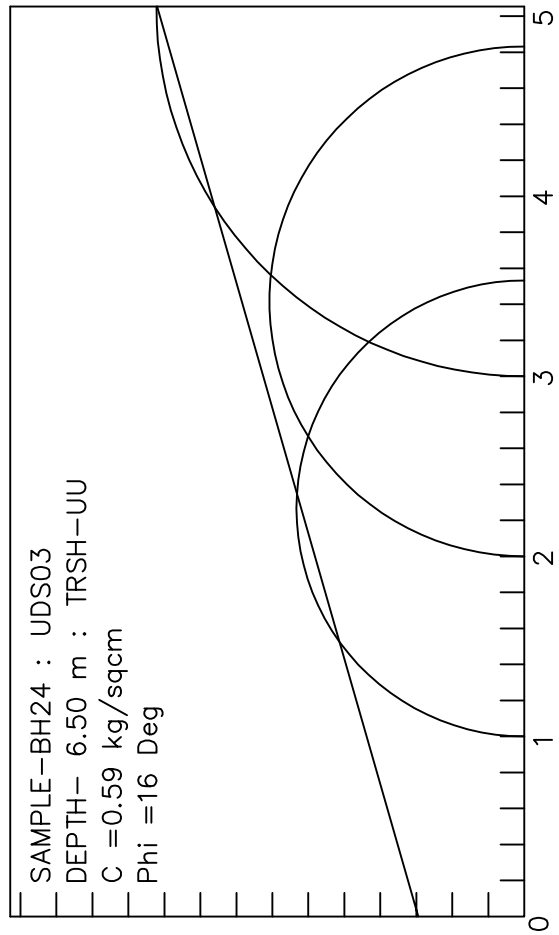

SAMPLE-BH05 : UDS02
DEPTH- 4.00 m : TRSH-UU
C =1.84 kg/sqcm
Phi = 6 Deg
SAMPLE-BH09 : UDS01
DEPTH- 2.00 m : TRSH-UU
C =1.11 kg/sqcm
Phi = 0 Deg
SAMPLE-BH04 : UDS03
DEPTH- 6.50 m : TRSH-UU
C =1.07 kg/sqcm
Phi = 7 Deg
SAMPLE-BH06 : UDS02
DEPTH- 4.00 m : TRSH-UU
C =1.22 kg/sqcm
Phi =11 Deg
NORMAL STRESS. KG/SQCM
SHEAR STRESS. KG/SQCM

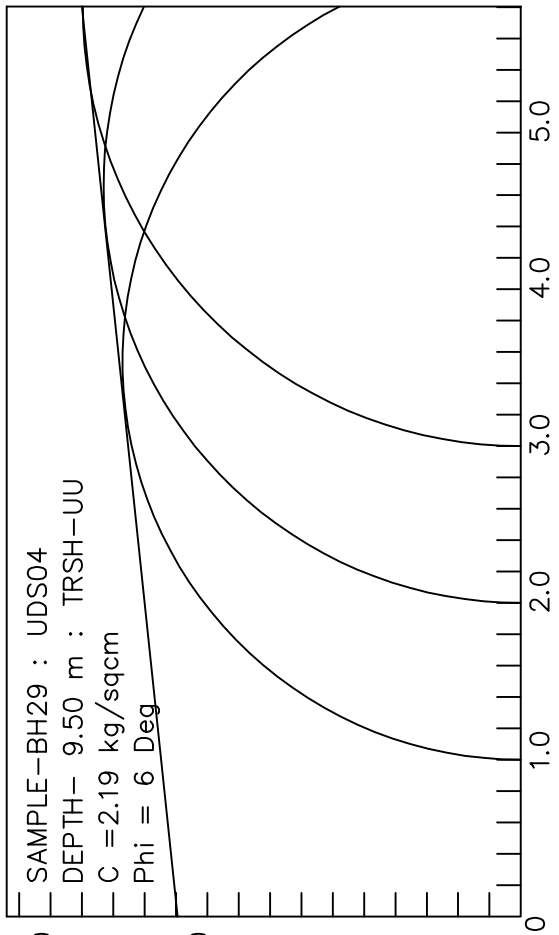

SAMPLE-BH12 : UDS02
DEPTH- 4.00 m : TRSH-UU
C =0.68 kg/sqcm
Phi =28 Deg
NORMAL STRESS. KG/SQCM
SAMPLE-BH16 : UDS04
DEPTH- 4.50 m : TRSH-UU
C =0.31 kg/sqcm
Phi = 0 Deg
NORMAL STRESS. KG/SQCM
SAMPLE-BH11 : UDS01
DEPTH- 2.00 m : TRSH-UU
C =1.35 kg/sqcm
Phi = 0 Deg
NORMAL STRESS. KG/SQCM
SHEAR STRESS. KG/SQCM
SAMPLE-BH14 : UDS02
DEPTH- 4.00 m : TRSH-UU
C =1.03 kg/sqcm
Phi = 5 Deg
NORMAL STRESS. KG/SQCM
SHEAR STRESS. KG/SQCM

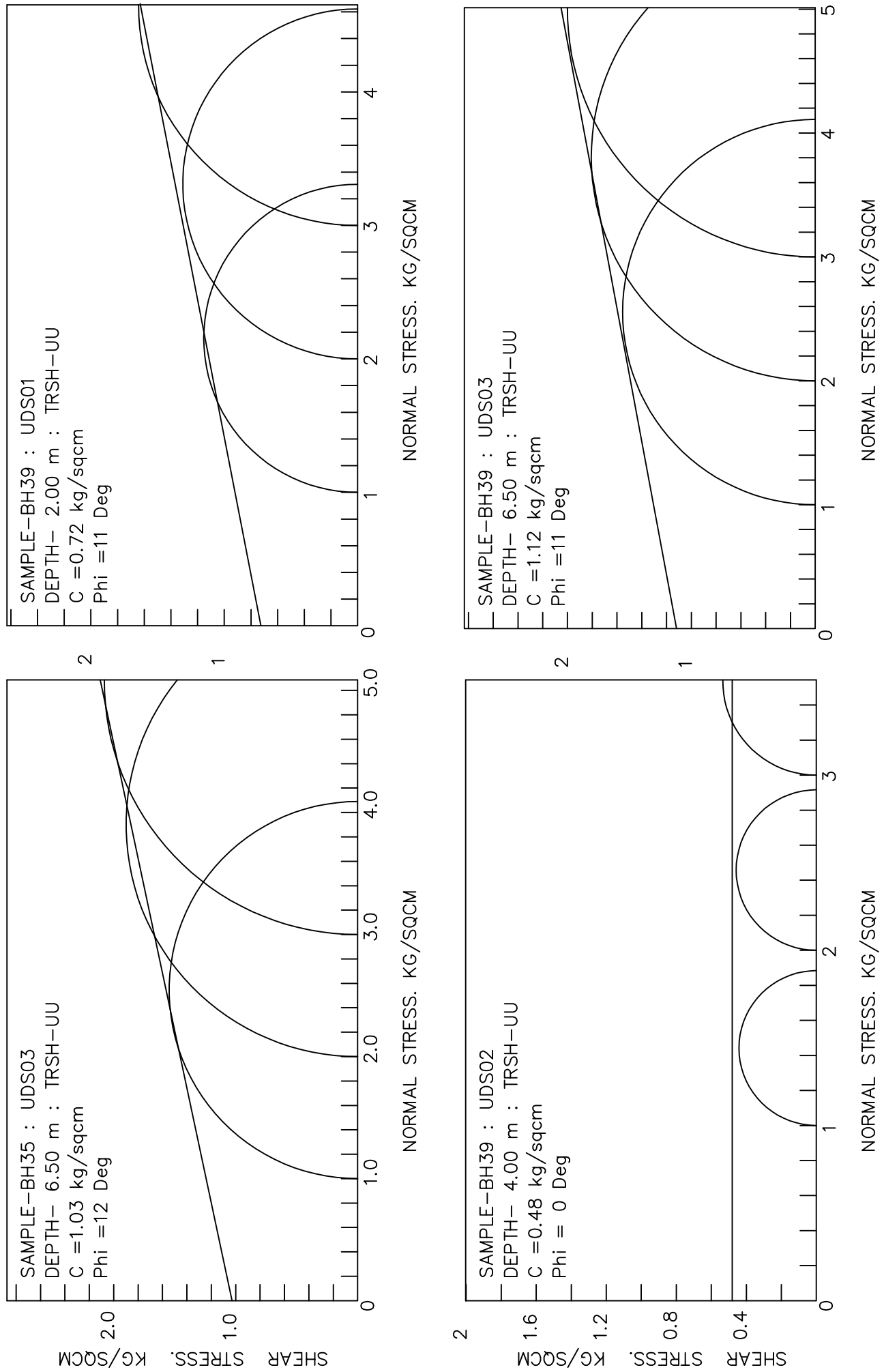

SAMPLE-BH19 : UDS03
DEPTH- 6.50 m : TRSH-UU
C =1.52 kg/sqcm
Phi = 0 Deg
NORMAL STRESS. KG/SQCM
SAMPLE-BH23 : UDS02
DEPTH- 4.00 m : TRSH-UU
C =0.63 kg/sqcm
Phi =18 Deg
NORMAL STRESS. KG/SQCM
SAMPLE-BH17 : UDS04
DEPTH- 9.50 m : TRSH-UU
C =2.37 kg/sqcm
Phi = 0 Deg
SHEAR STRESS. KG/SQCM
NORMAL STRESS. KG/SQCM
SAMPLE-BH22 : UDS01
DEPTH- 2.00 m : TRSH-UU
C =1.99 kg/sqcm
Phi = 0 Deg
SHEAR STRESS. KG/SQCM
NORMAL STRESS. KG/SQCM

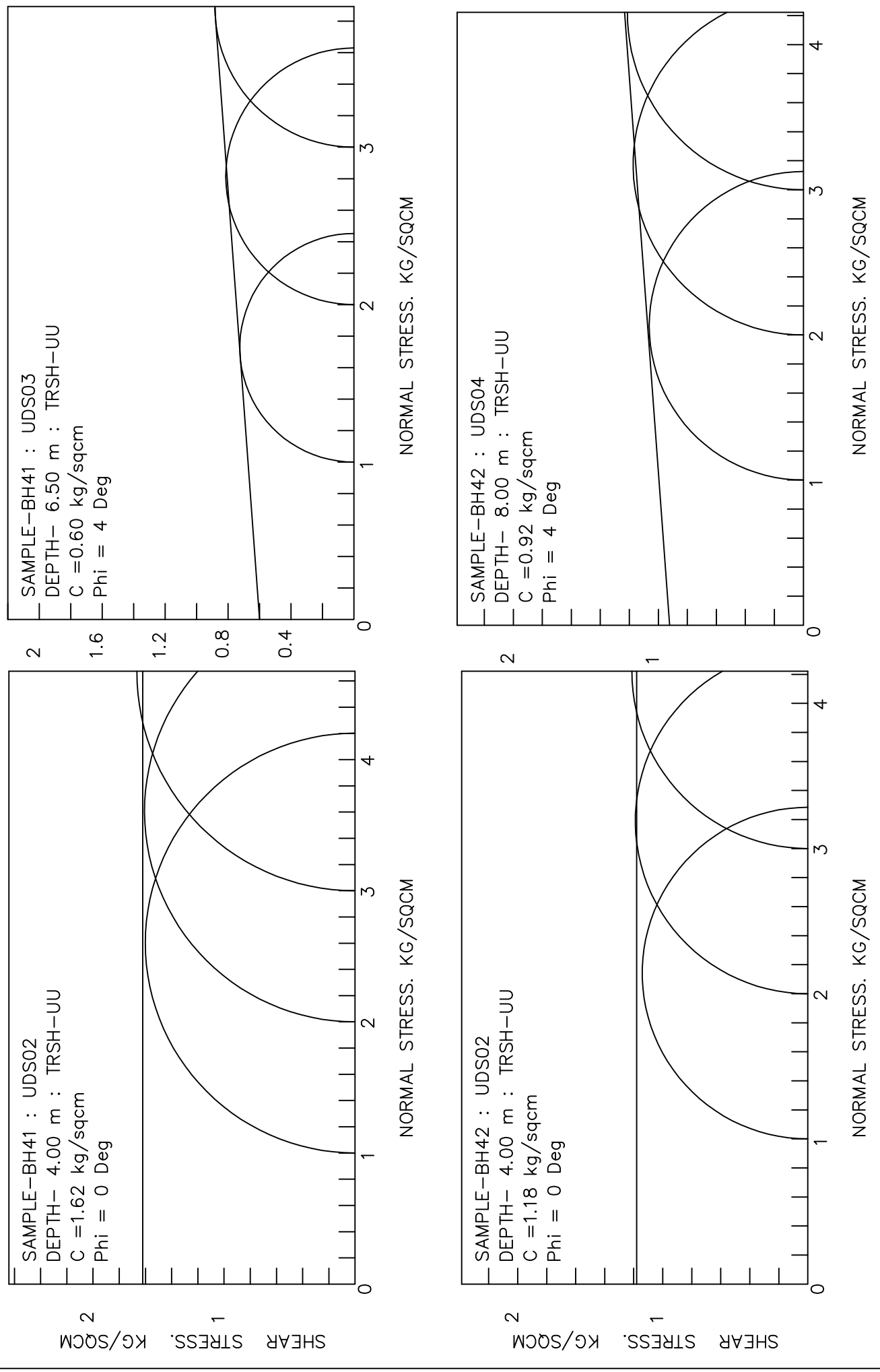

SAMPLE-BH26 : UDS03
DEPTH- 6.50 m : TRSH-UU
C =1.25 kg/sqcm
Phi = 0 Deg
NORMAL STRESS. KG/SQCM

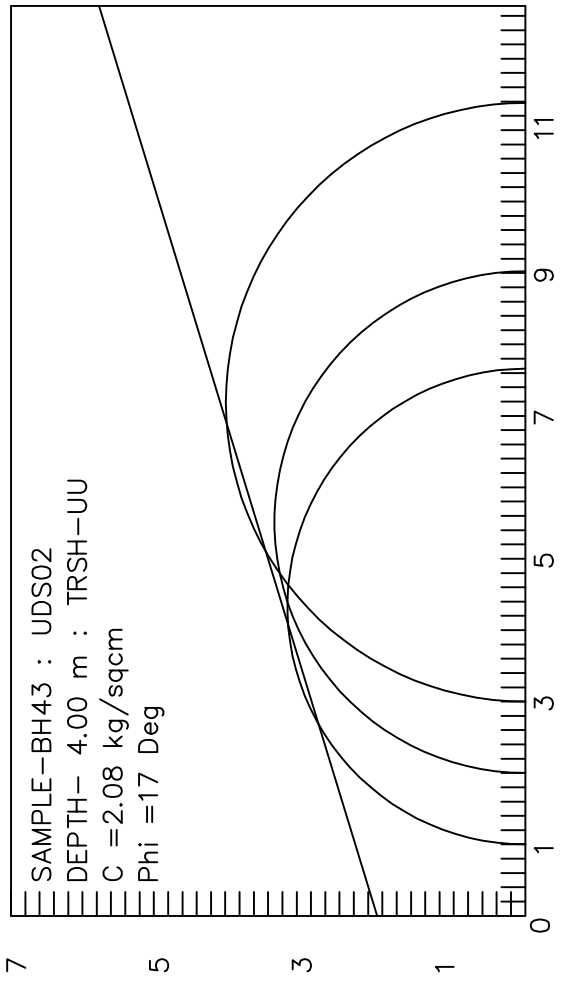

SAMPLE-BH32 : UDS04
DEPTH- 9.50 m : TRSH-UU
C =1.24 kg/sqcm
Phi = 6 Deg
NORMAL STRESS. KG/SQCM

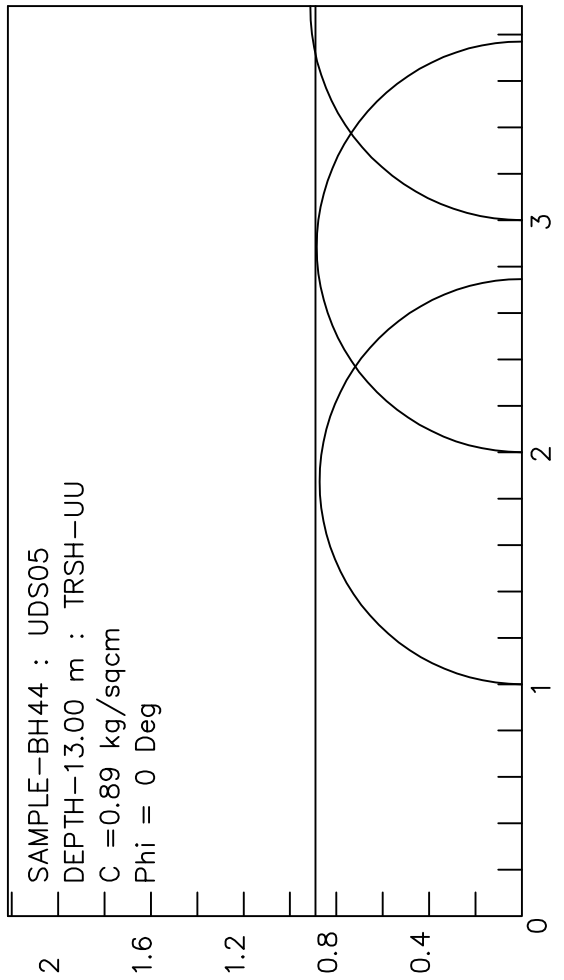

SAMPLE-BH24 : UDS03
DEPTH- 6.50 m : TRSH-UU
C =0.59 kg/sqcm
Phi =16 Deg
SHEAR STRESS. KG/SQCM
NORMAL STRESS. KG/SQCM

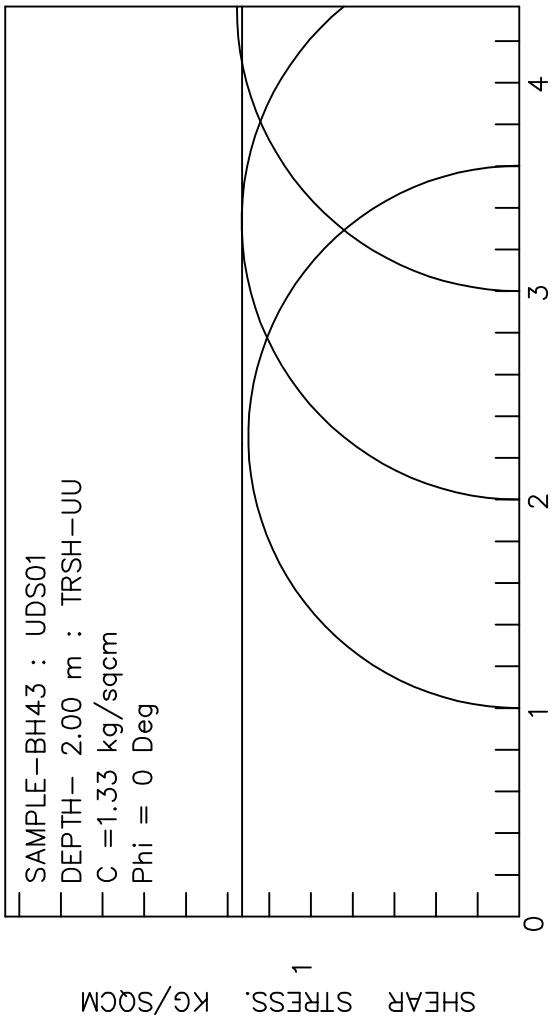

SAMPLE-BH29 : UDS04
DEPTH- 9.50 m : TRSH-UU
C =2.19 kg/sqcm
Phi = 6 Deg
SHEAR STRESS. KG/SQCM
NORMAL STRESS. KG/SQCM

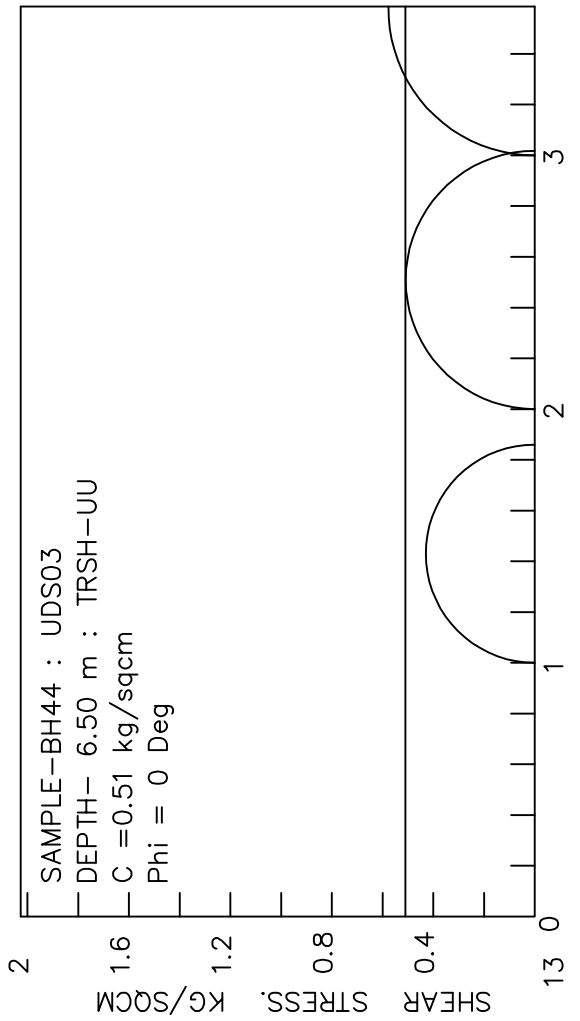

SAMPLE-BH39 : UDS01
DEPTH- 2.00 m : TRSH-UU
C =0.72 kg/sqcm
Phi =11 Deg
NORMAL STRESS. KG/SQCM
SAMPLE-BH39 : UDS03
DEPTH- 6.50 m : TRSH-UU
C =1.12 kg/sqcm
Phi =11 Deg
NORMAL STRESS. KG/SQCM
SAMPLE-BH35 : UDS03
DEPTH- 6.50 m : TRSH-UU
C =1.03 kg/sqcm
Phi =12 Deg
NORMAL STRESS. KG/SQCM
SAMPLE-BH39 : UDS02
DEPTH- 4.00 m : TRSH-UU
C =0.48 kg/sqcm
Phi = 0 Deg
NORMAL STRESS. KG/SQCM
SHEAR STRESS. KG/SQCM

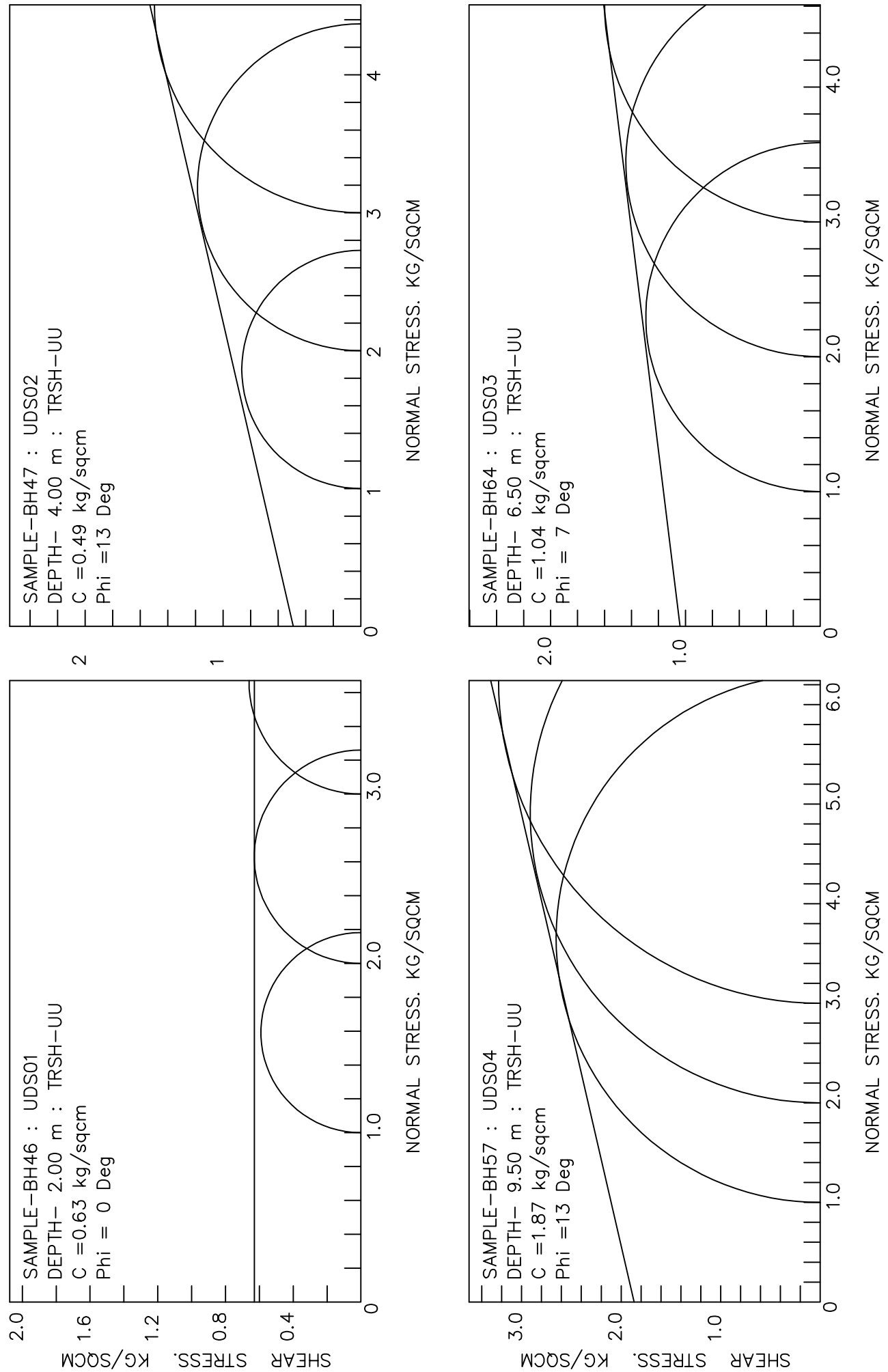

SAMPLE-BH41 : UDS03
DEPTH- 6.50 m : TRSH-UU
C =0.60 kg/sqcm
Phi = 4 Deg
SAMPLE-BH42 : UDS04
DEPTH- 8.00 m : TRSH-UU
C =0.92 kg/sqcm
Phi = 4 Deg
SAMPLE-BH41 : UDS02
DEPTH- 4.00 m : TRSH-UU
C =1.62 kg/sqcm
Phi = 0 Deg
SAMPLE-BH42 : UDS02
DEPTH- 4.00 m : TRSH-UU
C =1.18 kg/sqcm
Phi = 0 Deg
NORMAL STRESS. KG/SQCM
SHEAR STRESS. KG/SQCM

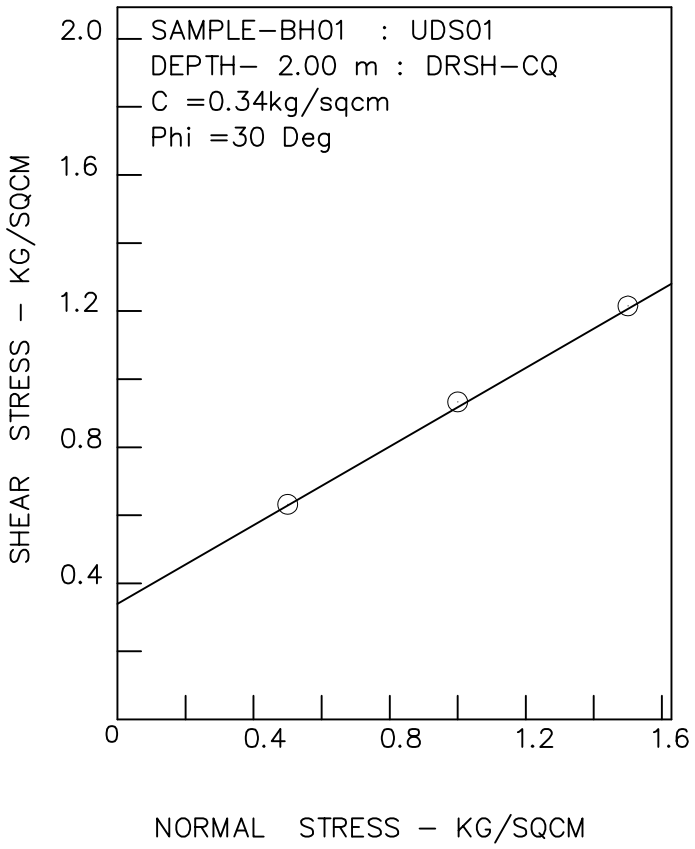

SAMPLE-BH43 : UDS02
DEPTH- 4.00 m : TRSH-UU
C =2.08 kg/sqcm
Phi =17 Deg
NORMAL STRESS. KG/SQCM
0
1
3
5
7
9
11

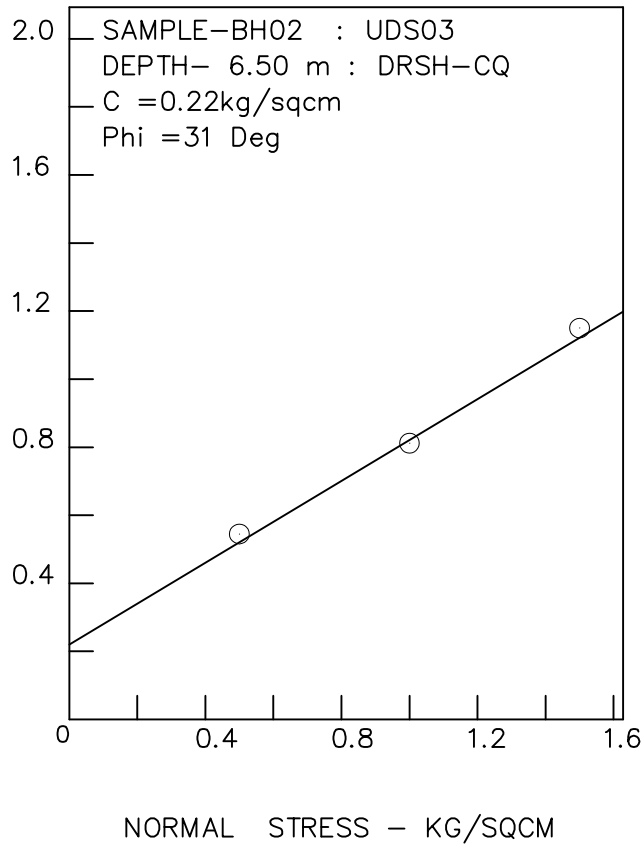

SAMPLE-BH44 : UDS05
DEPTH-13.00 m : TRSH-UU
C =0.89 kg/sqcm
Phi = 0 Deg
NORMAL STRESS. KG/SQCM
0
0.4
0.8
1.2
1.6
2
1
2
3

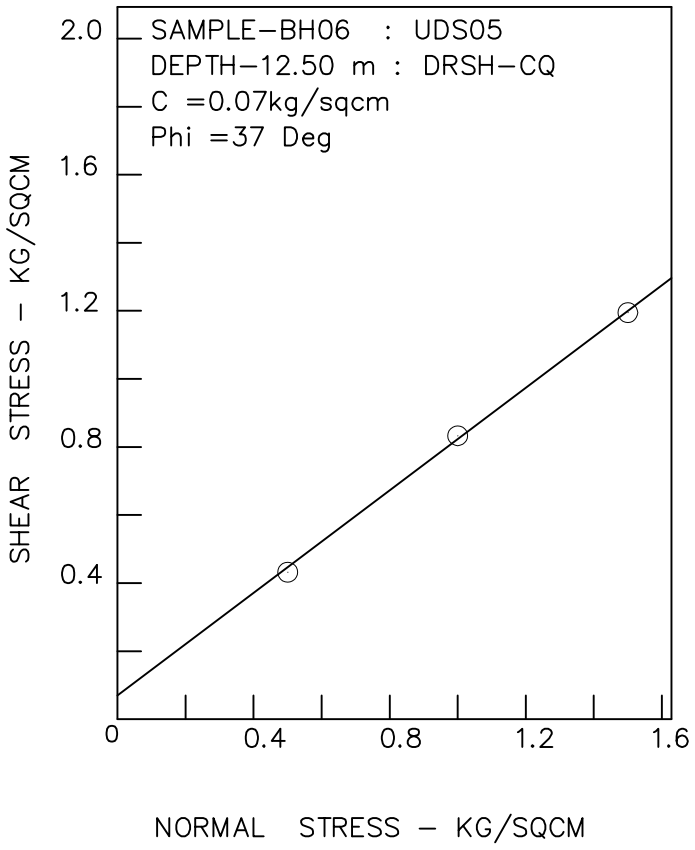

SAMPLE-BH43 : UDS01
DEPTH- 2.00 m : TRSH-UU
C =1.33 kg/sqcm
Phi = 0 Deg
NORMAL STRESS. KG/SQCM
SHEAR STRESS. KG/SQCM
0
1
2
3
4

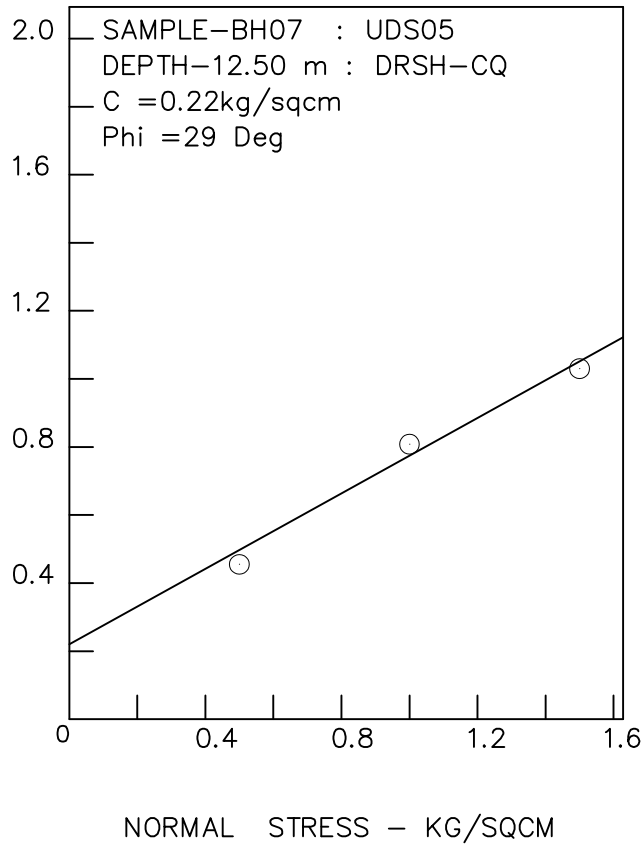

SAMPLE-BH44 : UDS03
DEPTH- 6.50 m : TRSH-UU
C =0.51 kg/sqcm
Phi = 0 Deg
NORMAL STRESS. KG/SQCM
SHEAR STRESS. KG/SQCM
0
0.4
0.8
1.2
1.6
2
1
2
3

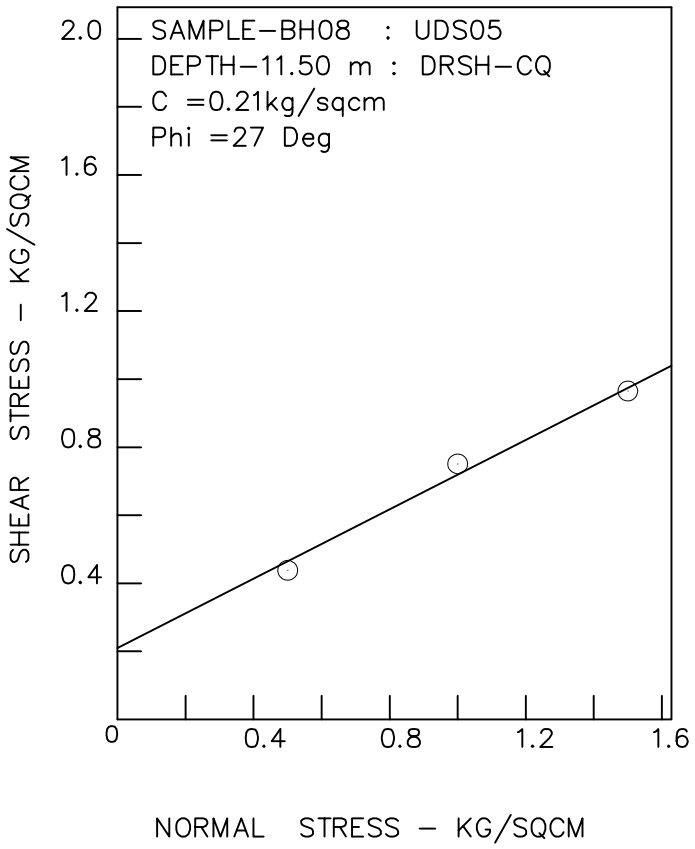

SAMPLE-BH46 : UDS01
DEPTH- 2.00 m : TRSH-UU
C =0.63 kg/sqcm
Phi = 0 Deg
SHEAR STRESS. KG/SQCM
NORMAL STRESS. KG/SQCM
SAMPLE-BH47 : UDS02
DEPTH- 4.00 m : TRSH-UU
C =0.49 kg/sqcm
Phi =13 Deg
NORMAL STRESS. KG/SQCM
SAMPLE-BH57 : UDS04
DEPTH- 9.50 m : TRSH-UU
C =1.87 kg/sqcm
Phi =13 Deg
SHEAR STRESS. KG/SQCM
NORMAL STRESS. KG/SQCM
SAMPLE-BH64 : UDS03
DEPTH- 6.50 m : TRSH-UU
C =1.04 kg/sqcm
Phi = 7 Deg
NORMAL STRESS. KG/SQCM

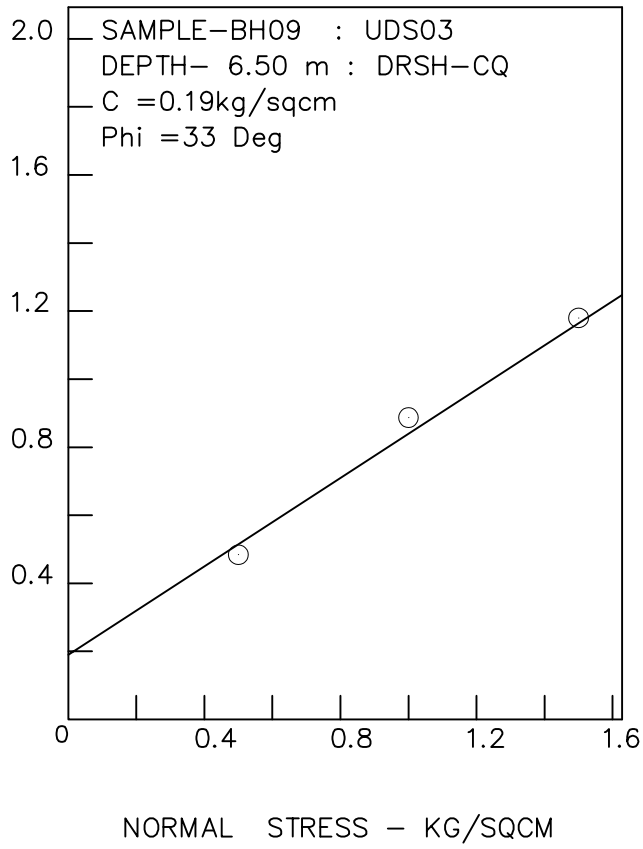

SAMPLE-BH01 : UDS01
DEPTH- 2.00 m : DRSH-CQ
C =0.34kg/sqcm
Phi =30 Deg
SHEAR STRESS - KG/SQCM
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

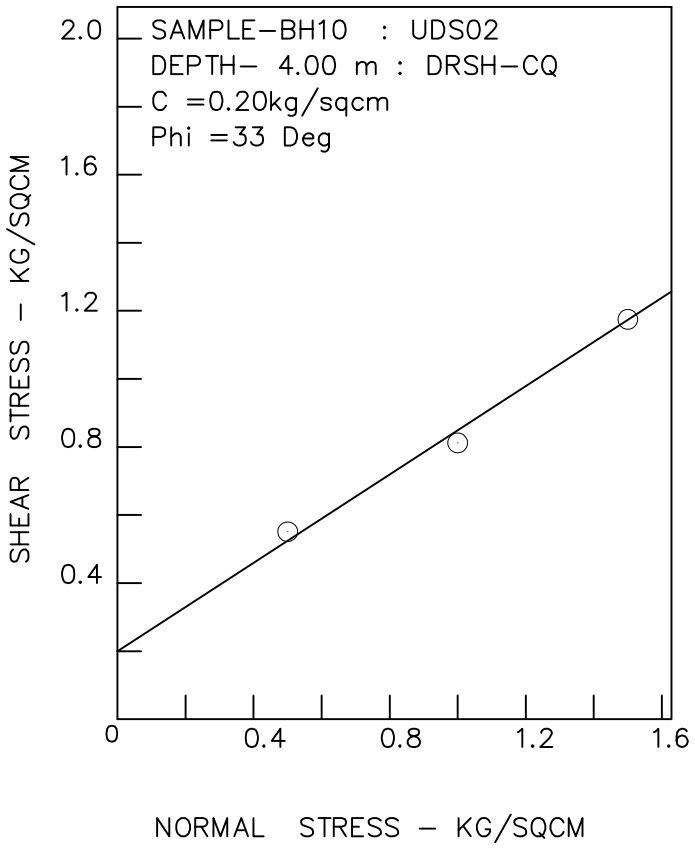

SAMPLE-BH02 : UDS03
DEPTH- 6.50 m : DRSH-CQ
C =0.22kg/sqcm
Phi =31 Deg
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

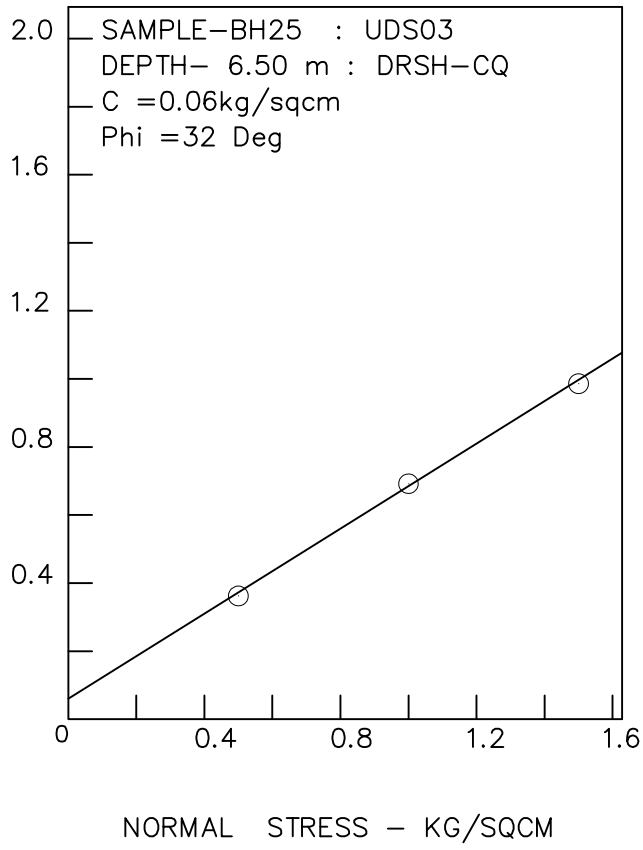

SAMPLE-BH06 : UDS05
DEPTH-12.50 m : DRSH-CQ
C =0.07kg/sqcm
Phi =37 Deg
SHEAR STRESS - KG/SQCM
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

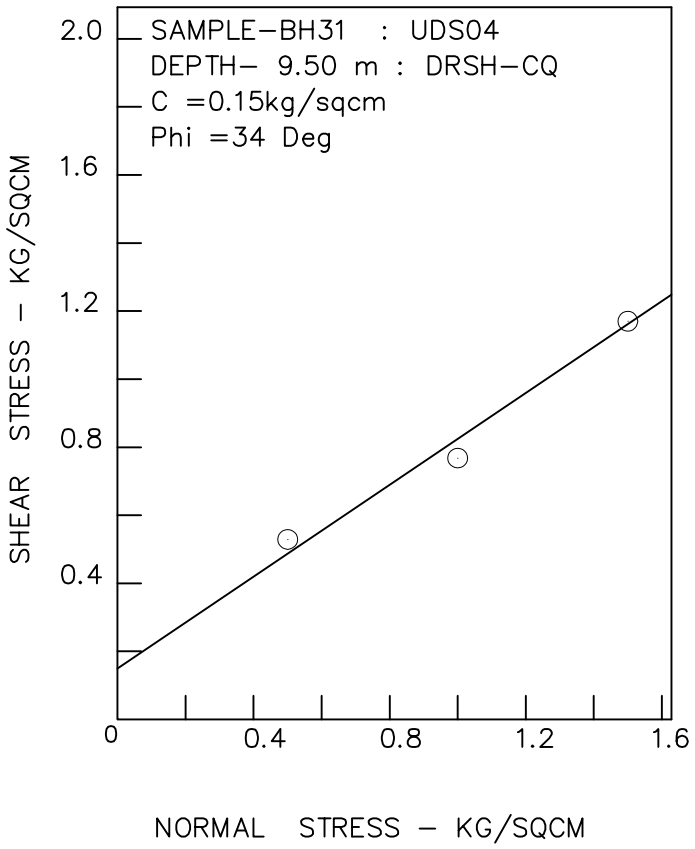

SAMPLE-BH07 : UDS05
DEPTH-12.50 m : DRSH-CQ
C =0.22kg/sqcm
Phi =29 Deg
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

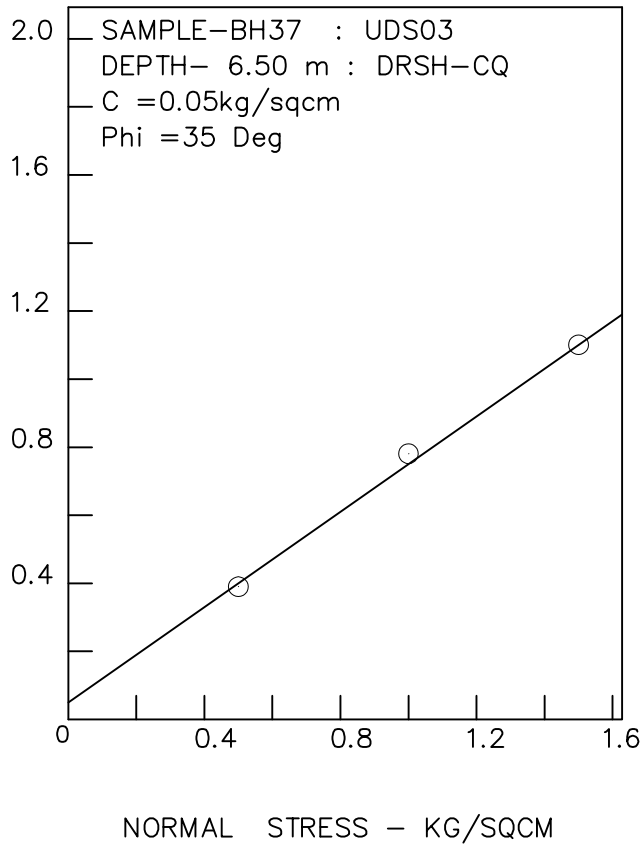

SAMPLE-BH08 : UDS05
DEPTH-11.50 m : DRSH-CQ
C =0.21kg/sqcm
Phi =27 Deg
SHEAR STRESS - KG/SQCM
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

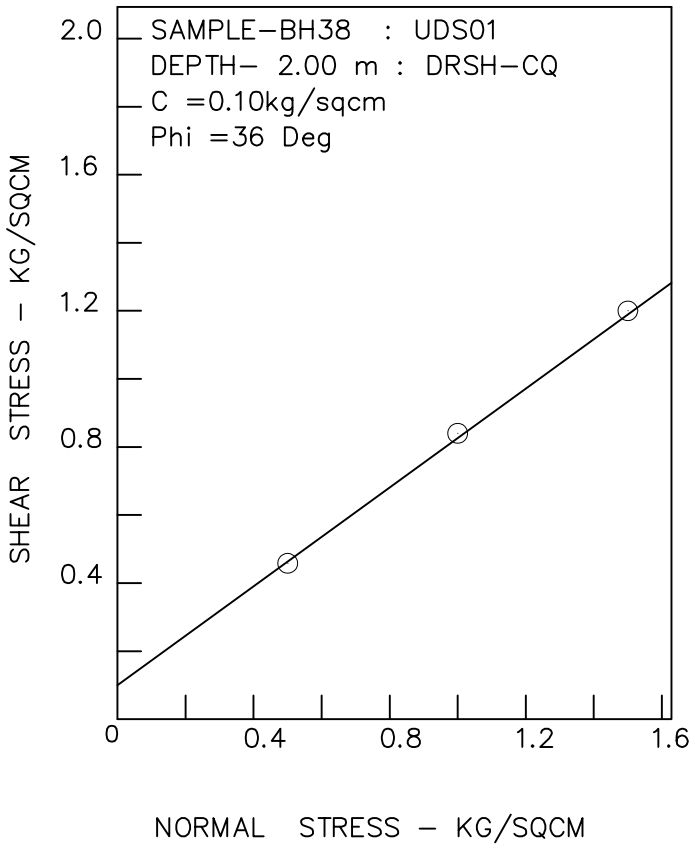

SAMPLE-BH09 : UDS03
DEPTH- 6.50 m : DRSH-CQ
C =0.19kg/sqcm
Phi =33 Deg
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

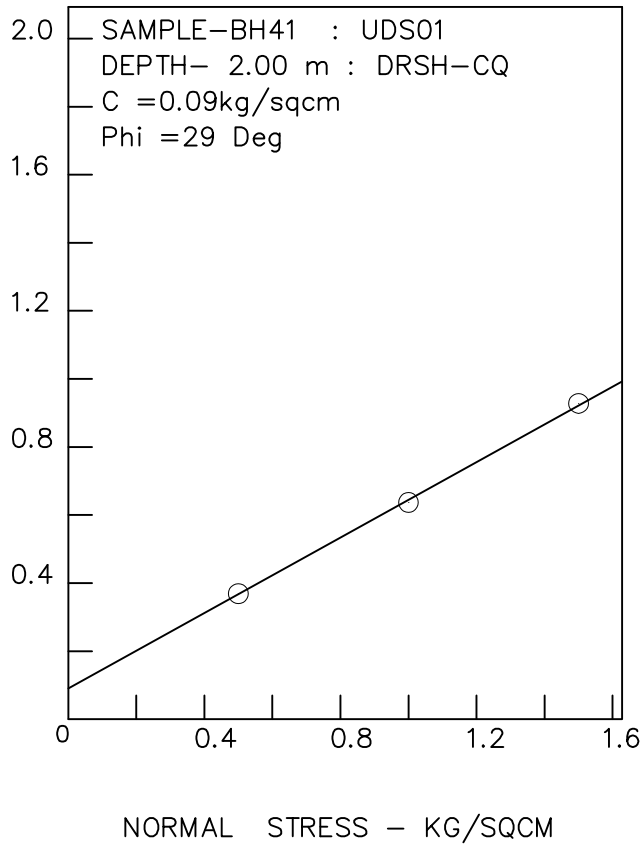

SAMPLE-BH10 : UDS02
DEPTH- 4.00 m : DRSH-CQ
C =0.20kg/sqcm
Phi =33 Deg
SHEAR STRESS - KG/SQCM
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

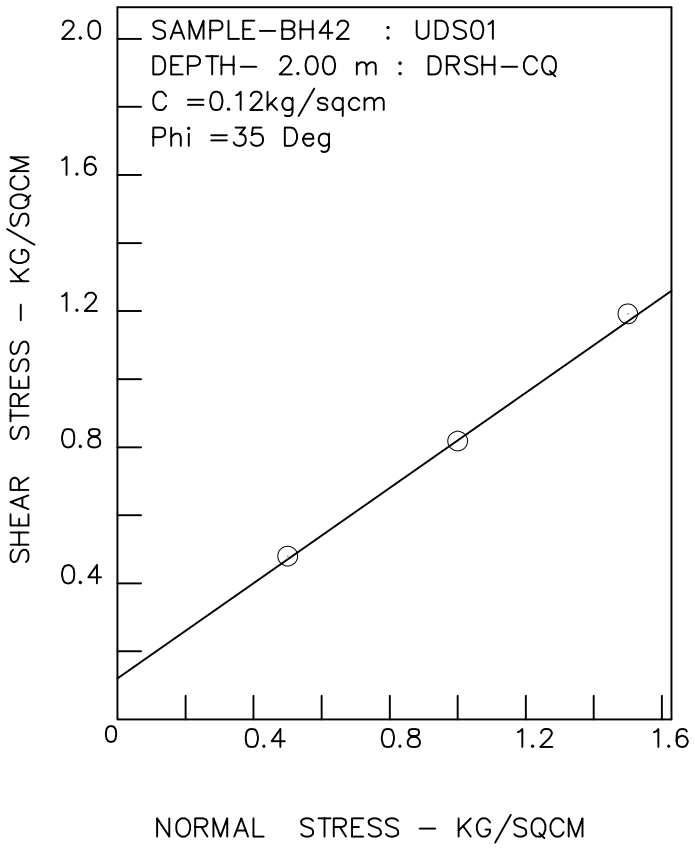

SAMPLE-BH25 : UDS03
DEPTH- 6.50 m : DRSH-CQ
C =0.06kg/sqcm
Phi =32 Deg
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

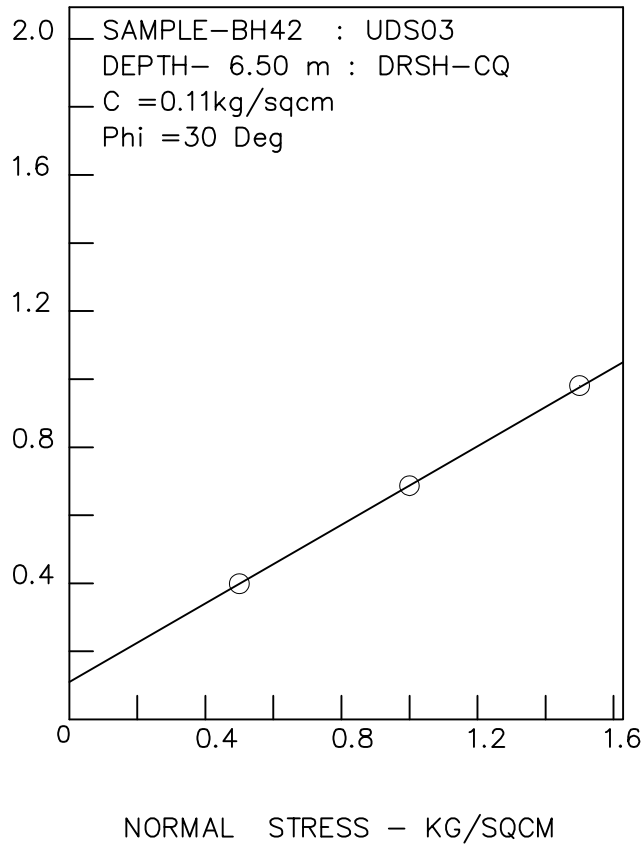

SAMPLE-BH31 : UDS04
DEPTH- 9.50 m : DRSH-CQ
C =0.15kg/sqcm
Phi =34 Deg
SHEAR STRESS - KG/SQCM
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

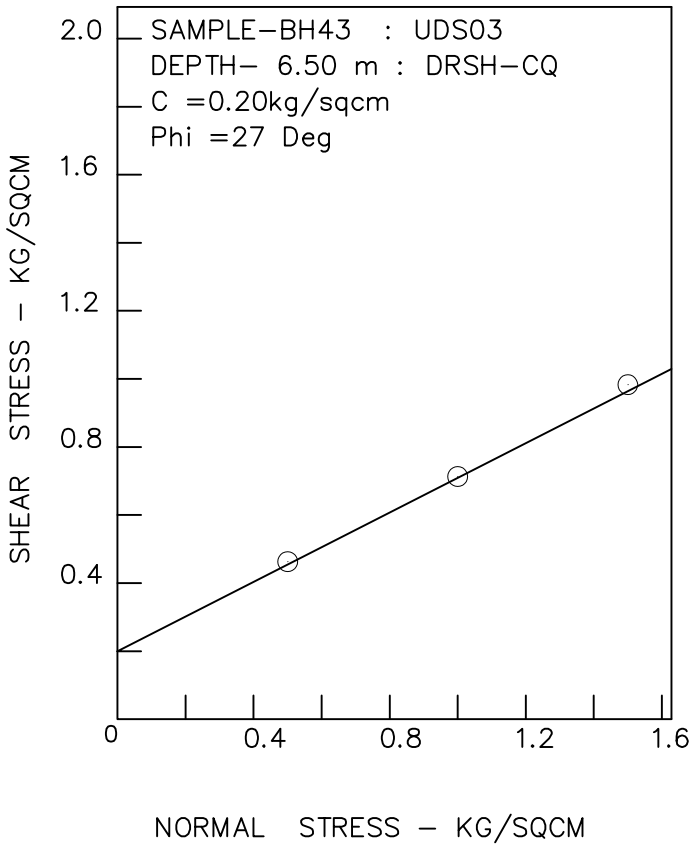

SAMPLE-BH37 : UDS03
DEPTH- 6.50 m : DRSH-CQ
C =0.05kg/sqcm
Phi =35 Deg
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

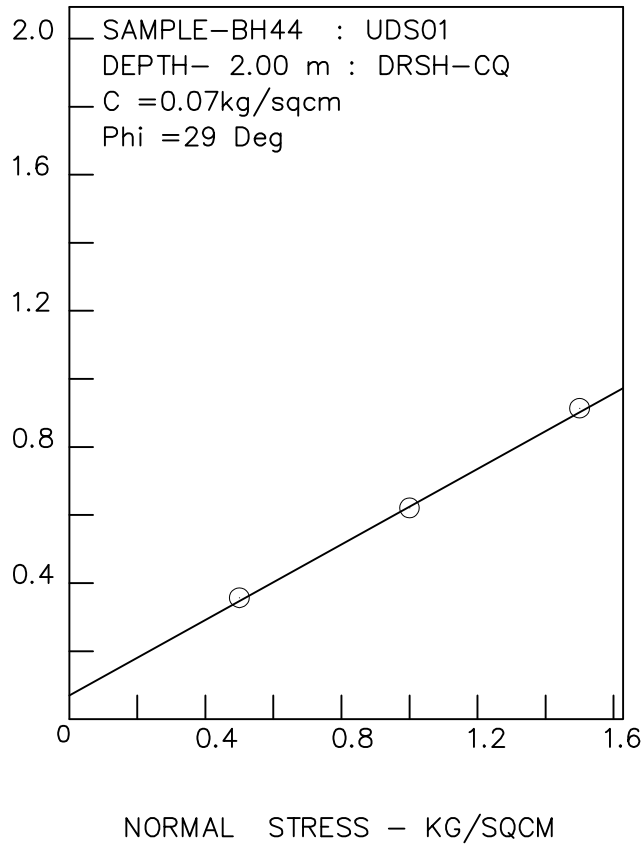

SAMPLE-BH38 : UDS01
DEPTH- 2.00 m : DRSH-CQ
C =0.10kg/sqcm
Phi =36 Deg
SHEAR STRESS - KG/SQCM
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

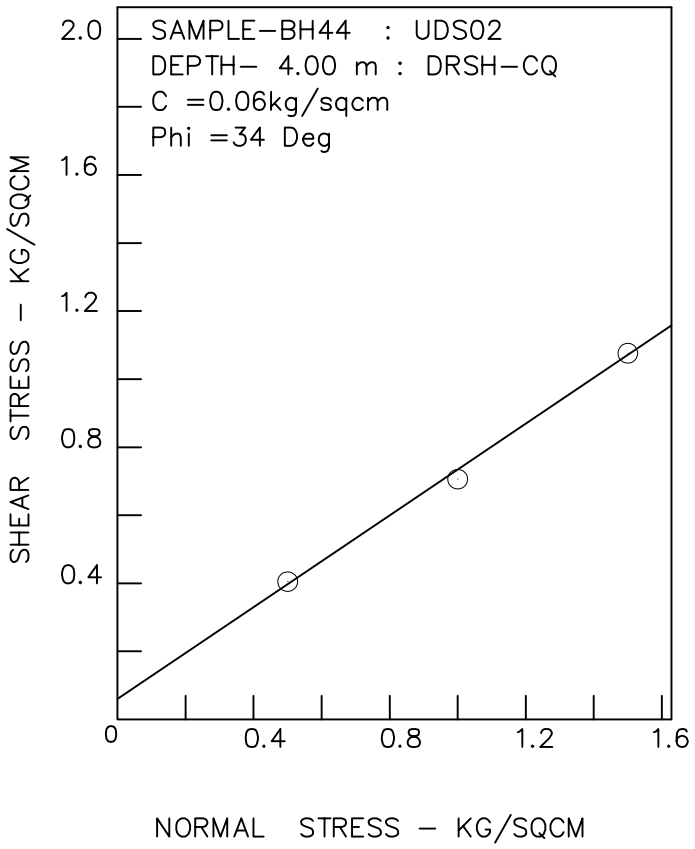

SAMPLE-BH41 : UDS01
DEPTH- 2.00 m : DRSH-CQ
C =0.09kg/sqcm
Phi =29 Deg
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

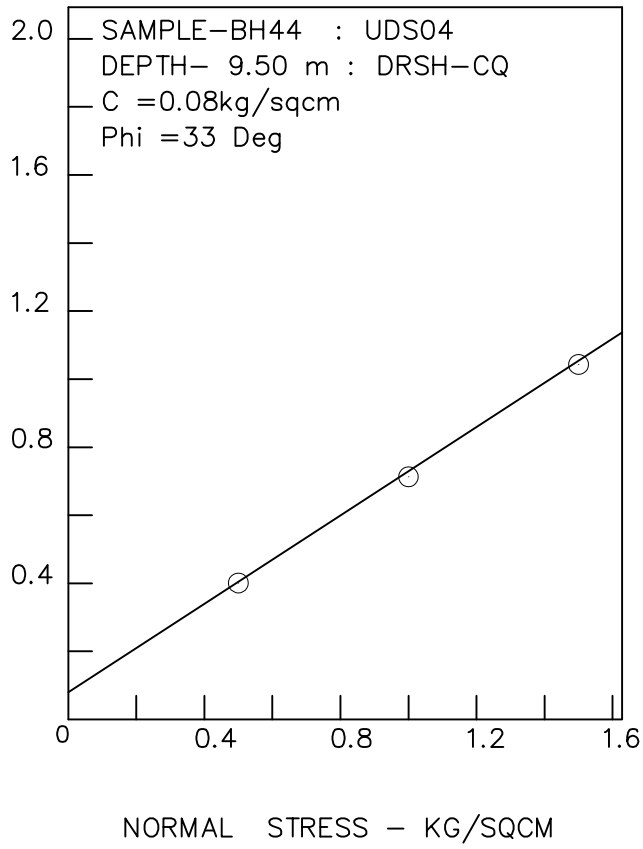

SAMPLE-BH42 : UDS01
DEPTH- 2.00 m : DRSH-CQ
C =0.12kg/sqcm
Phi =35 Deg
SHEAR STRESS - KG/SQCM
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

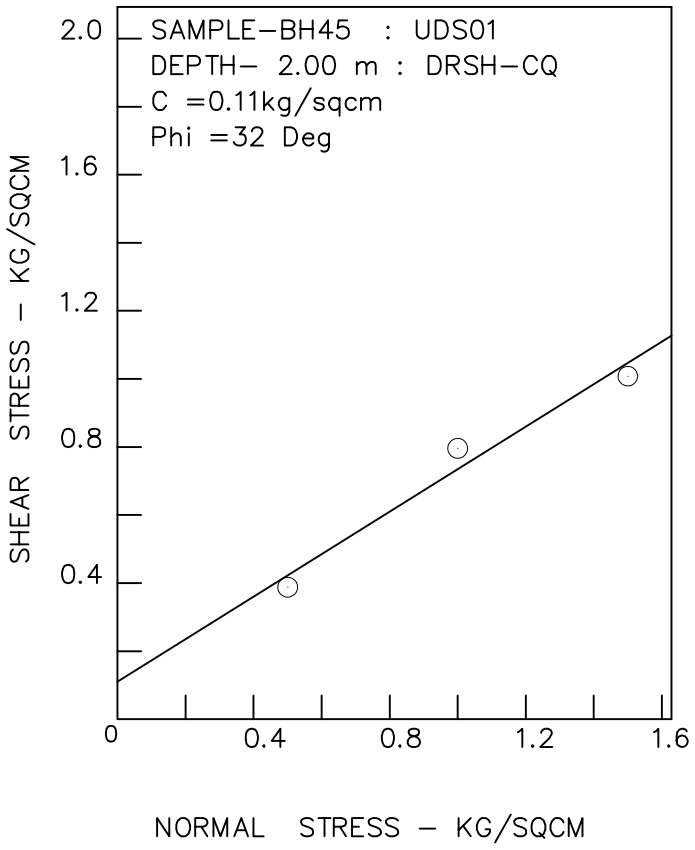

SAMPLE-BH42 : UDS03
DEPTH- 6.50 m : DRSH-CQ
C =0.11kg/sqcm
Phi =30 Deg
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

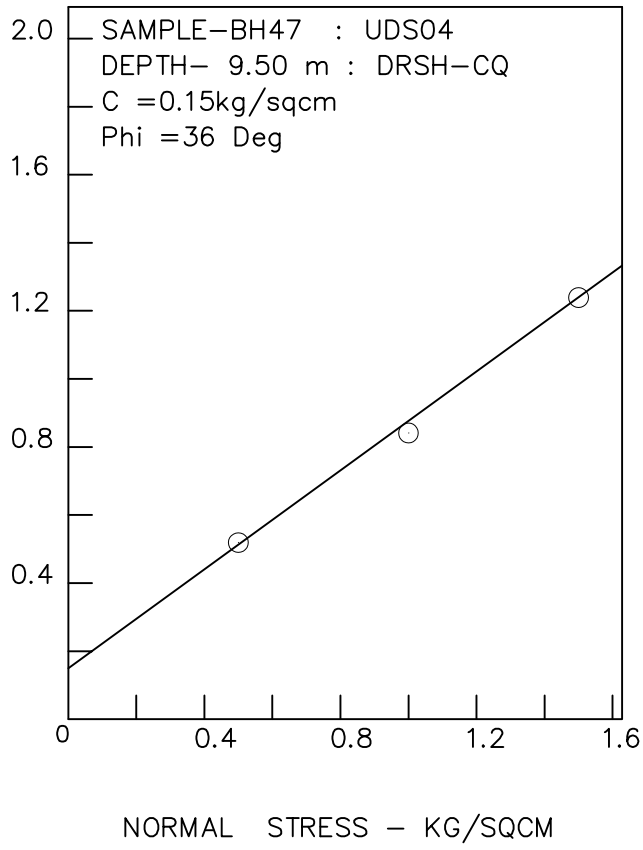

SAMPLE-BH43 : UDS03
DEPTH- 6.50 m : DRSH-CQ
C =0.20kg/sqcm
Phi =27 Deg
SHEAR STRESS - KG/SQCM
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

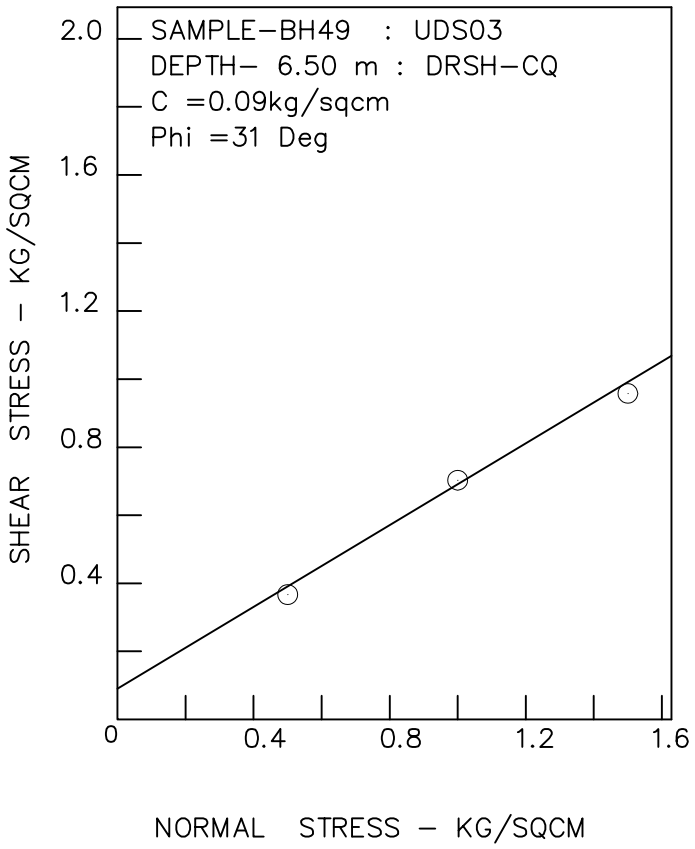

SAMPLE-BH44 : UDS01
DEPTH- 2.00 m : DRSH-CQ
C =0.07kg/sqcm
Phi =29 Deg
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

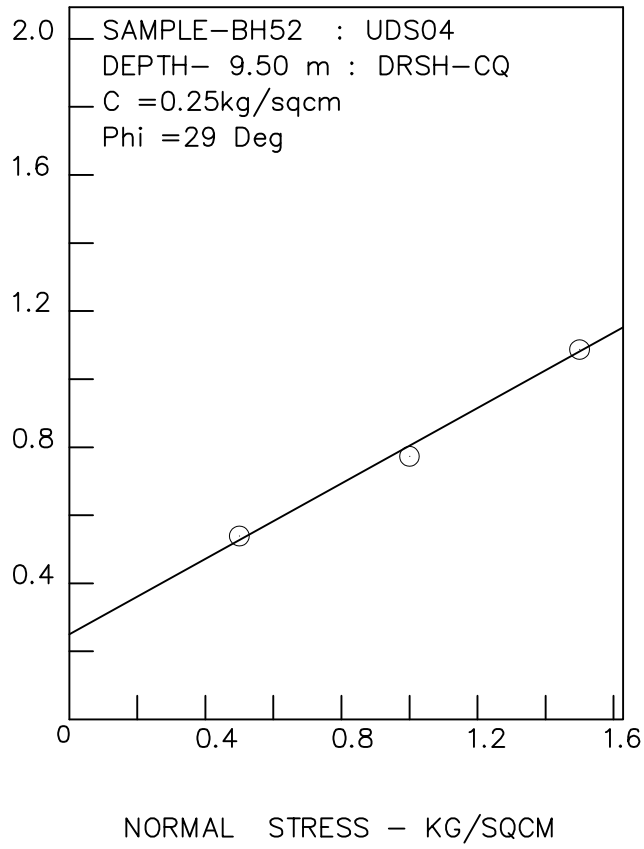

SAMPLE-BH44 : UDS02
DEPTH- 4.00 m : DRSH-CQ
C =0.06kg/sqcm
Phi =34 Deg
SHEAR STRESS - KG/SQCM
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

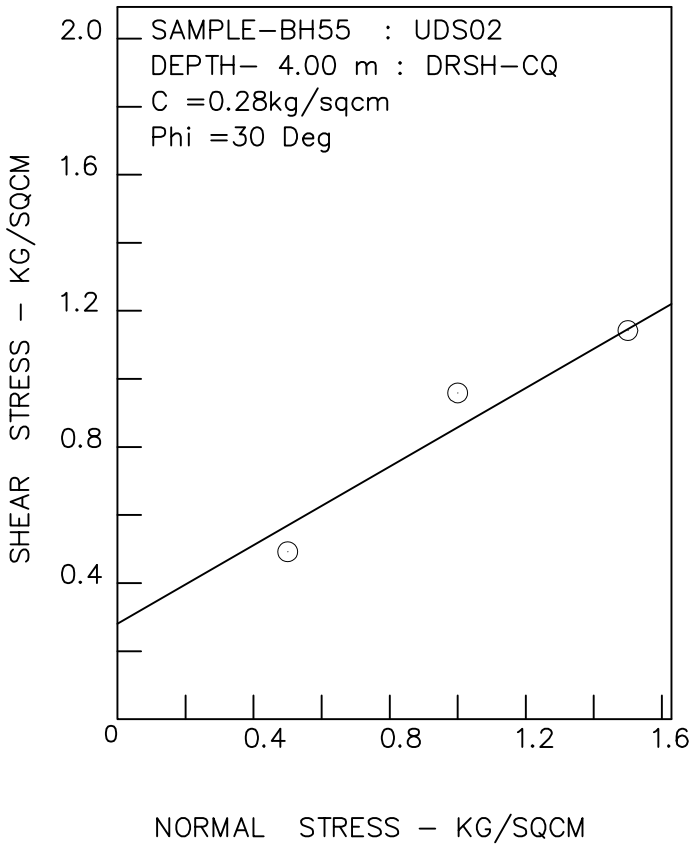

SAMPLE-BH44 : UDS04
DEPTH- 9.50 m : DRSH-CQ
C =0.08kg/sqcm
Phi =33 Deg
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

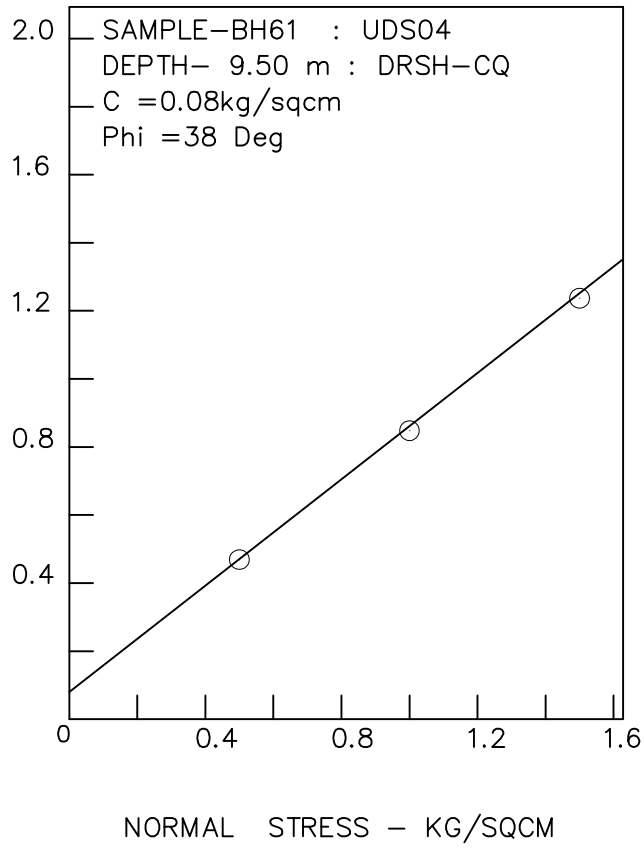

SAMPLE-BH45 : UDS01
DEPTH- 2.00 m : DRSH-CQ
C =0.11kg/sqcm
Phi =32 Deg
SHEAR STRESS - KG/SQCM
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0

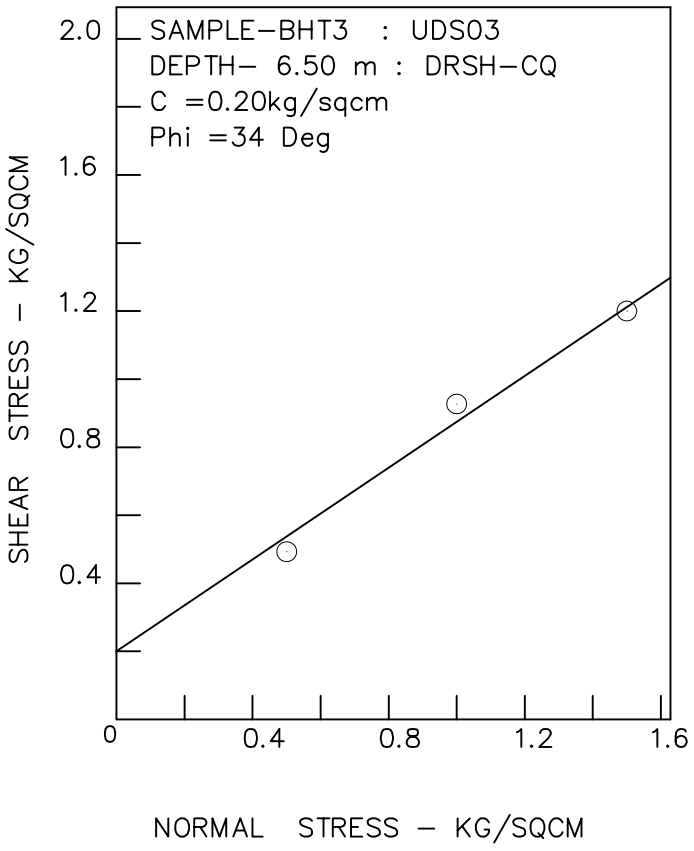

SAMPLE-BH47 : UDS04
DEPTH- 9.50 m : DRSH-CQ
C =0.15kg/sqcm
Phi =36 Deg
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0


SAMPLE-BH49 : UDS03
DEPTH- 6.50 m : DRSH-CQ
C =0.09kg/sqcm
Phi =31 Deg
SHEAR STRESS - KG/SQCM
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0


SAMPLE-BH52 : UDS04
DEPTH- 9.50 m : DRSH-CQ
C =0.25kg/sqcm
Phi =29 Deg
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0


SAMPLE-BH55 : UDS02
DEPTH- 4.00 m : DRSH-CQ
C =0.28kg/sqcm
Phi =30 Deg
SHEAR STRESS - KG/SQCM
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0


SAMPLE-BH61 : UDS04
DEPTH- 9.50 m : DRSH-CQ
C =0.08kg/sqcm
Phi =38 Deg
NORMAL STRESS - KG/SQCM
0
0.4
0.8
1.2
1.6
2.0


SAMPLE-BHT3 : UDS03
DEPTH- 6.50 m : DRSH-CQ
C =0.20kg/sqcm
Phi =34 Deg
SHEAR STRESS - KG/SQCM
2.0
1.6
1.2
0.8
0.4
0
0.4
0.8
1.2
1.6
NORMAL STRESS - KG/SQCM

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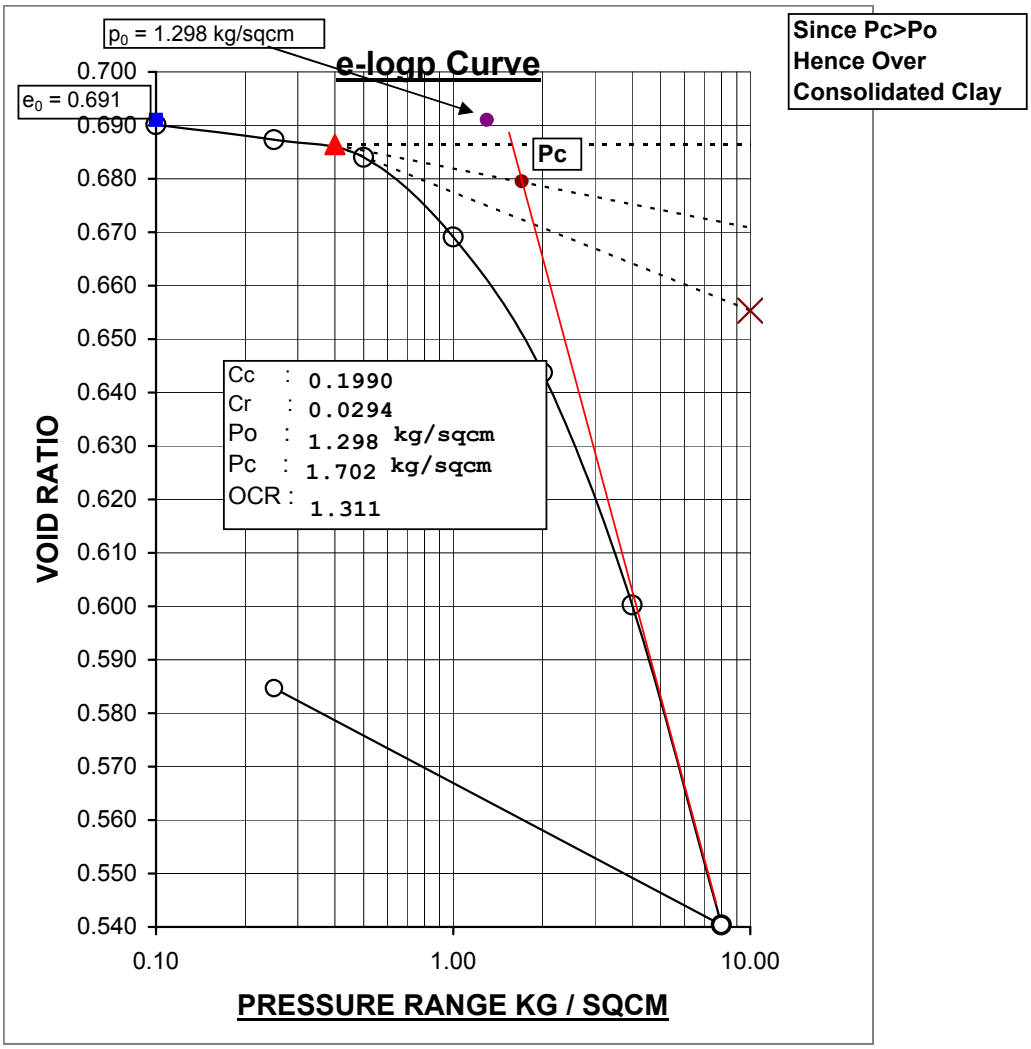
CONSOLIDATION TEST RESULTS

Sample Number:BH-04/UDS-03 Depth :6.5-6.95 meters
Description :Deep brown silty clay with traces of kankars.
Water content:Initial=25.3% Final =26% Initial Void Ratio =0.691

P1-P2 Kg/Sqcm	Dial Change	Void Ratio	Mv Sqcm/kg	Comprn %	Mvc sqcm/kg	T90 Sec	1000.Cv sqcm/sec
0.00 - 0.10	3	0.690	0.0031				
0.10 - 0.25	16	0.687	0.0111	56.25	0.0048	146.0	5.384
0.25 - 0.50	19	0.684	0.0079	57.89	0.0033	112.5	6.937
0.50 - 1.00	85	0.669	0.0177	31.76	0.0121	126.2	6.053
1.00 - 2.00	145	0.644	0.0152	46.21	0.0082	126.2	5.763
2.00 - 4.00	248	0.600	0.0132	48.79	0.0068	155.5	4.286
4.00 - 8.00	342	0.540	0.0094	41.23	0.0055	317.4	1.830
8.00 - 0.25	253	0.585	0.0037				



Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	CETEST
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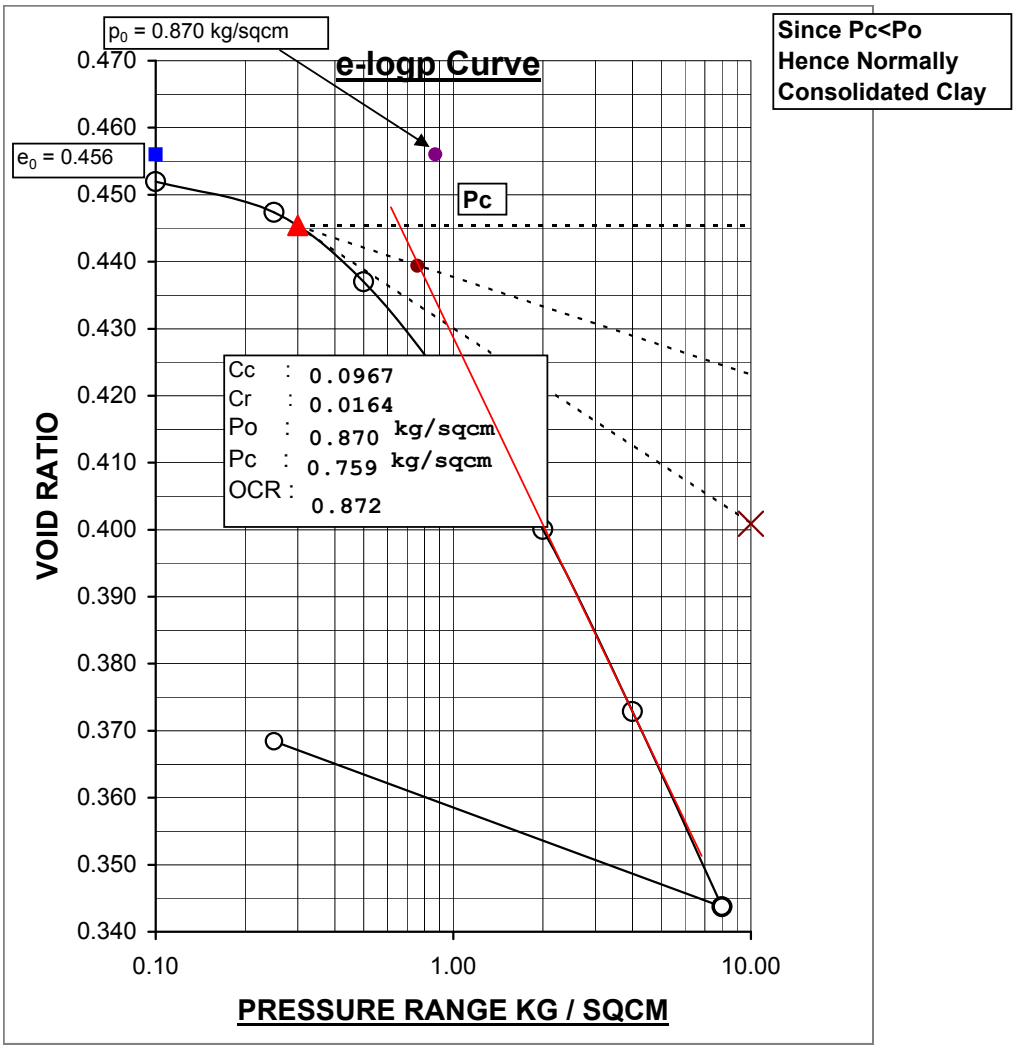
CONSOLIDATION TEST RESULTS

Sample Number:BH-06/UDS-02 Depth :4-4.45 meters
Description :Brownish grey clayey silt with traces of sand mixtures.
Water content:Initial=13.3% Final =15.8% Initial Void Ratio =0.456

P1-P2 Kg/Sqcm	Dial Change	Void Ratio	Mv Sqcm/kg	Comprn %	Mvc sqcm/kg	T90 Sec	1000.Cv sqcm/sec
0.00 - 0.10	29	0.452	0.0294				
0.10 - 0.25	31	0.447	0.0210	41.38	0.0123	220.4	3.666
0.25 - 0.50	70	0.437	0.0286	35.71	0.0184	267.1	2.962
0.50 - 1.00	113	0.420	0.0233	59.29	0.0095	161.4	4.720
1.00 - 2.00	137	0.400	0.0143	39.42	0.0086	118.5	6.093
2.00 - 4.00	184	0.373	0.0097	55.98	0.0043	103.0	6.532
4.00 - 8.00	197	0.344	0.0053	64.47	0.0019	103.5	5.954
8.00 - 0.25	167	0.368	0.0024				



Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	CETEST
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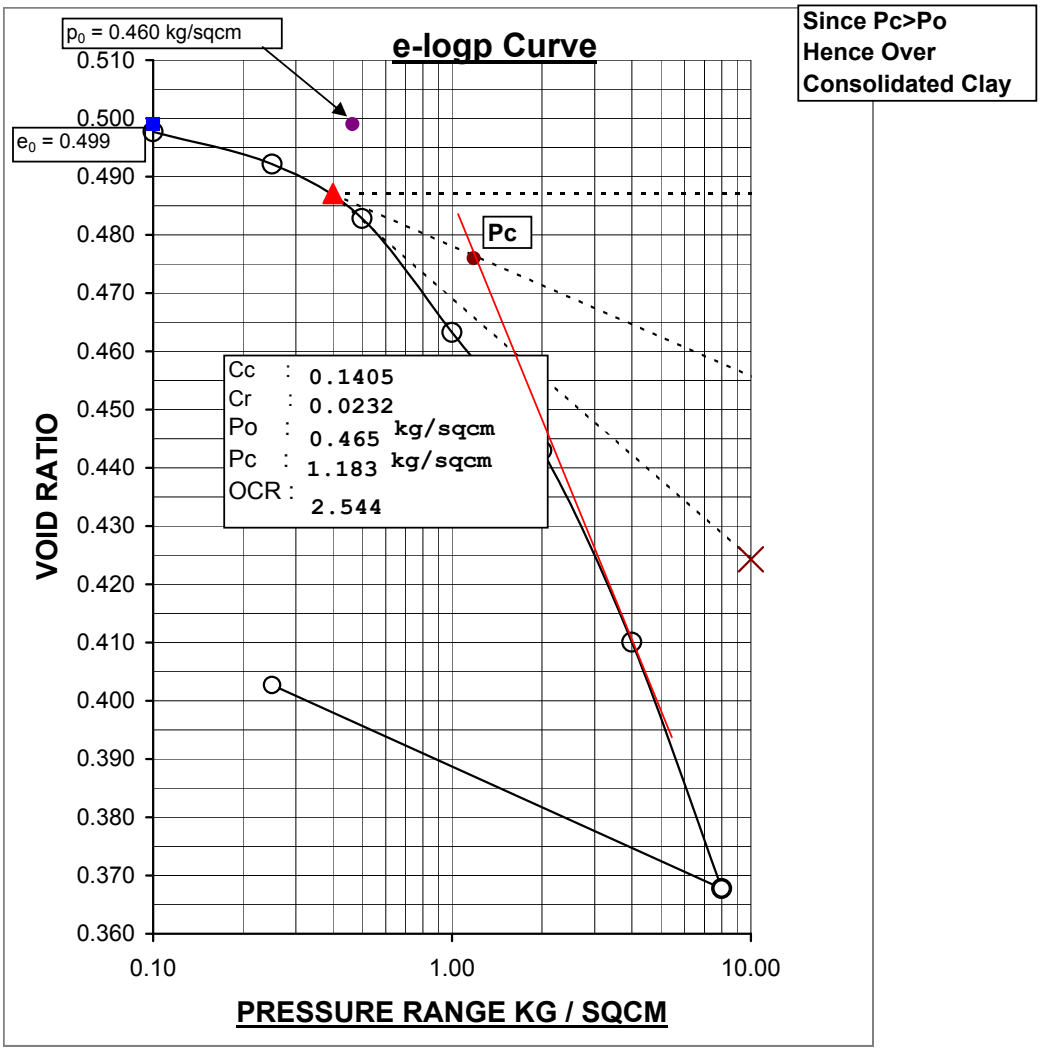
CONSOLIDATION TEST RESULTS

Sample Number:BH-09/UDS-01 Depth :2-2.45 meters
Description :Brownish grey clayey silt with traces of sand mixtures.
Water content:Initial=17% Final =17.7% Initial Void Ratio =0.499

P1-P2 Kg/Sqcm	Dial Change	Void Ratio	Mv Sqcm/kg	Comprn %	Mvc sqcm/kg	T90 Sec	1000.Cv sqcm/sec
0.00 - 0.10	10	0.498	0.0103				
0.10 - 0.25	36	0.492	0.0246	38.89	0.0151	214.4	3.717
0.25 - 0.50	61	0.483	0.0251	36.07	0.0161	163.7	4.771
0.50 - 1.00	127	0.463	0.0263	59.06	0.0108	173.4	4.329
1.00 - 2.00	132	0.443	0.0139	34.09	0.0091	119.3	5.952
2.00 - 4.00	214	0.410	0.0114	43.46	0.0064	117.6	5.589
4.00 - 8.00	275	0.368	0.0075	45.09	0.0041	117.6	4.986
8.00 - 0.25	227	0.403	0.0033				



Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	CETEST
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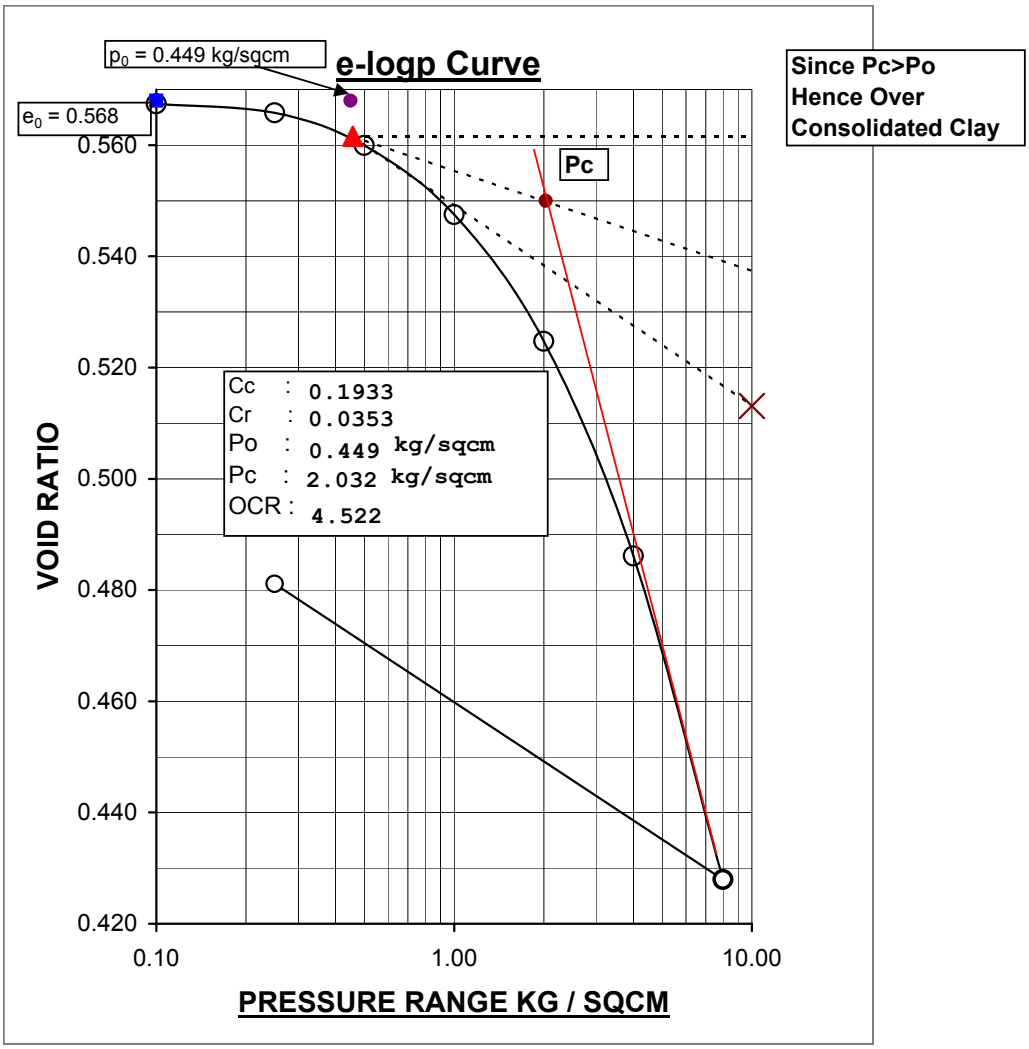
CONSOLIDATION TEST RESULTS

Sample Number:BH-11/UDS-01 Depth :2-2.45 meters
Description :Deep brown silty clay
Water content:Initial=21.6% Final =21.5% Initial Void Ratio =0.568

P1-P2 Kg/Sqcm	Dial Change	Void Ratio	Mv Sqcm/kg	Comprn %	Mvc sqcm/kg	T90 Sec	1000.Cv sqcm/sec
0.00 - 0.10	2	0.567	0.0021				
0.10 - 0.25	10	0.566	0.0069	20.00	0.0055	106.5	7.470
0.25 - 0.50	36	0.560	0.0149	38.89	0.0091	111.4	7.074
0.50 - 1.00	77	0.548	0.0160	36.36	0.0102	103.0	7.475
1.00 - 2.00	141	0.525	0.0147	39.72	0.0089	106.1	6.924
2.00 - 4.00	239	0.486	0.0127	46.44	0.0068	124.4	5.434
4.00 - 8.00	360	0.428	0.0098	38.06	0.0061	101.2	5.814
8.00 - 0.25	329	0.481	0.0048				



Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	CETEST
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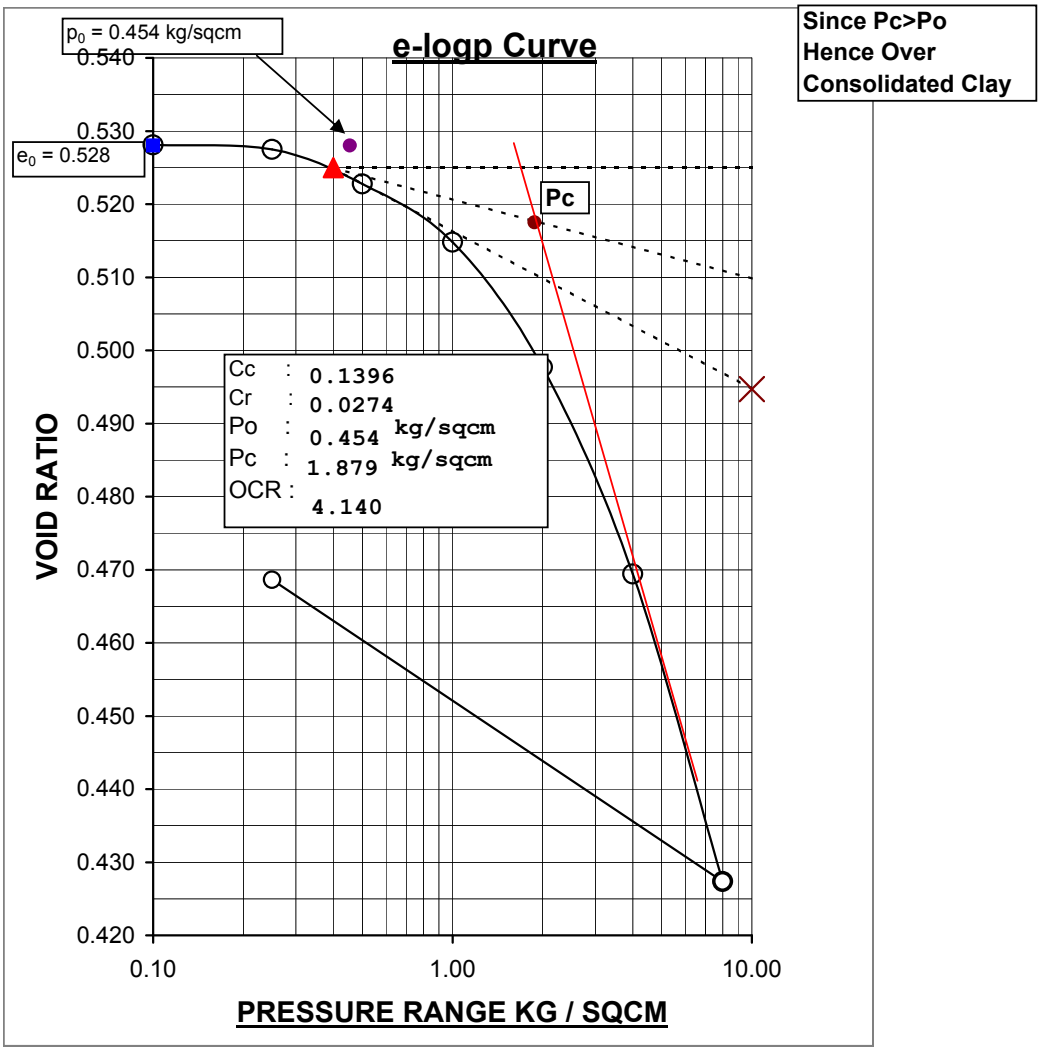
CONSOLIDATION TEST RESULTS

Sample Number:BH-22/UDS-01 Depth :2-2.45 meters
Description :Brownish grey silty clay with traces of kankars.
Water content:Initial=20% Final =21.3% Initial Void Ratio =0.528

P1-P2 Kg/Sqcm	Dial Change	Void Ratio	Mv Sqcm/kg	Comprn %	Mvc sqcm/kg	T90 Sec	1000.Cv sqcm/sec
0.00 - 0.10	2	0.528	0.0020				
0.10 - 0.25	4	0.527	0.0027				
0.25 - 0.50	31	0.523	0.0124	12.90	0.0108	227.7	3.692
0.50 - 1.00	52	0.515	0.0104	36.54	0.0066	181.7	4.551
1.00 - 2.00	112	0.498	0.0113	39.29	0.0069	126.2	6.338
2.00 - 4.00	185	0.469	0.0094	40.54	0.0056	117.6	6.389
4.00 - 8.00	275	0.427	0.0072	29.45	0.0050	115.9	5.863
8.00 - 0.25	270	0.469	0.0037				



Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	CETEST
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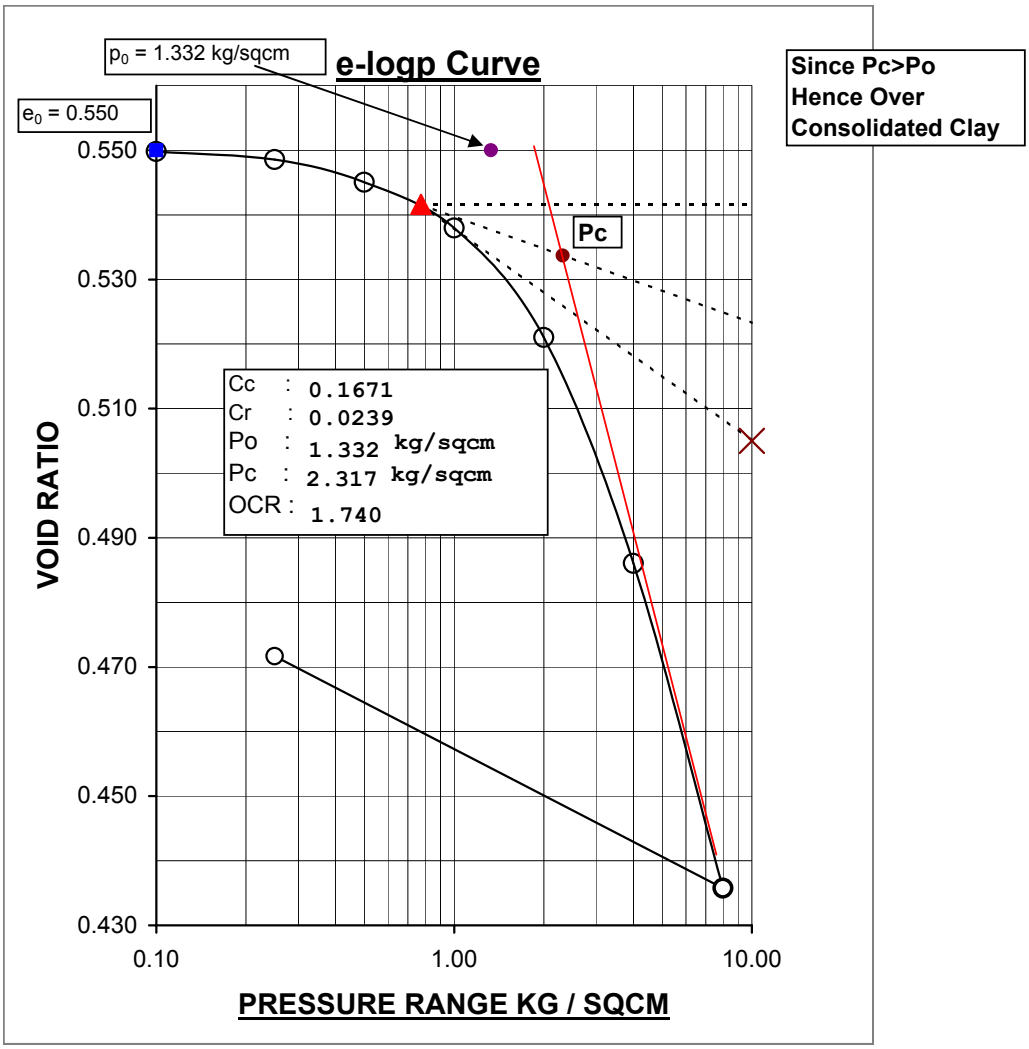
CONSOLIDATION TEST RESULTS

Sample Number:BH-26/UDS-03 Depth :6.5-6.95 meters
Description :Deep brown silty clay with traces of sand mixtures.
Water content:Initial=23.5% Final =22.8% Initial Void Ratio =0.55

P1-P2 Kg/Sqcm	Dial Change	Void Ratio	Mv Sqcm/kg	Comprn %	Mvc sqcm/kg	T90 Sec	1000.Cv sqcm/sec
0.00 - 0.10	3	0.550	0.0031				
0.10 - 0.25	8	0.549	0.0054	12.50	0.0048	182.5	4.450
0.25 - 0.50	22	0.545	0.0090	22.22	0.0070	145.6	5.543
0.50 - 1.00	45	0.538	0.0092	31.11	0.0063	163.4	4.873
1.00 - 2.00	107	0.521	0.0110	29.91	0.0077	187.5	4.114
2.00 - 4.00	221	0.486	0.0115	29.86	0.0081	149.6	4.807
4.00 - 8.00	318	0.436	0.0085	20.13	0.0068	181.2	3.518
8.00 - 0.25	227	0.472	0.0032				



Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	CETEST
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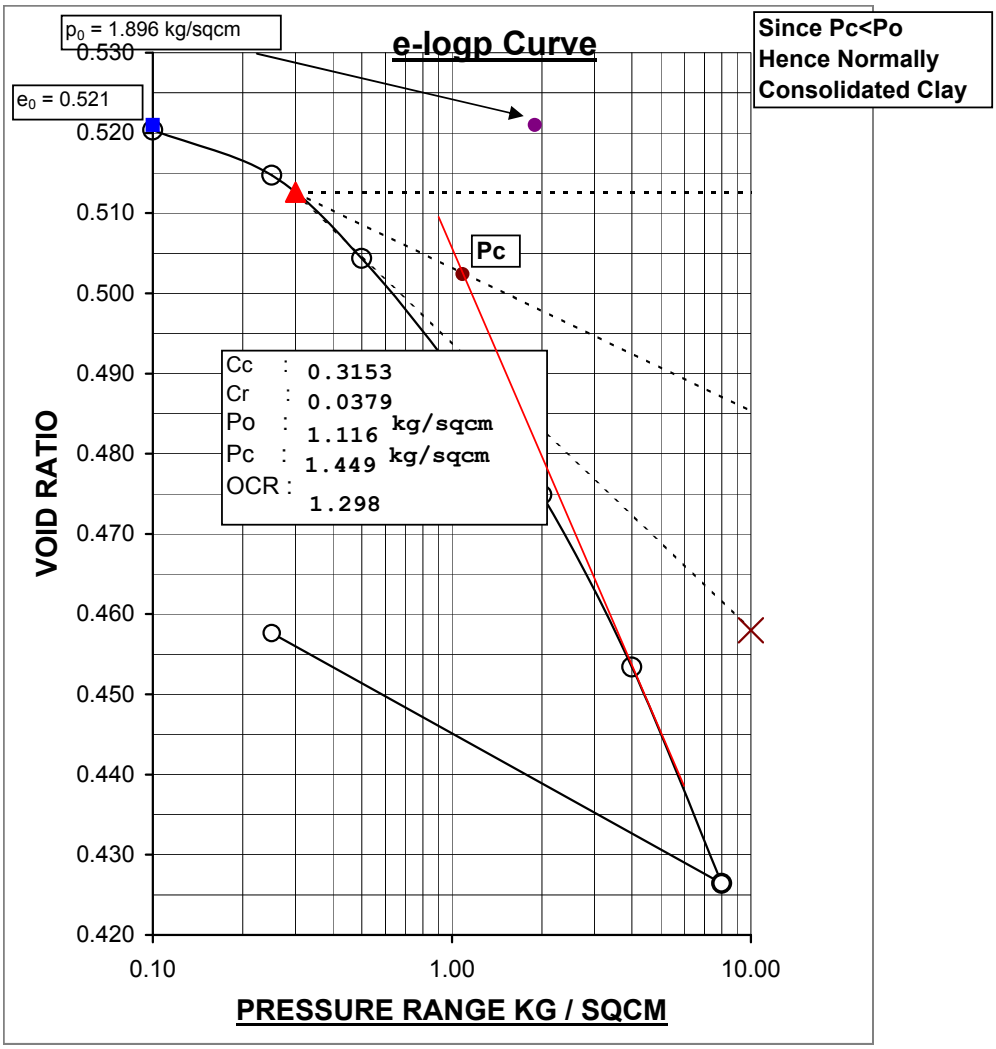
CONSOLIDATION TEST RESULTS

Sample Number:BH-29/UDS-04 Depth :9.5-9.95 meters
Description :Brownish grey clayey silt with traces of kankars.
Water content:Initial=19% Final =22.6% Initial Void Ratio =0.521

P1-P2 Kg/Sqcm	Dial Change	Void Ratio	Mv Sqcm/kg	Comprn %	Mvc sqcm/kg	T90 Sec	1000.Cv sqcm/sec
0.00 - 0.10	6	0.520	0.0062				
0.10 - 0.25	36	0.515	0.0248	61.11	0.0096	181.9	4.343
0.25 - 0.50	66	0.504	0.0273	51.52	0.0133	114.3	6.769
0.50 - 1.00	88	0.491	0.0183	52.27	0.0088	151.7	4.936
1.00 - 2.00	100	0.475	0.0105	64.00	0.0038	181.0	3.972
2.00 - 4.00	137	0.453	0.0073	70.07	0.0022	155.5	4.388
4.00 - 8.00	172	0.426	0.0046	59.30	0.0019	108.5	5.864
8.00 - 0.25	199	0.458	0.0028				



Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	CETEST
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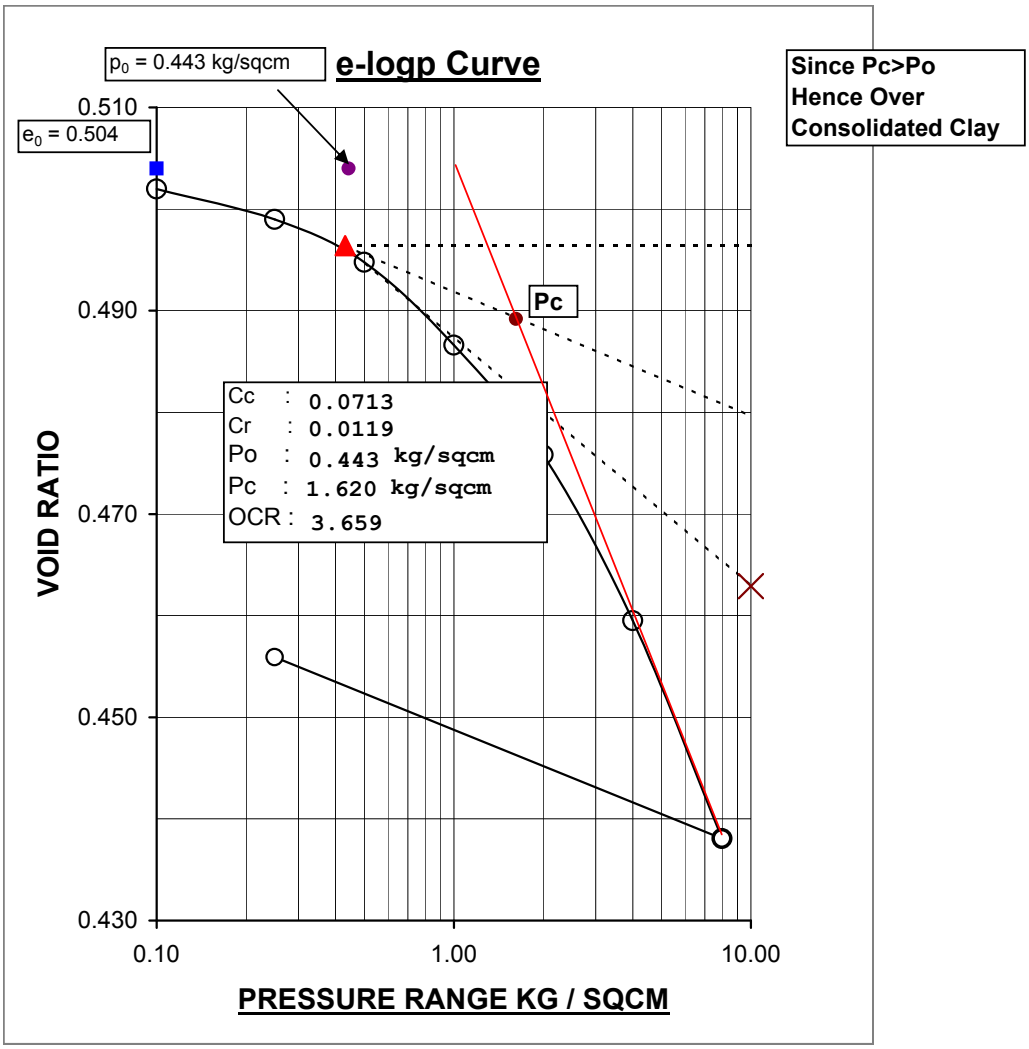
CONSOLIDATION TEST RESULTS

Sample Number:BH-39/UDS-01 Depth :2-2.45 meters
Description :Brownish grey clayey silt with sand mixture.
Water content:Initial=12.4% Final =16.3% Initial Void Ratio =0.504

P1-P2 Kg/Sqcm	Dial Change	Void Ratio	Mv Sqcm/kg	Comprn %	Mvc sqcm/kg	T90 Sec	1000.Cv sqcm/sec
0.00 - 0.10	14	0.502	0.0146				
0.10 - 0.25	19	0.499	0.0132	57.89	0.0056	101.0	7.662
0.25 - 0.50	27	0.495	0.0113	55.56	0.0050	133.5	5.741
0.50 - 1.00	52	0.487	0.0109	67.31	0.0036	103.5	7.283
1.00 - 2.00	69	0.476	0.0073	63.77	0.0026	159.4	4.608
2.00 - 4.00	104	0.460	0.0055	73.08	0.0015	106.1	6.666
4.00 - 8.00	137	0.438	0.0037	72.26	0.0010	112.6	5.955
8.00 - 0.25	114	0.456	0.0016				



Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	CETEST
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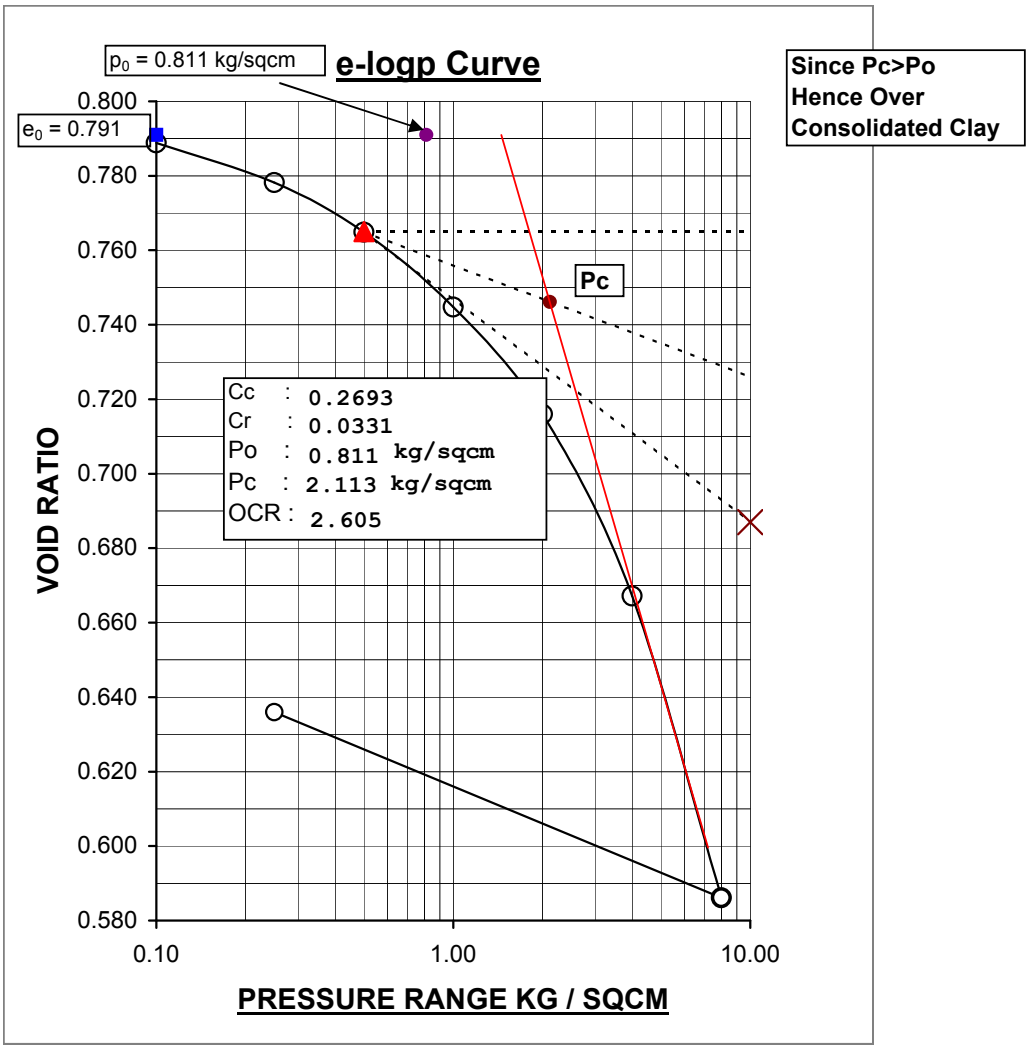
CONSOLIDATION TEST RESULTS

Sample Number:BH-41/UDS-02 Depth :4-4.45 meters
Description :Brownish grey clayey silt with traces of kankars.
Water content:Initial=25.6% Final =25.8% Initial Void Ratio =0.791

P1-P2 Kg/Sqcm	Dial Change	Void Ratio	Mv Sqcm/kg	Comprn %	Mvc sqcm/kg	T90 Sec	1000.Cv sqcm/sec
0.00 - 0.10	13	0.789	0.0134				
0.10 - 0.25	58	0.778	0.0399	37.93	0.0248	275.5	2.846
0.25 - 0.50	72	0.765	0.0299	43.60	0.0169	381.0	2.003
0.50 - 1.00	109	0.745	0.0228	42.40	0.0131	375.0	1.958
1.00 - 2.00	156	0.716	0.0165	53.85	0.0076	325.7	2.128
2.00 - 4.00	264	0.667	0.0142	56.82	0.0061	195.7	3.220
4.00 - 8.00	439	0.586	0.0122	52.10	0.0058	172.6	3.079
8.00 - 0.25	270	0.636	0.0041				



Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	CETEST
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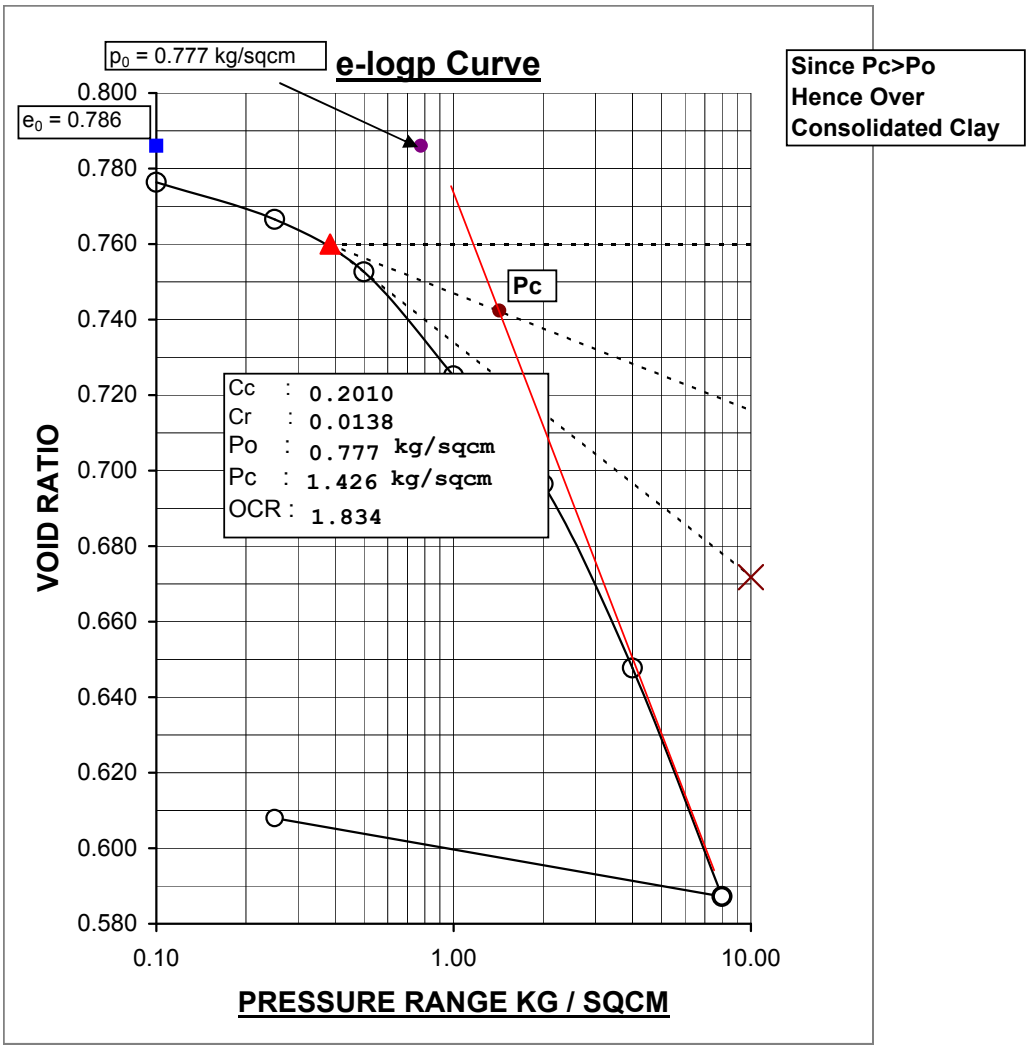
CONSOLIDATION TEST RESULTS

Sample Number:BH-42/UDS-02 Depth :4-4.45 meters
Description :Brownish grey clayey silt with traces of sand mixture.
Water content:Initial=26.8% Final =27.7% Initial Void Ratio =0.786

P1-P2 Kg/Sqcm	Dial Change	Void Ratio	Mv Sqcm/kg	Comprn %	Mvc sqcm/kg	T90 Sec	1000.Cv sqcm/sec
0.00 - 0.10	51	0.776	0.0528				
0.10 - 0.25	53	0.767	0.0368	50.20	0.0183	160.2	4.772
0.25 - 0.50	75	0.753	0.0314	52.00	0.0151	259.6	2.866
0.50 - 1.00	149	0.725	0.0315	64.50	0.0112	188.0	3.771
1.00 - 2.00	155	0.696	0.0166	51.61	0.0080	167.3	3.959
2.00 - 4.00	263	0.648	0.0143	61.60	0.0055	129.5	4.644
4.00 - 8.00	327	0.587	0.0092	63.00	0.0034	127.9	4.066
8.00 - 0.25	112	0.608	0.0017				



Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	CETEST
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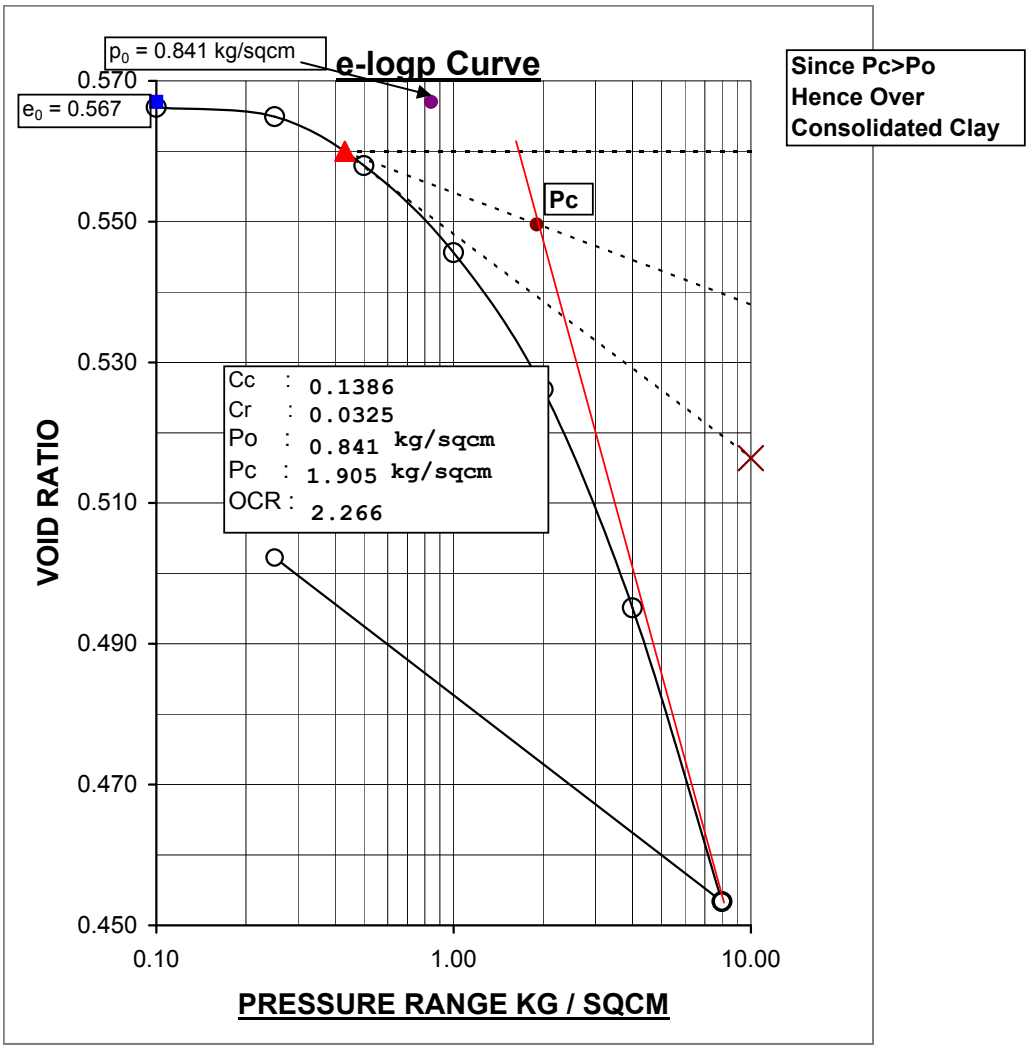
CONSOLIDATION TEST RESULTS

Sample Number:BH-47/UDS-02 Depth :4-4.45 meters
Description :Greyish brown silty clay.
Water content:Initial=21.3% Final =24.2% Initial Void Ratio =0.567

P1-P2 Kg/Sqcm	Dial Change	Void Ratio	Mv Sqcm/kg	Comprn %	Mvc sqcm/kg	T90 Sec	1000.Cv sqcm/sec
0.00 - 0.10	2	0.566	0.0021				
0.10 - 0.25	8	0.565	0.0055	25.00	0.0041	98.3	8.013
0.25 - 0.50	43	0.558	0.0178	39.53	0.0108	93.8	8.314
0.50 - 1.00	76	0.546	0.0158	33.50	0.0105	106.1	7.162
1.00 - 2.00	120	0.526	0.0126	32.50	0.0085	106.1	6.869
2.00 - 4.00	191	0.495	0.0102	34.55	0.0066	115.9	5.874
4.00 - 8.00	257	0.453	0.0070	35.41	0.0045	109.8	5.597
8.00 - 0.25	301	0.502	0.0043				



Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	CETEST
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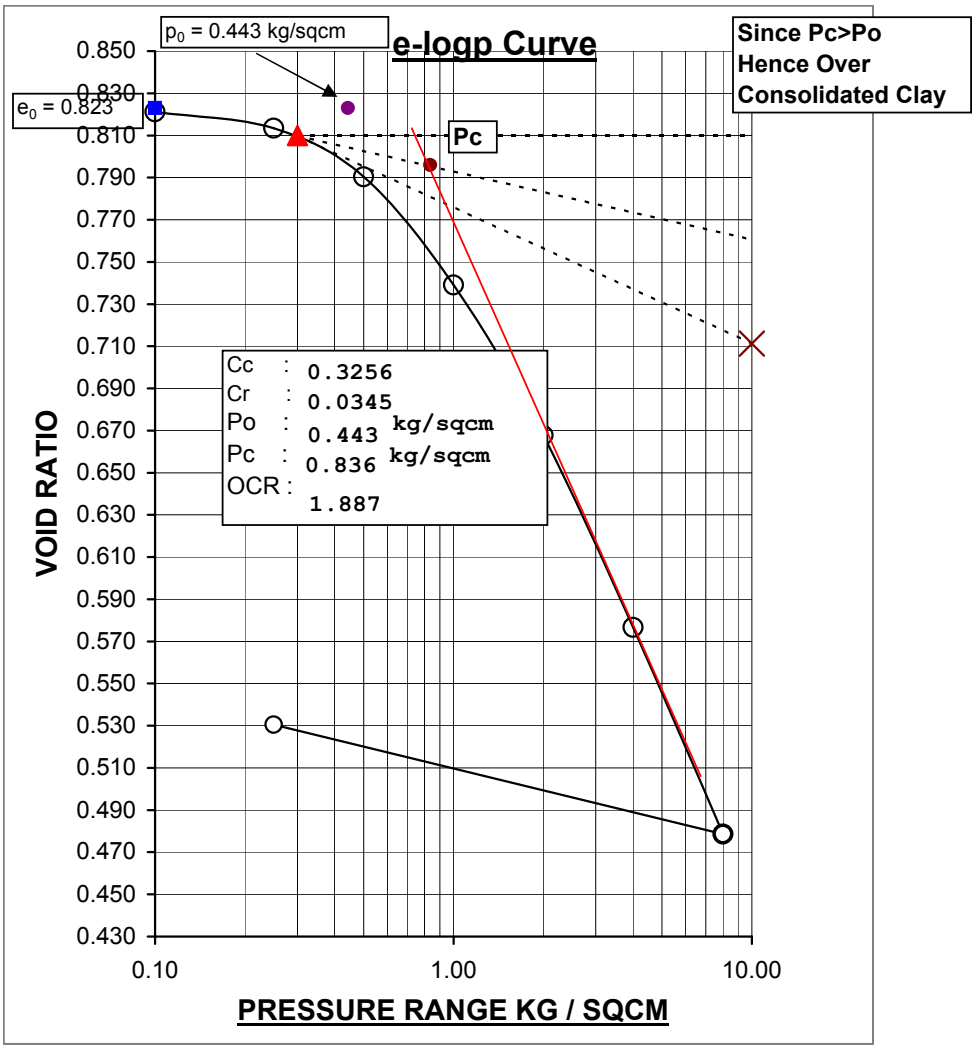
CONSOLIDATION TEST RESULTS

Sample Number:BH-46/UDS-01 Depth :2-2.45 meters
Description :Deep brown silty clay with kankars.
Water content:Initial=31.3% Final =24.1% Initial Void Ratio =0.823

P1-P2 Kg/Sqcm	Dial Change	Void Ratio	Mv Sqcm/kg	Comprn %	Mvc sqcm/kg	T90 Sec	1000.Cv sqcm/sec
0.00 - 0.10	10	0.821	0.0102				
0.10 - 0.25	41	0.813	0.0279	24.39	0.0211	203.5	3.952
0.25 - 0.50	124	0.790	0.0509	19.35	0.0410	211.6	3.673
0.50 - 1.00	276	0.739	0.0574	19.20	0.0463	252.2	2.830
1.00 - 2.00	384	0.668	0.0411	17.97	0.0337	295.7	2.079
2.00 - 4.00	489	0.577	0.0273	18.61	0.0222	225.8	2.193
4.00 - 8.00	527	0.479	0.0155	12.33	0.0136	183.5	2.028
8.00 - 0.25	279	0.531	0.0045				



Project : Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	CETEST
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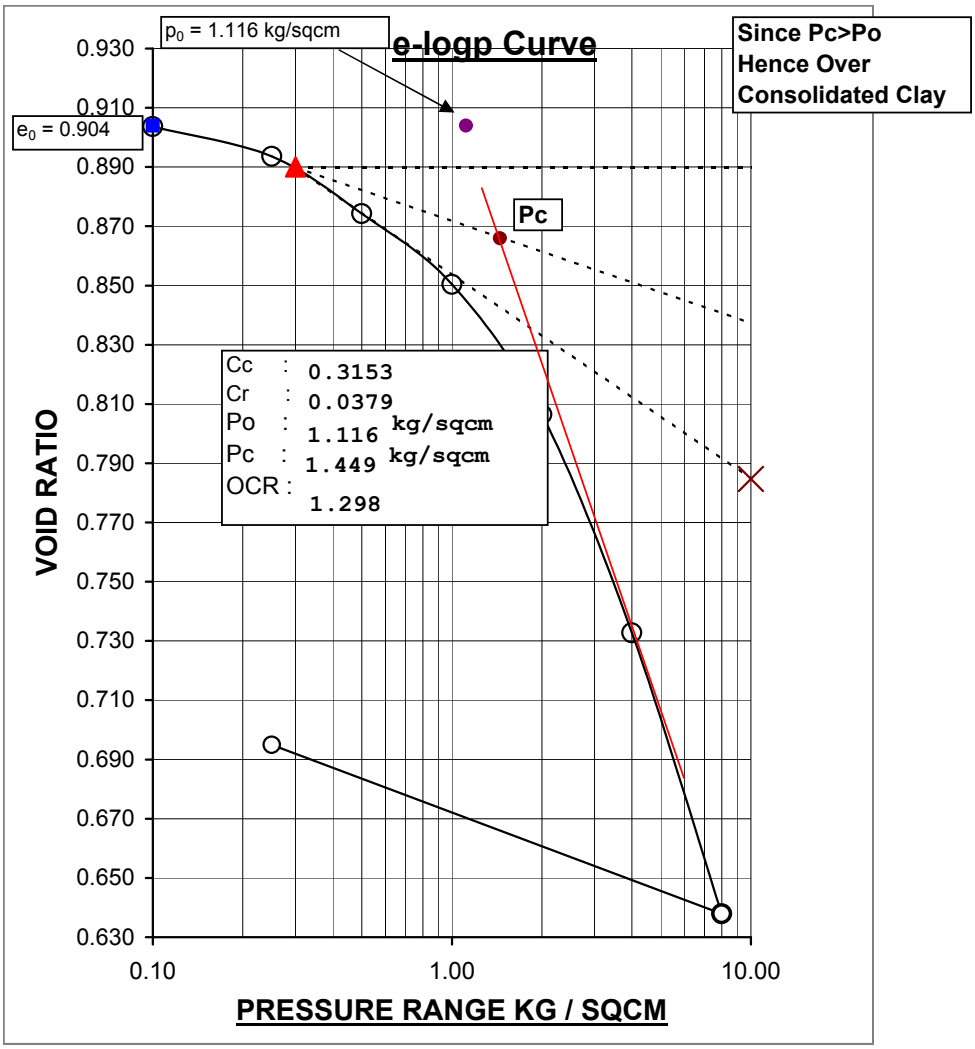
CONSOLIDATION TEST RESULTS

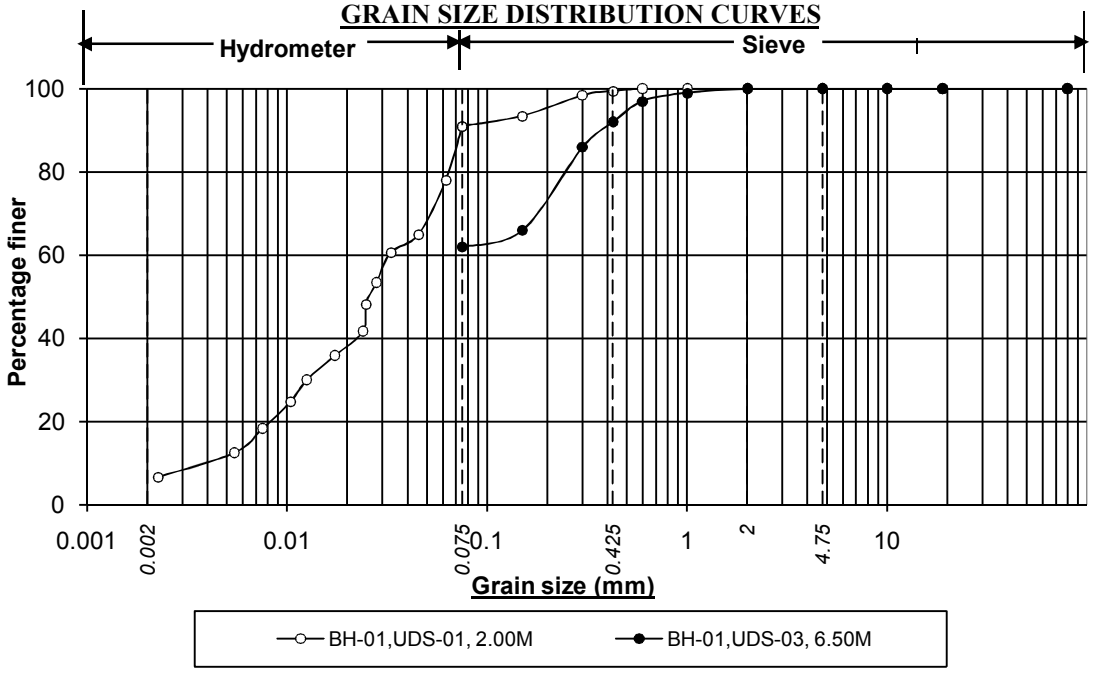
Sample Number:BH-64/UDS-03 Depth :6.5-6.95 meters
Description :Brownish grey clayey silt with traces of sand mixtures.
Water content:Initial=21.3% Final =32.4% Initial Void Ratio =0.904

P1-P2 Kg/Sqcm	Dial Change	Void Ratio	Mv Sqcm/kg	Comprn %	Mvc sqcm/kg	T90 Sec	1000.Cv sqcm/sec
0.00 - 0.10	4	0.904	0.0041				
0.10 - 0.25	51	0.894	0.0352	54.90	0.0159	144.2	5.411
0.25 - 0.50	98	0.874	0.0409	52.04	0.0196	106.1	7.123
0.50 - 1.00	121	0.850	0.0255	54.55	0.0116	115.9	6.222
1.00 - 2.00	223	0.806	0.0238	56.05	0.0105	101.4	6.593
2.00 - 4.00	373	0.733	0.0204	61.39	0.0079	101.4	5.738
4.00 - 8.00	481	0.638	0.0137	55.72	0.0061	112.6	4.156
8.00 - 0.25	289	0.695	0.0045				

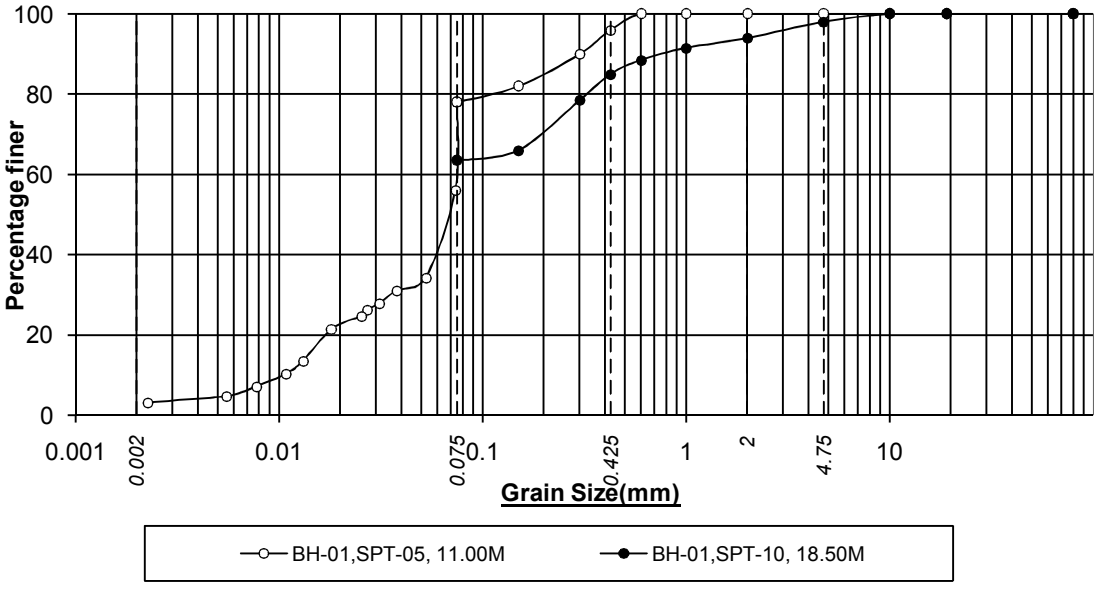


C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-01,UDS-01, 2.00M	5.8	85.2	8.5	0.5	0.0	9.0		0.0
BH-01,UDS-03, 6.50M		62.0	30.0	8.0	0.0	38.0		0.0

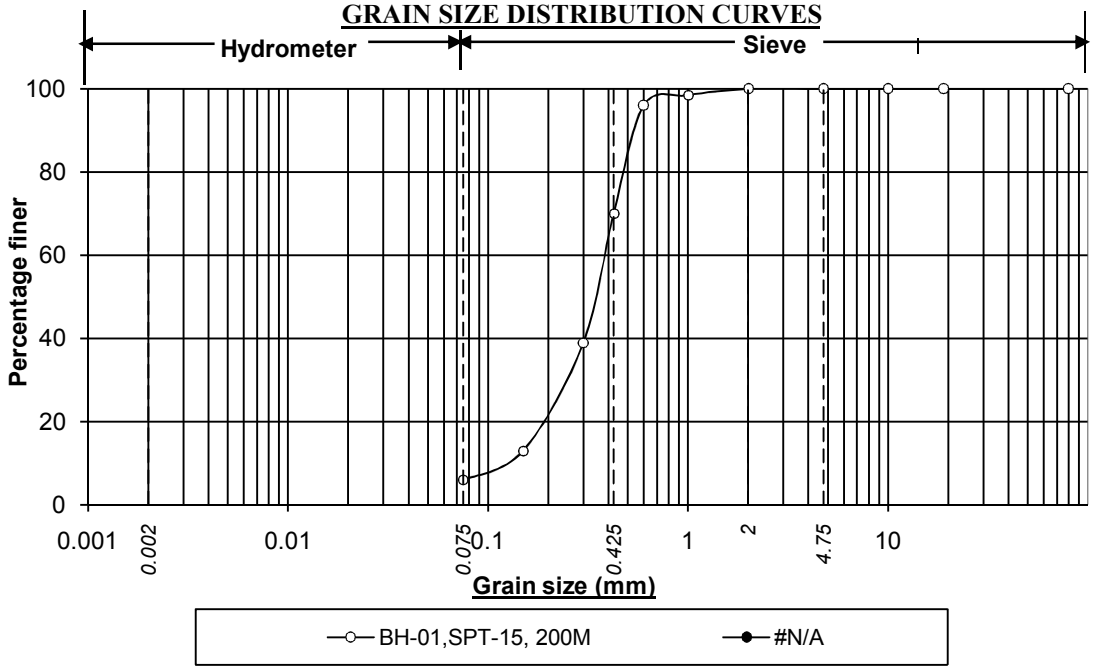


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-01,SPT-05, 11.00M	3.0	75.0	18.0	4.0	0.0	22.0		0.0
BH-01,SPT-10, 18.50M		63.5	21.5	9.0	4.0	34.5		2.0

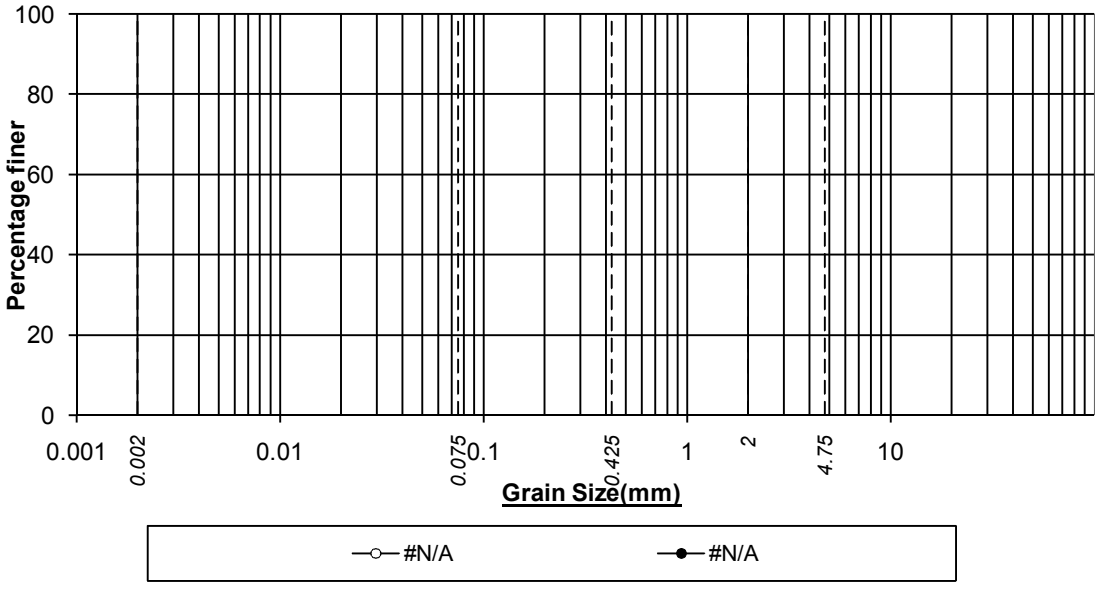
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-01,SPT-15, 200M		6.0	64.0	30.0	0.0	94.0	3.191/1.355	0.0

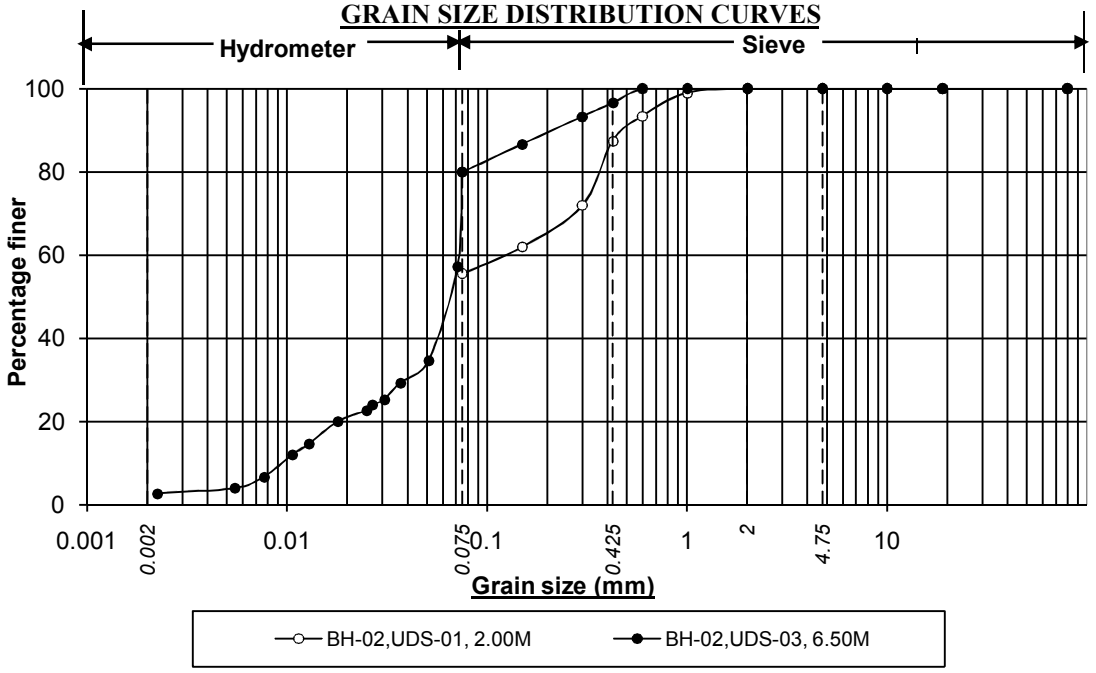


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

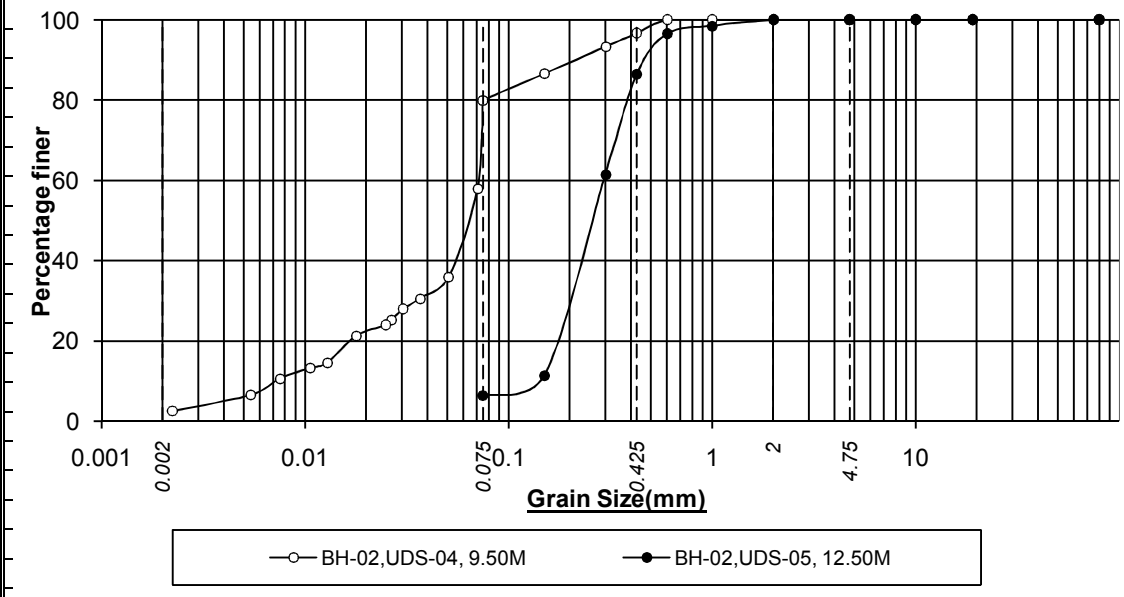
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-02,UDS-01, 2.00M		55.5	32.0	12.5	0.0	44.5		0.0
BH-02,UDS-03, 6.50M	2.5	77.5	16.7	3.3	0.0	20.0		0.0

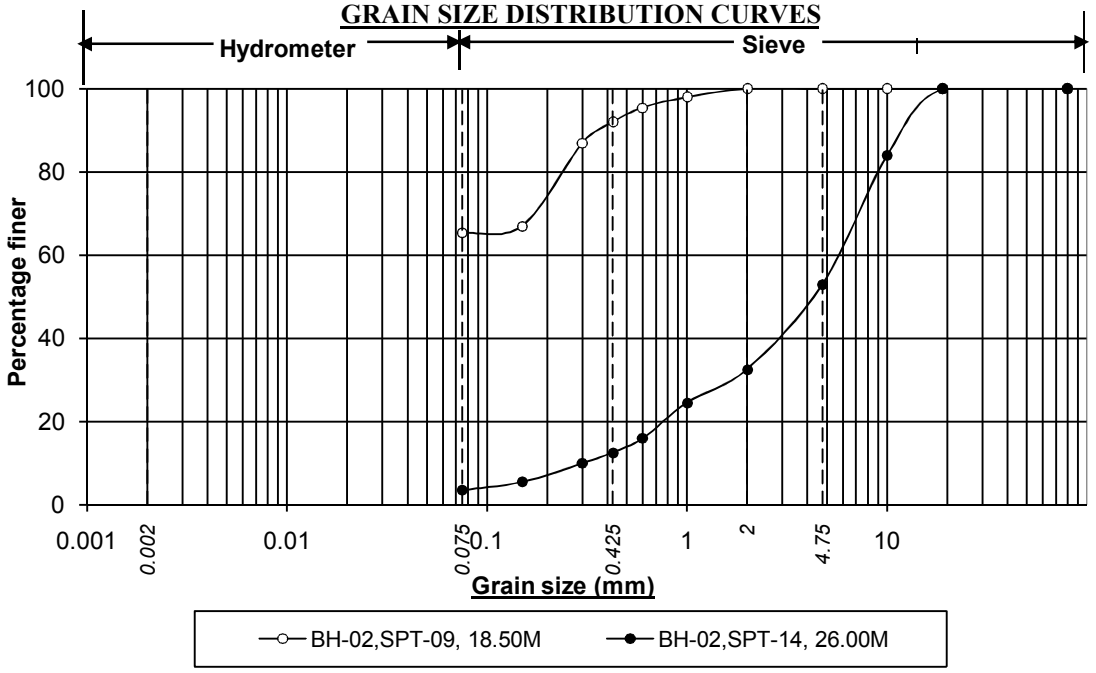


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-02,UDS-04, 9.50M	2.2	77.8	16.7	3.3	0.0	20.0		0.0
BH-02,UDS-05, 12.50M		6.5	80.0	13.5	0.0	93.5	2.06/1.042	0.0

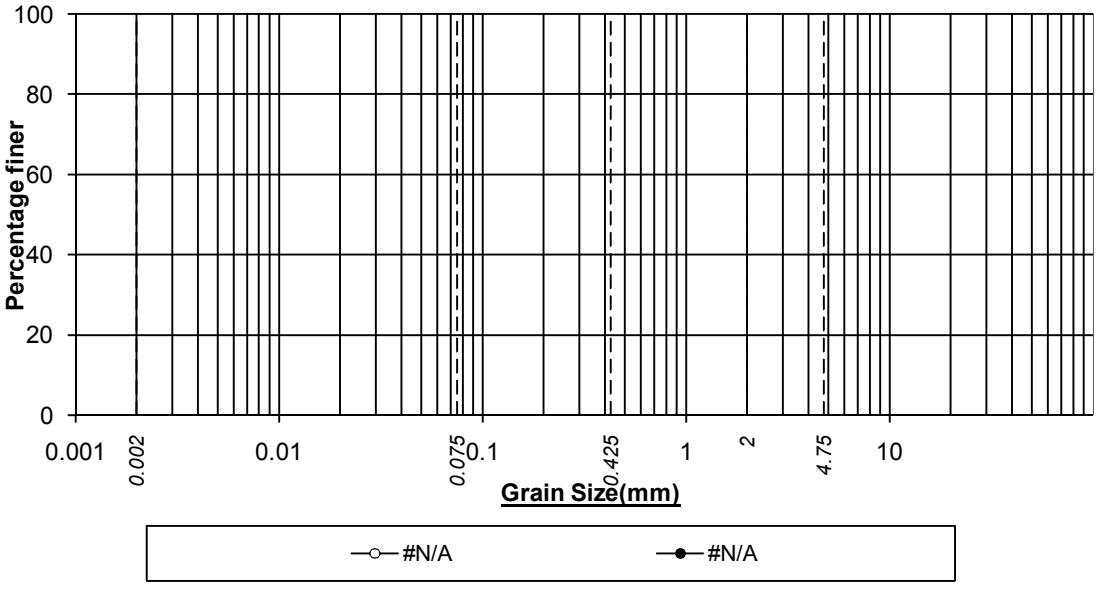
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-02,SPT-09, 18.50M		65.5	26.5	8.0	0.0	34.5		0.0
BH-02,SPT-14, 26.00M		3.5	9.0	20.0	20.5	49.5	20.606/1.778	47.0

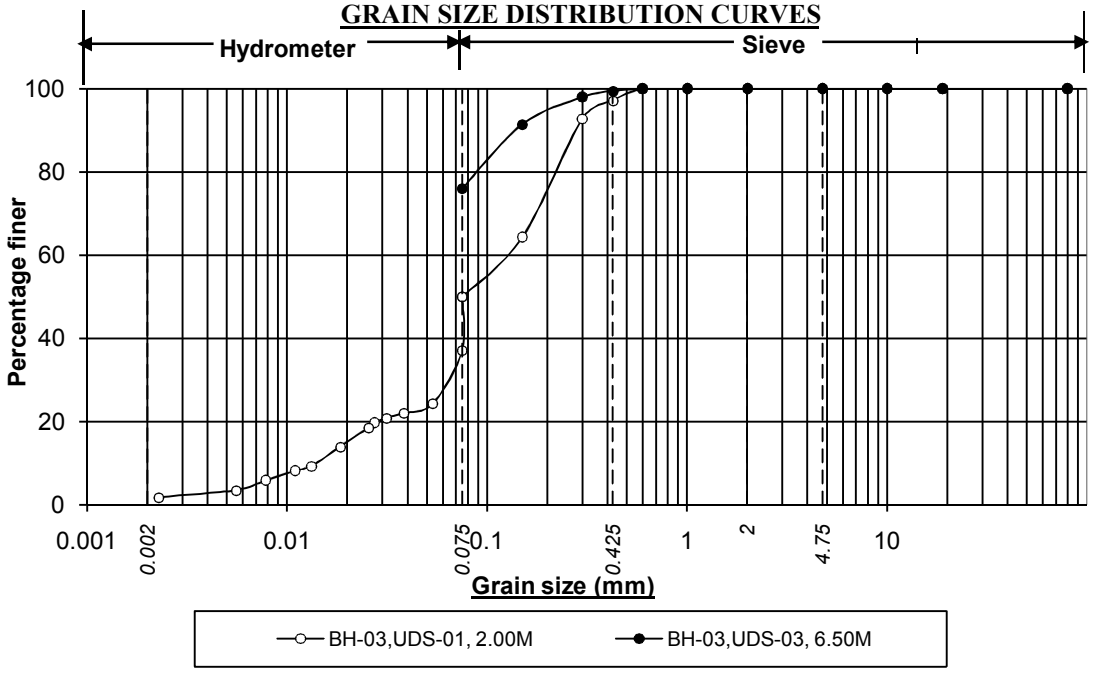


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)

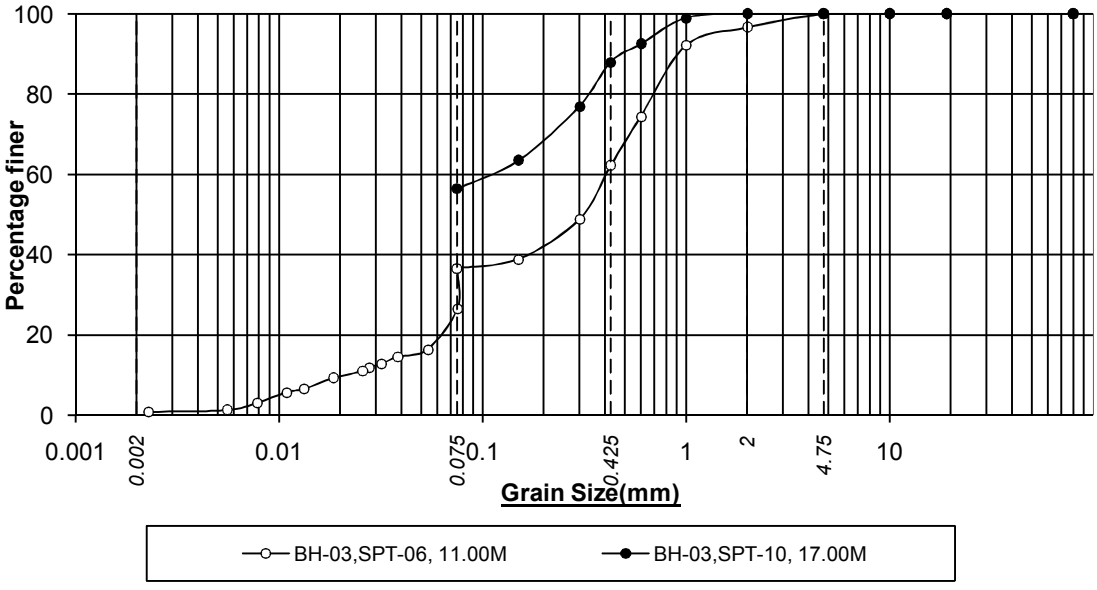
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	Job No. 3369	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-03,UDS-01, 2.00M	1.5	48.5	47.1	2.9	0.0	50.0		0.0
BH-03,UDS-03, 6.50M		76.0	23.5	0.5	0.0	24.0		0.0

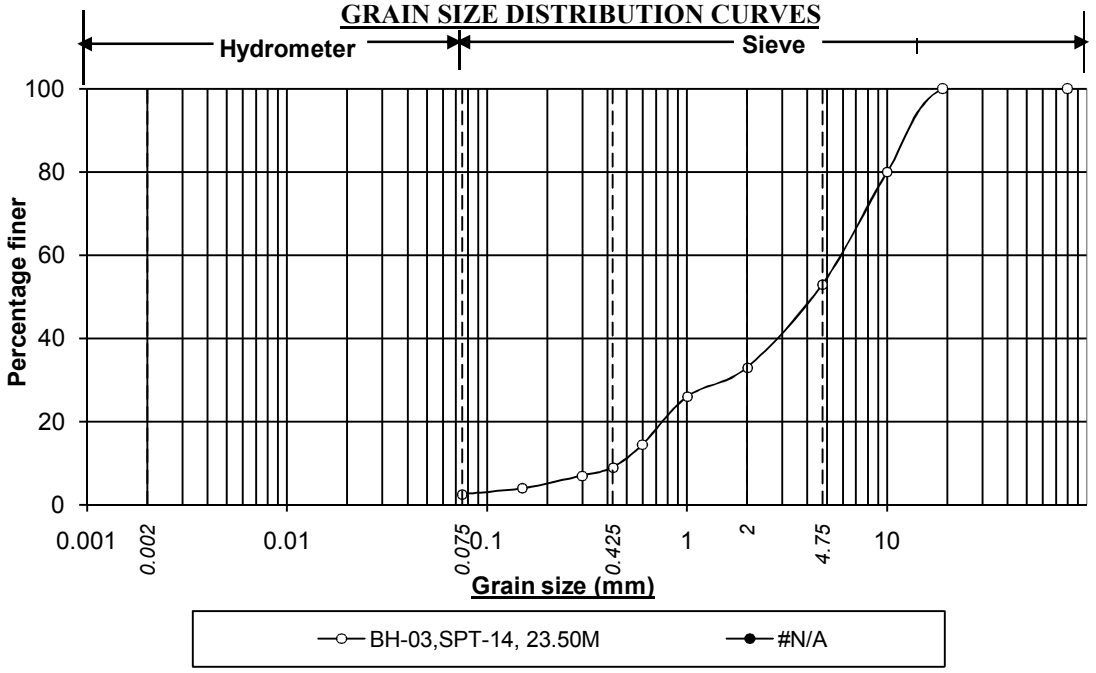


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-03,SPT-06, 11.00M	0.8	35.8	25.7	34.4	3.3	63.4		0.0
BH-03,SPT-10, 17.00M		56.5	31.5	12.0	0.0	43.5		0.0

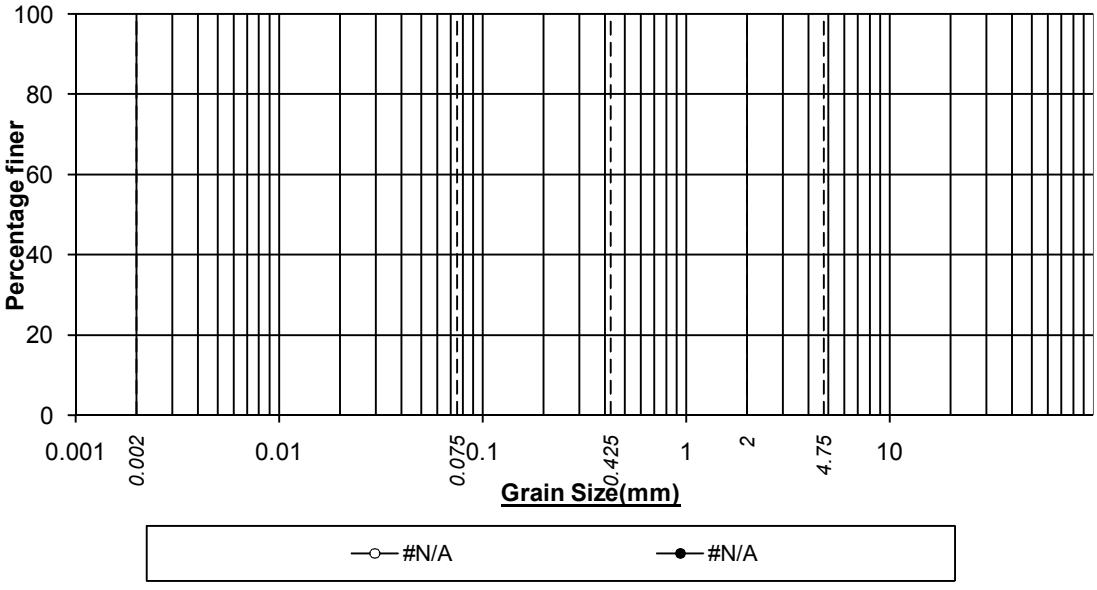
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	**Job No.3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-03,SPT-14, 23.50M		2.5	6.5	24.0	20.0	50.5	12.852/0.948	47.0

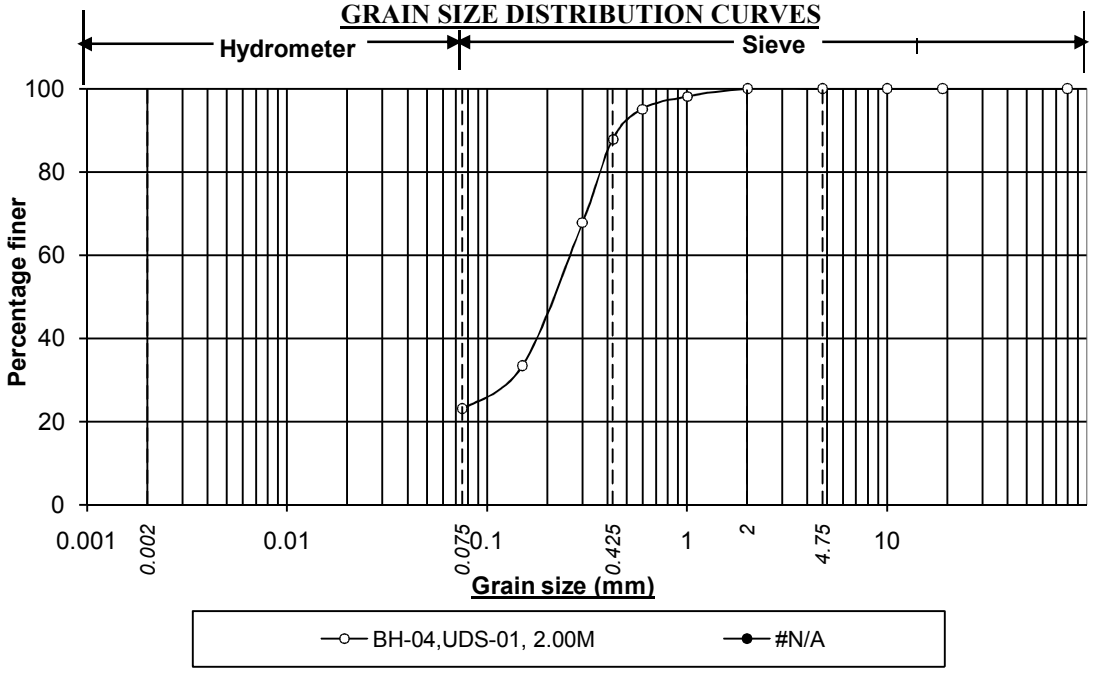


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

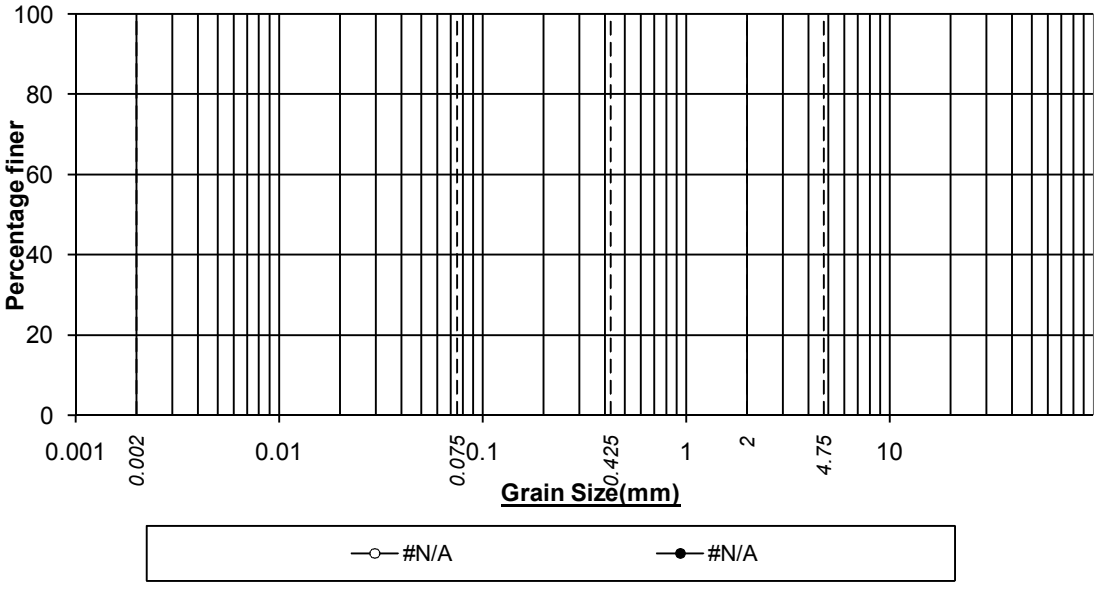
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-04,UDS-01, 2.00M		23.0	64.9	12.1	0.0	77.0		0.0

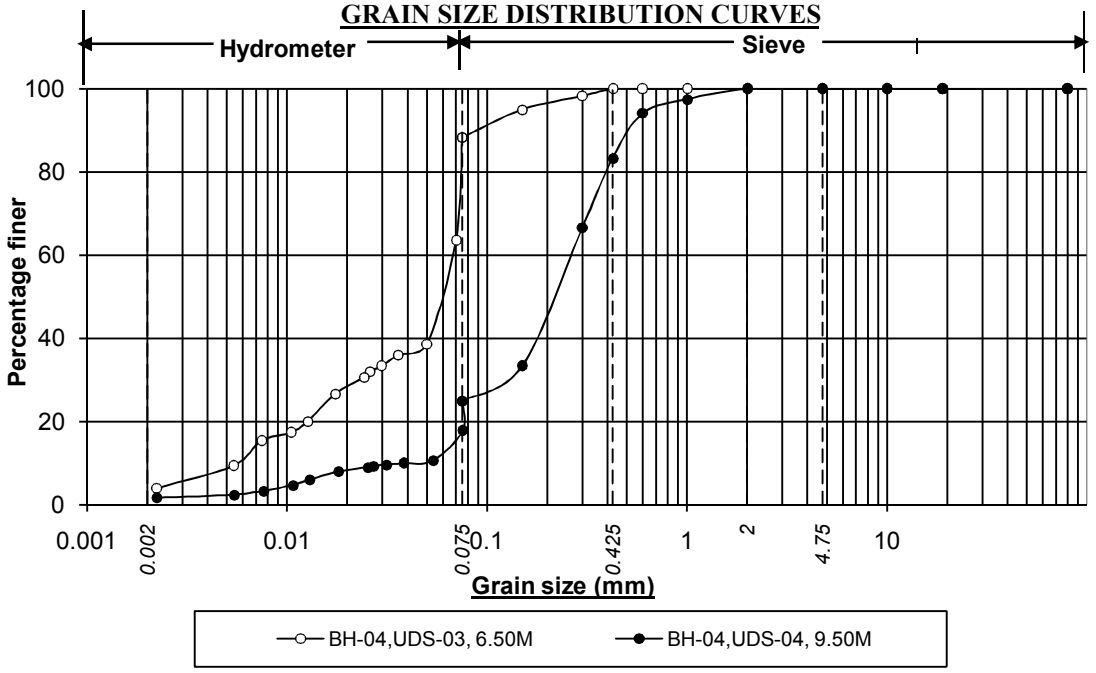


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

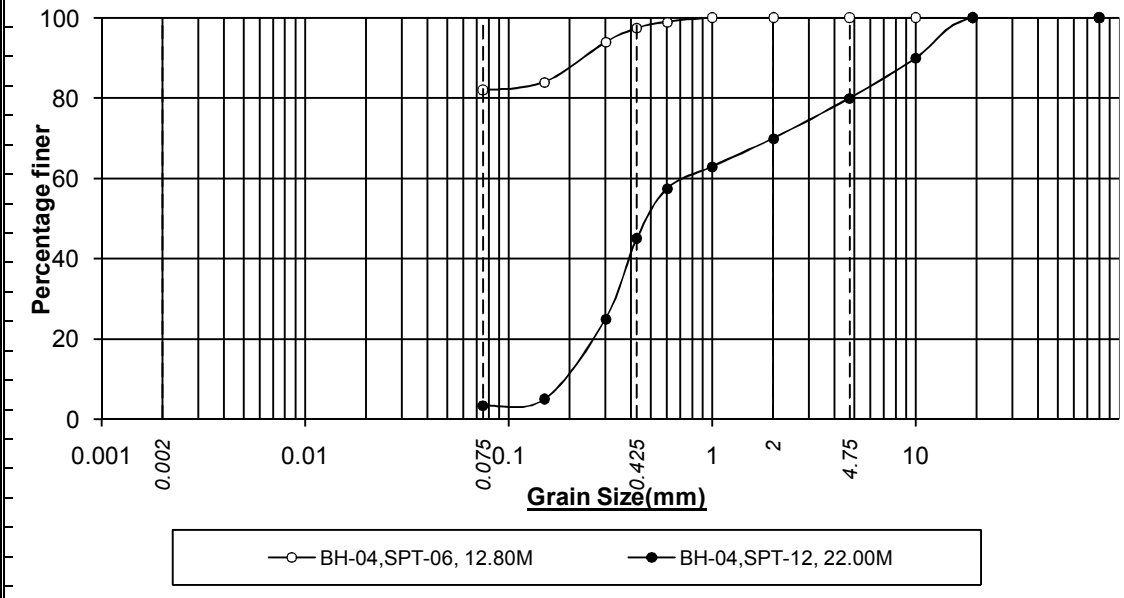
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-04,UDS-03, 6.50M	3.3	85.0	11.7	0.0	0.0	11.7		0.0
BH-04,UDS-04, 9.50M	1.6	23.4	58.3	16.7	0.0	75.0		0.0

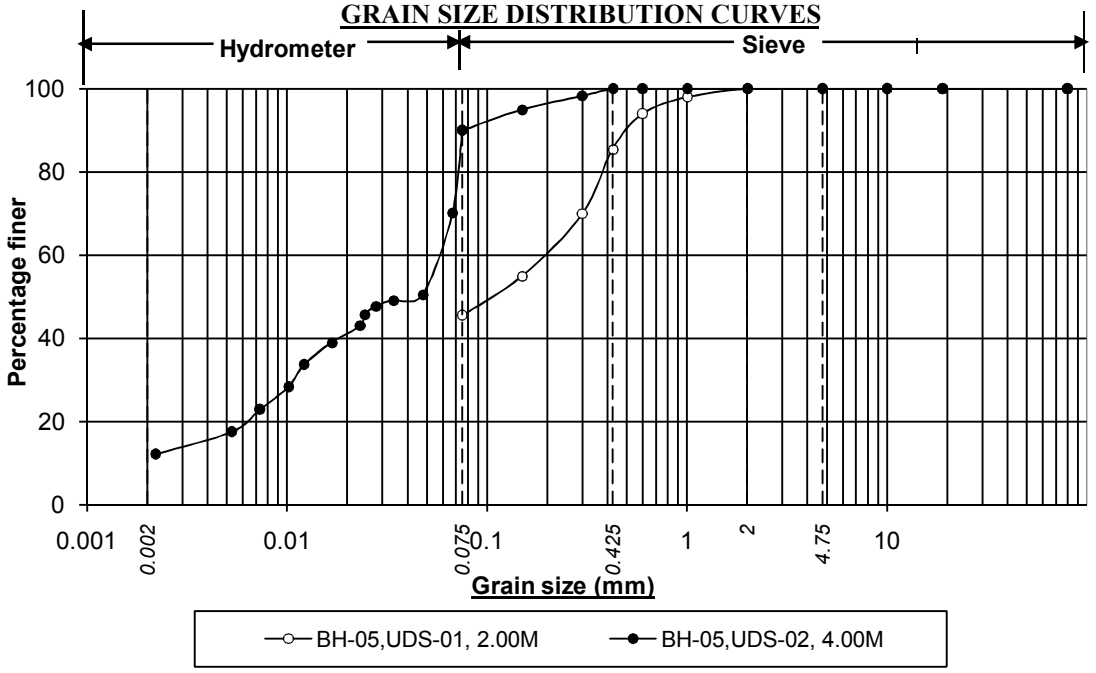


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-04,SPT-06, 12.80M		82.0	15.5	2.5	0.0	18.0		0.0
BH-04,SPT-12, 22.00M		3.5	41.5	25.0	10.0	76.5	3.854/0.843	20.0

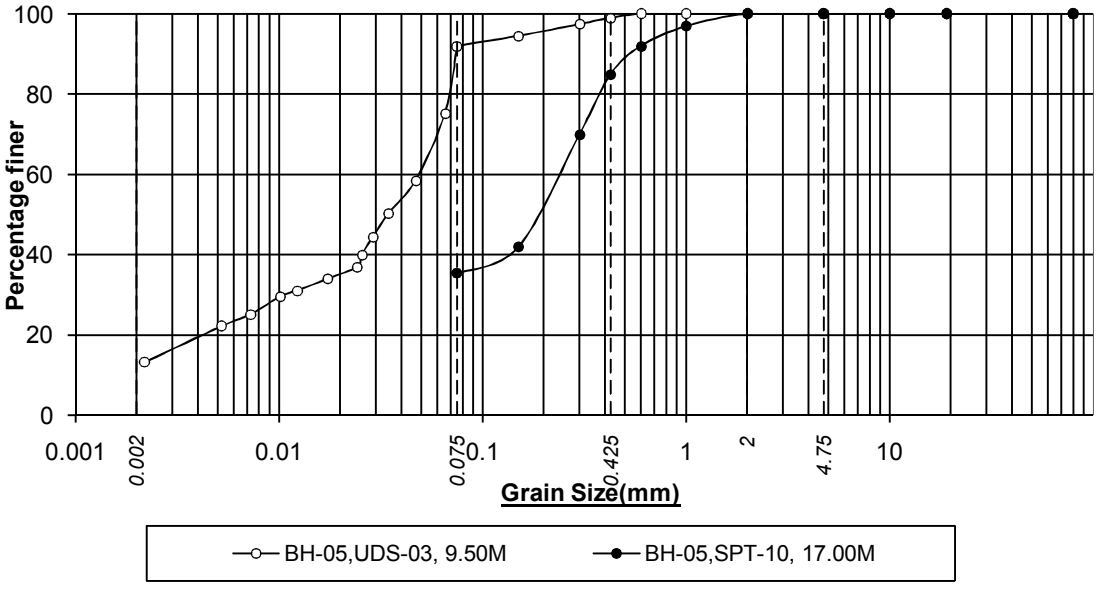
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-05,UDS-01, 2.00M		45.5	40.0	14.5	0.0	54.5		0.0
BH-05,UDS-02, 4.00M	11.5	78.5	10.0	0.0	0.0	10.0		0.0

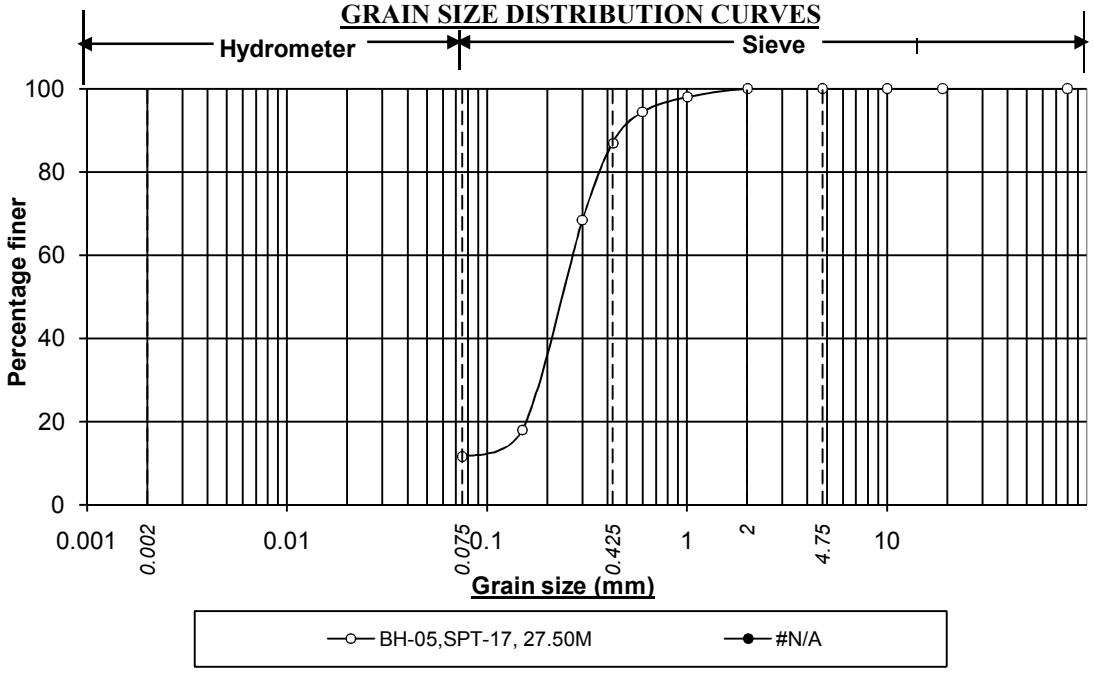


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-05,UDS-03, 9.50M	12.4	79.6	7.0	1.0	0.0	8.0		0.0
BH-05,SPT-10, 17.00M		35.5	49.5	15.0	0.0	64.5		0.0

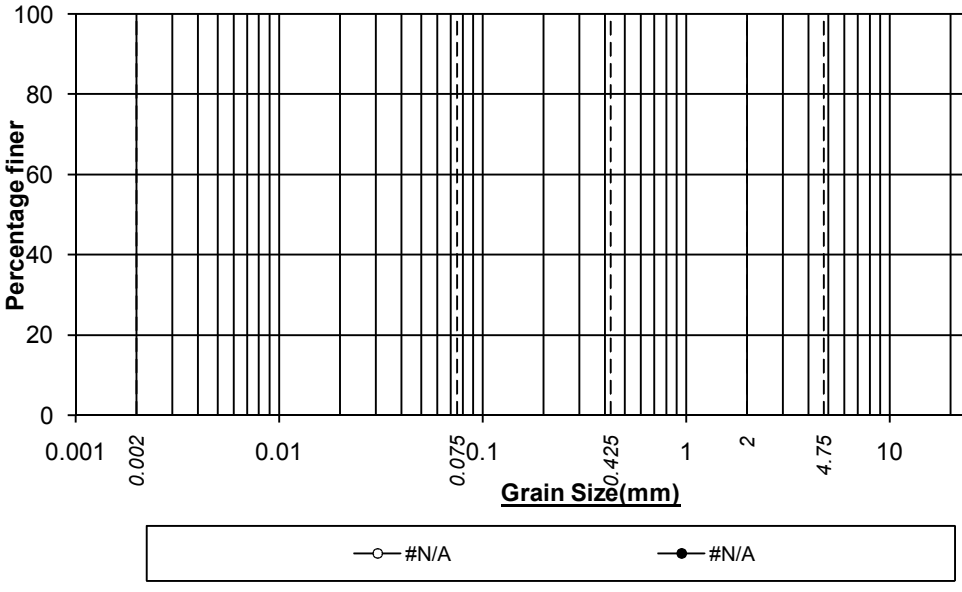
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-05,SPT-17, 27.50M		11.5	75.5	13.0	0.0	88.5		0.0

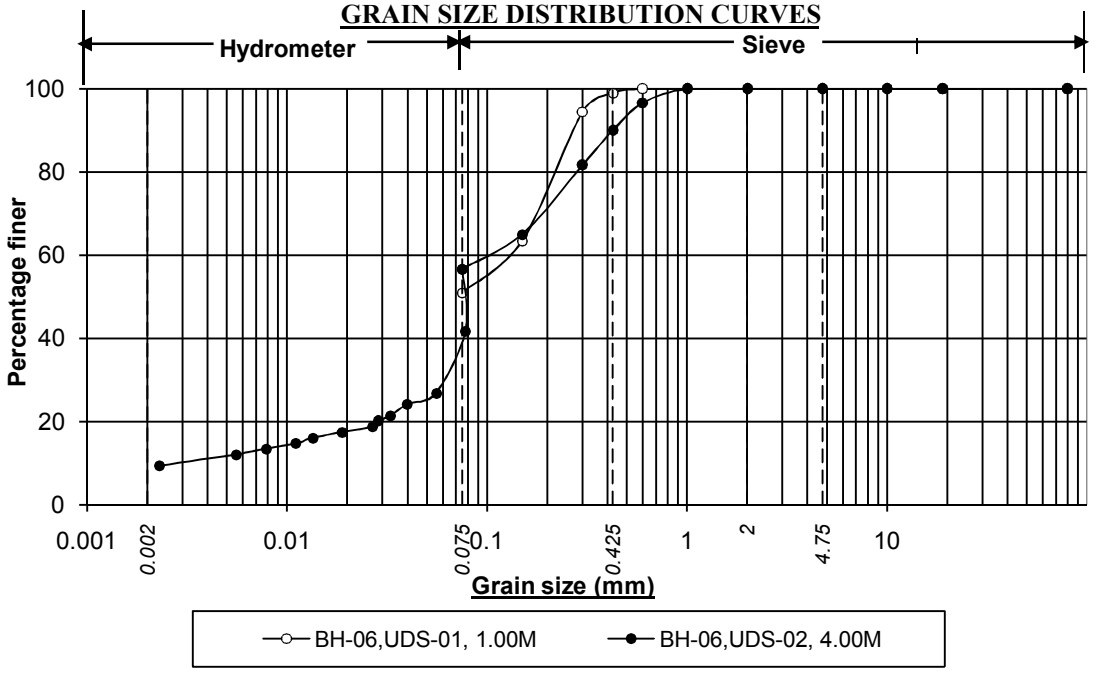


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

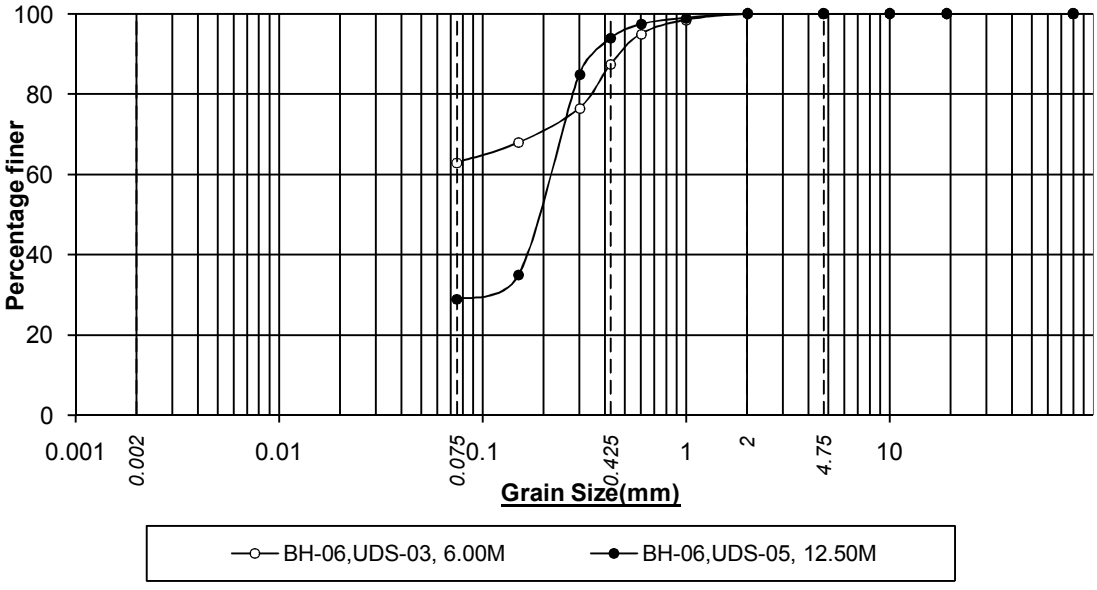
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-06,UDS-01, 1.00M		51.0	48.0	1.0	0.0	49.0		0.0
BH-06,UDS-02, 4.00M	9.0	47.7	33.3	10.0	0.0	43.3		0.0

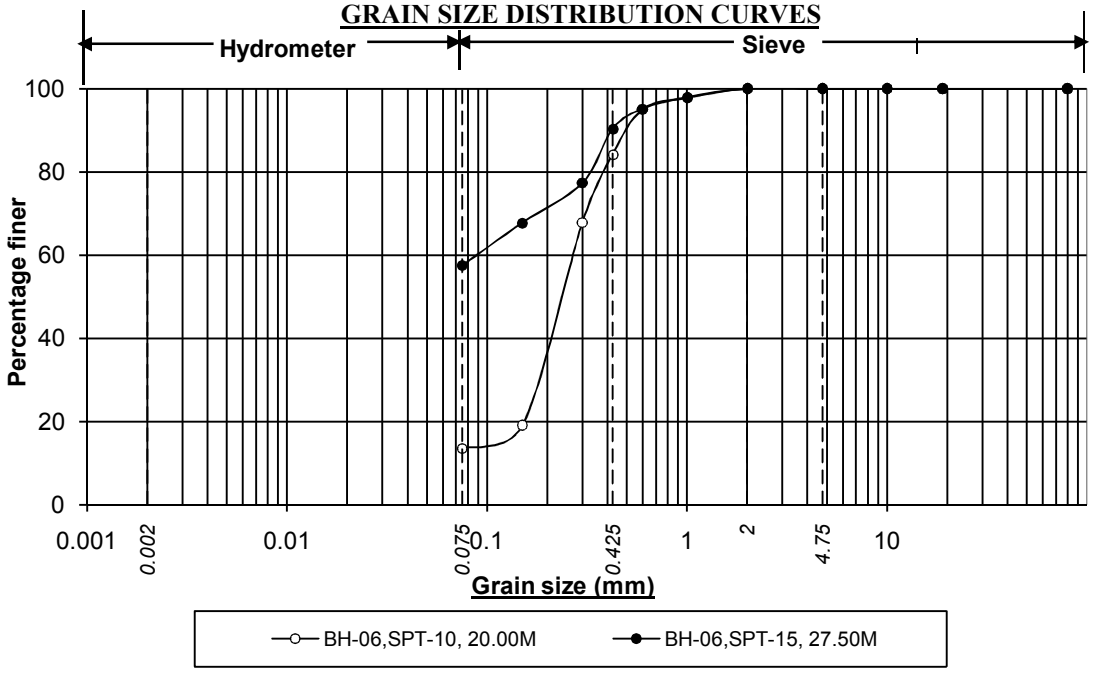


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-06,UDS-03, 6.00M		63.0	24.5	12.5	0.0	37.0		0.0
BH-06,UDS-05, 12.50M		29.0	65.0	6.0	0.0	71.0		0.0

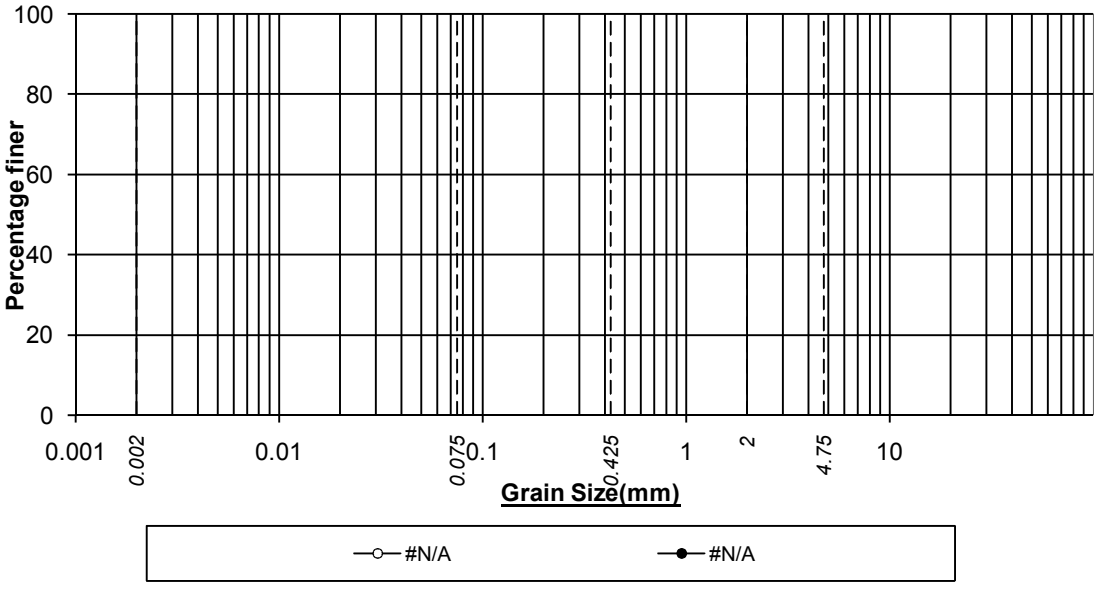
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-06,SPT-10, 20.00M		13.6	70.6	15.8	0.0	86.4		0.0
BH-06,SPT-15, 27.50M		57.5	32.9	9.6	0.0	42.5		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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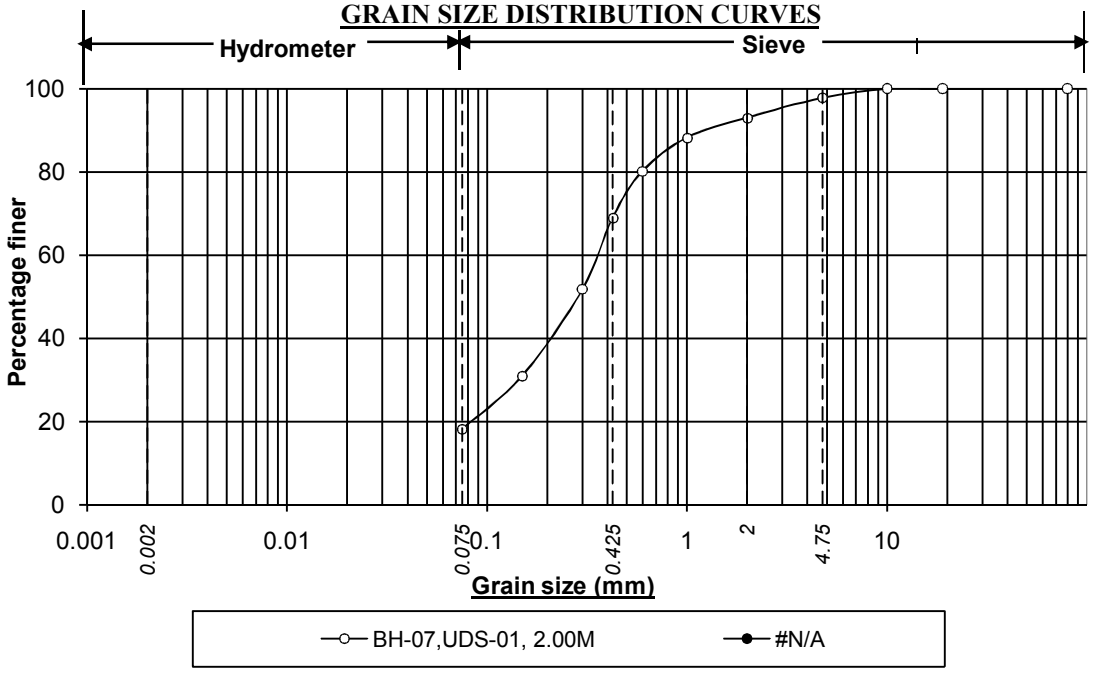
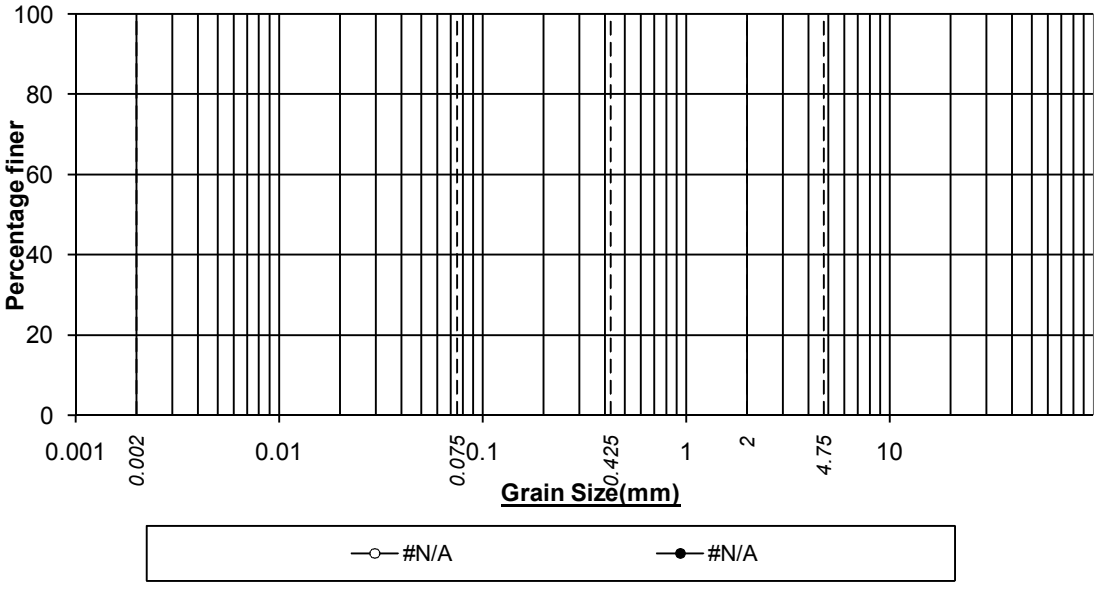
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-07,UDS-01, 2.00M		18.2	50.8	24.1	4.8	79.7		2.1

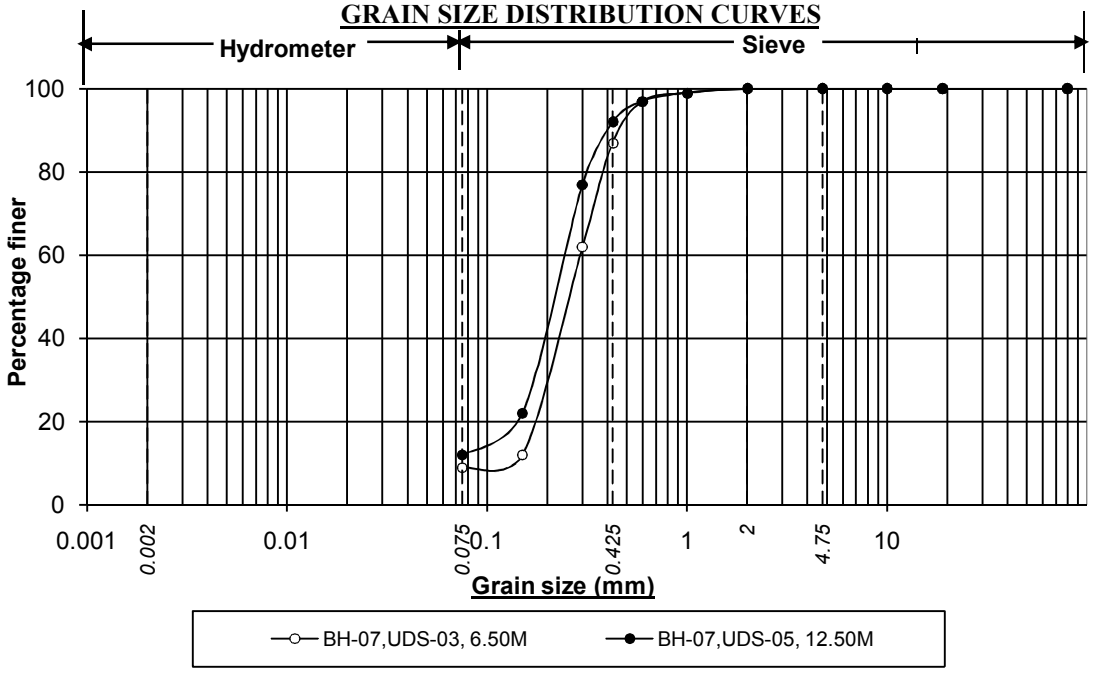


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

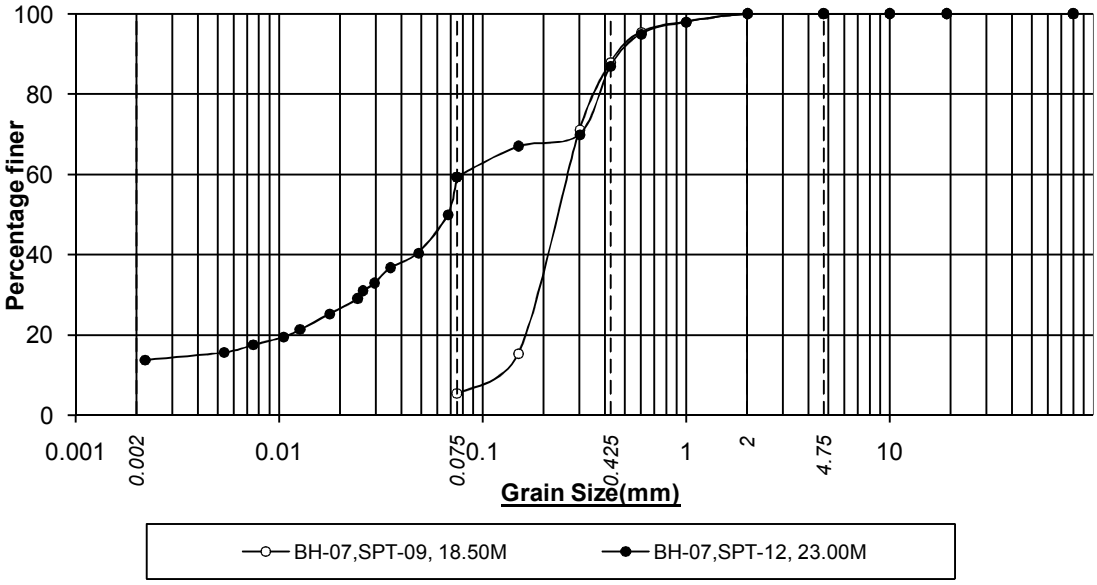
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-07,UDS-03, 6.50M		9.0	78.0	13.0	0.0	91.0	2.051/0.995	0.0
BH-07,UDS-05, 12.50M		12.0	80.0	8.0	0.0	88.0		0.0

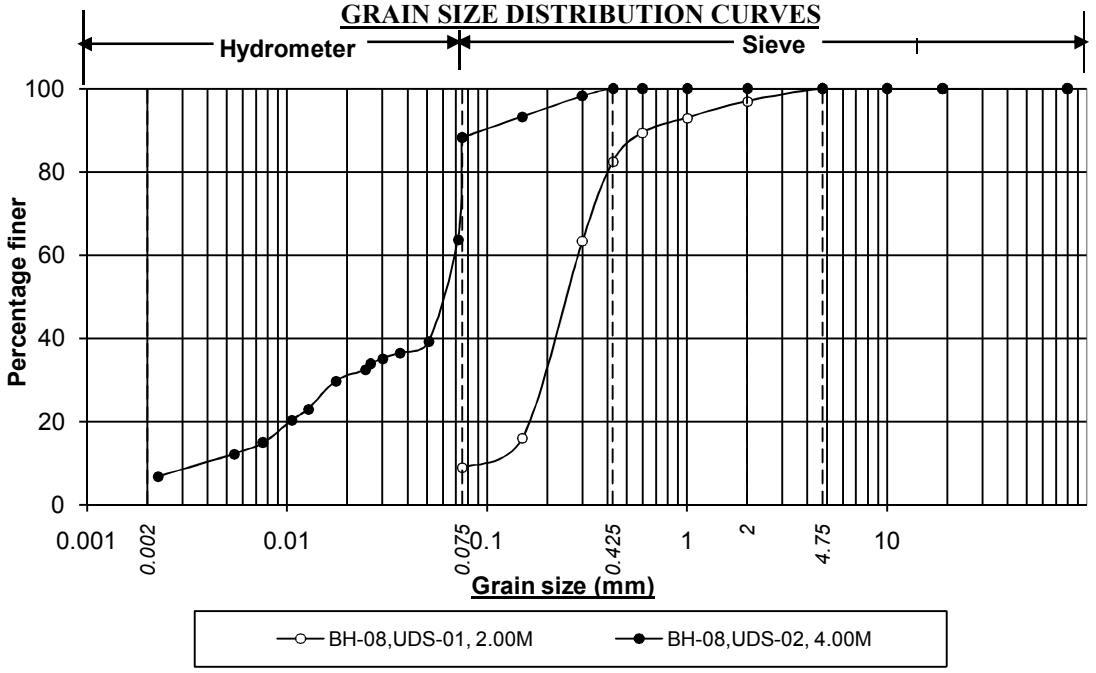


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-07,SPT-09, 18.50M		5.5	82.5	12.0	0.0	94.5	2.118/1.132	0.0
BH-07,SPT-12, 23.00M	13.6	45.9	27.5	13.0	0.0	40.5		0.0

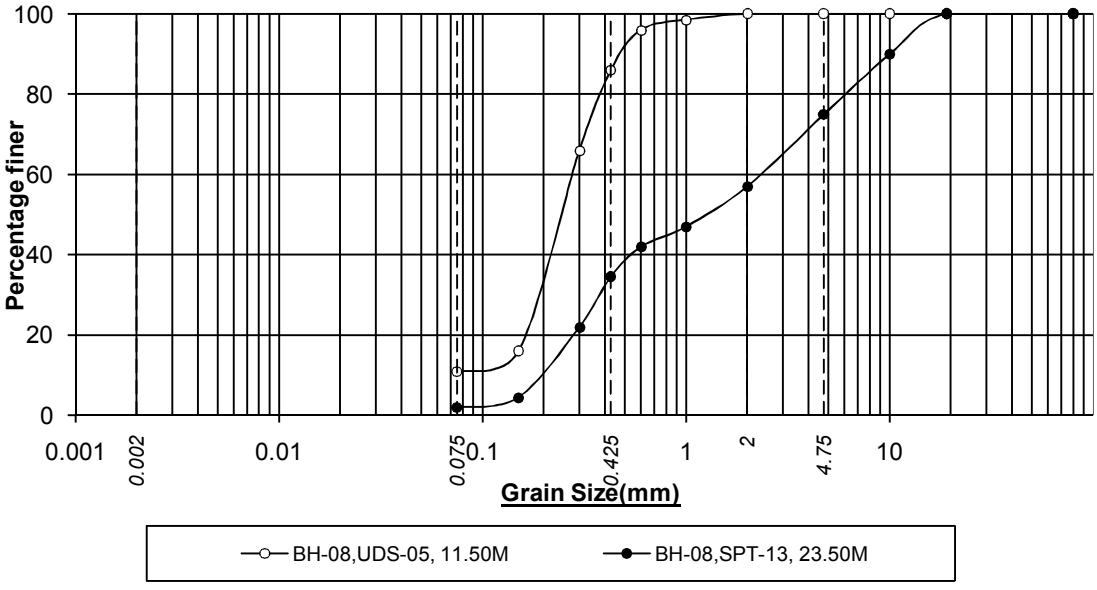
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-08,UDS-01, 2.00M		9.0	73.5	14.5	3.0	91.0	2.904/1.315	0.0
BH-08,UDS-02, 4.00M	6.0	82.3	11.7	0.0	0.0	11.7		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-08,UDS-05, 11.50M		11.0	75.0	14.0	0.0	89.0		0.0
BH-08,SPT-13, 23.50M		2.0	32.5	22.5	18.0	73.0	11.587/0.288	25.0

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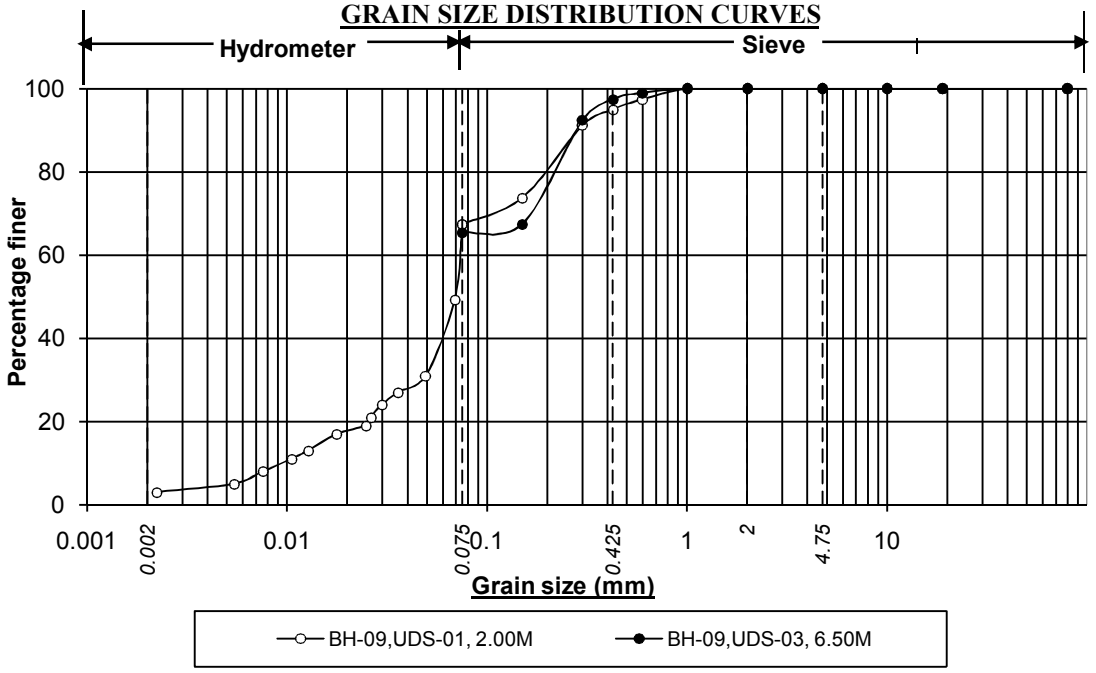
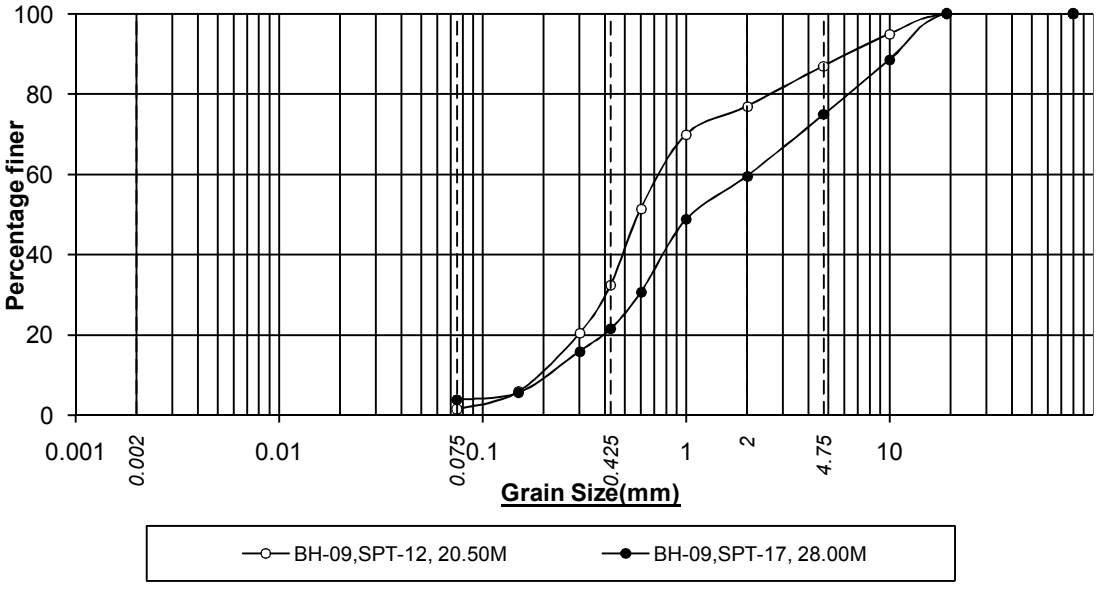
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-09,UDS-01, 2.00M	2.8	64.7	27.5	5.0	0.0	32.5		0.0
BH-09,UDS-03, 6.50M		65.5	32.0	2.5	0.0	34.5		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-09,SPT-12, 20.50M		1.5	31.0	44.5	10.0	85.5	3.715/1.148	13.0
BH-09,SPT-17, 28.00M		4.0	17.6	38.1	15.3	71.0	8.81/0.77	25.0

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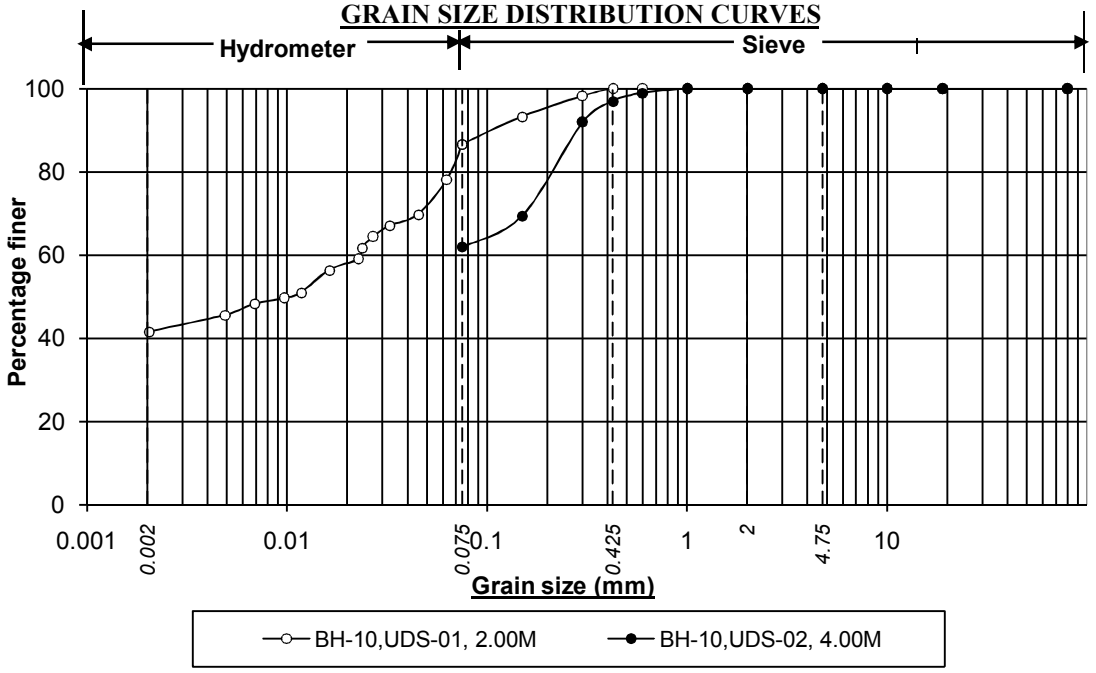
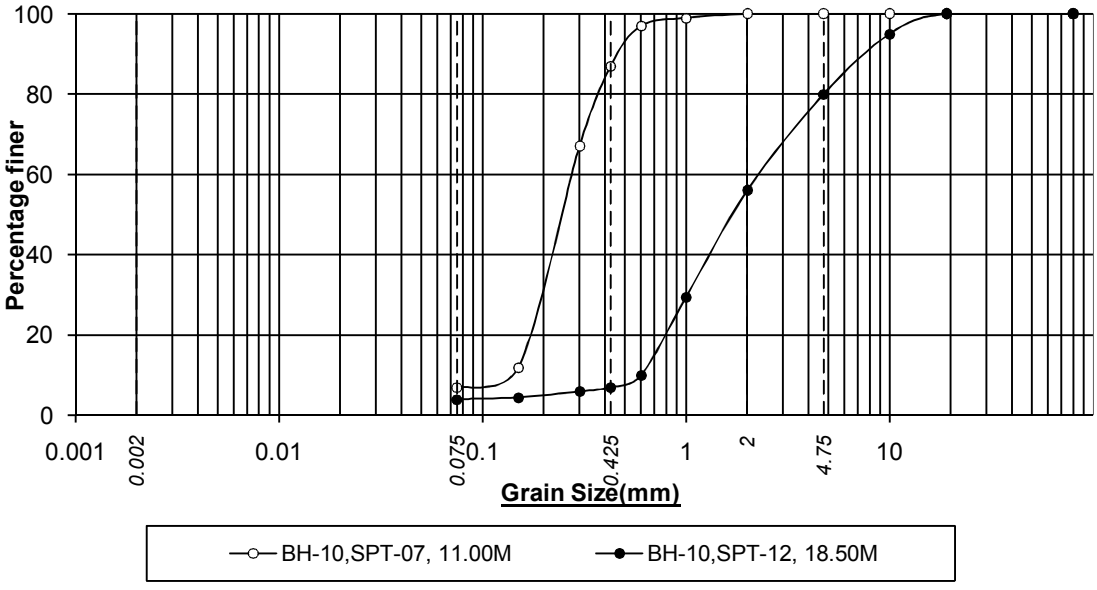
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-10,UDS-01, 2.00M	41.5	45.2	13.3	0.0	0.0	13.3		0.0
BH-10,UDS-02, 4.00M		62.0	35.0	3.0	0.0	38.0		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-10,SPT-07, 11.00M		7.0	80.0	13.0	0.0	93.0	1.972/0.997	0.0
BH-10,SPT-12, 18.50M		4.0	3.0	49.0	24.0	76.0	3.564/0.772	20.0

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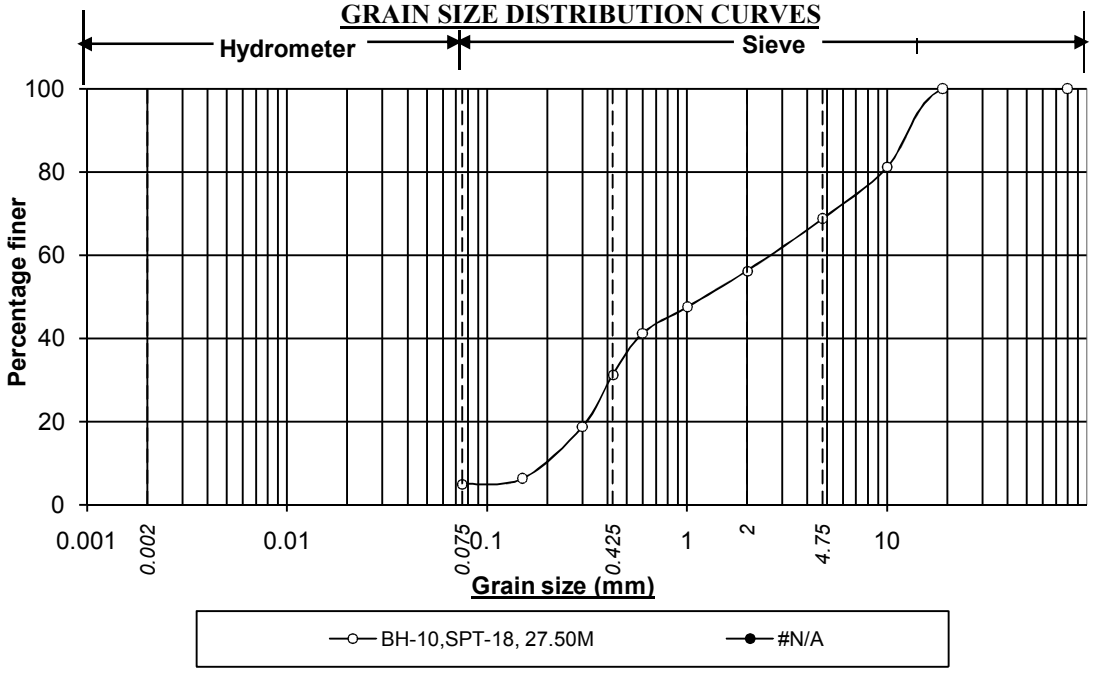
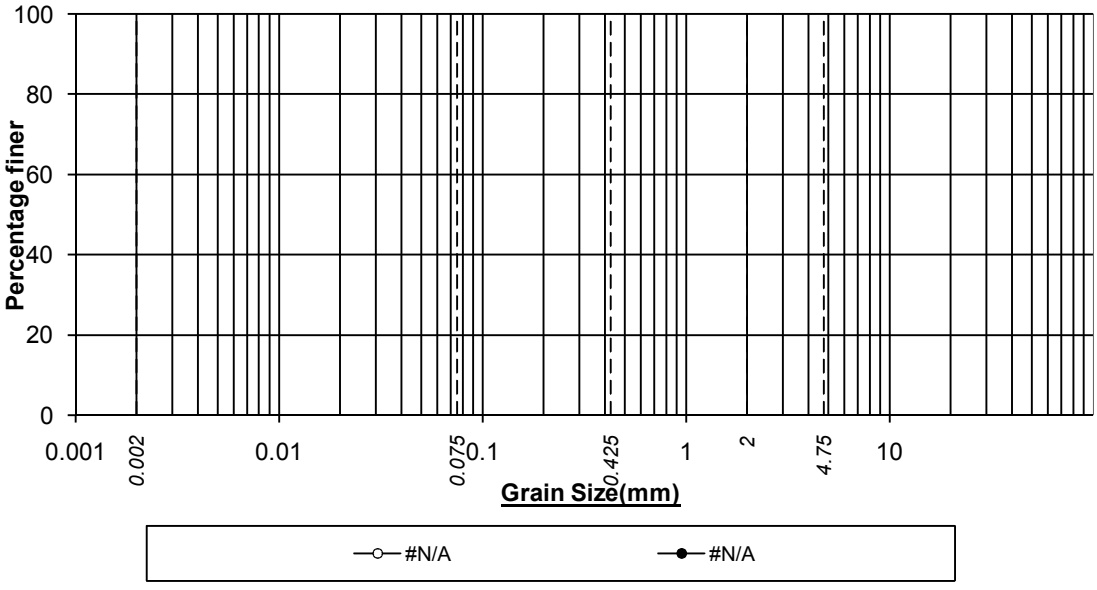
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-10,SPT-18, 27.50M		5.0	26.2	25.0	12.5	63.7	13.091/0.334	31.3



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

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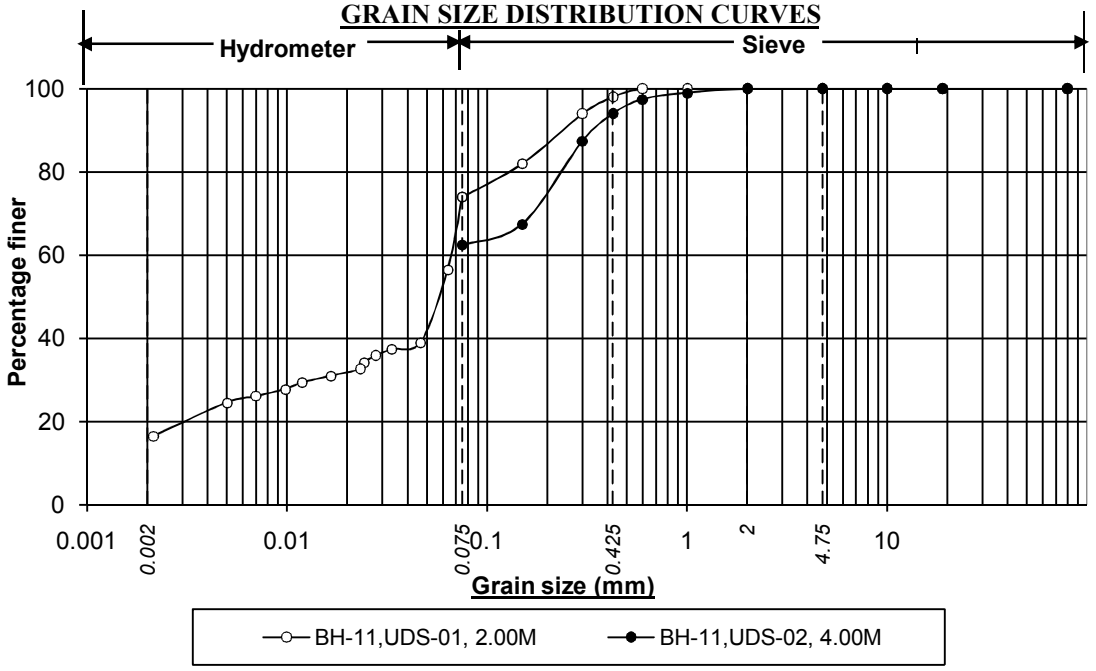
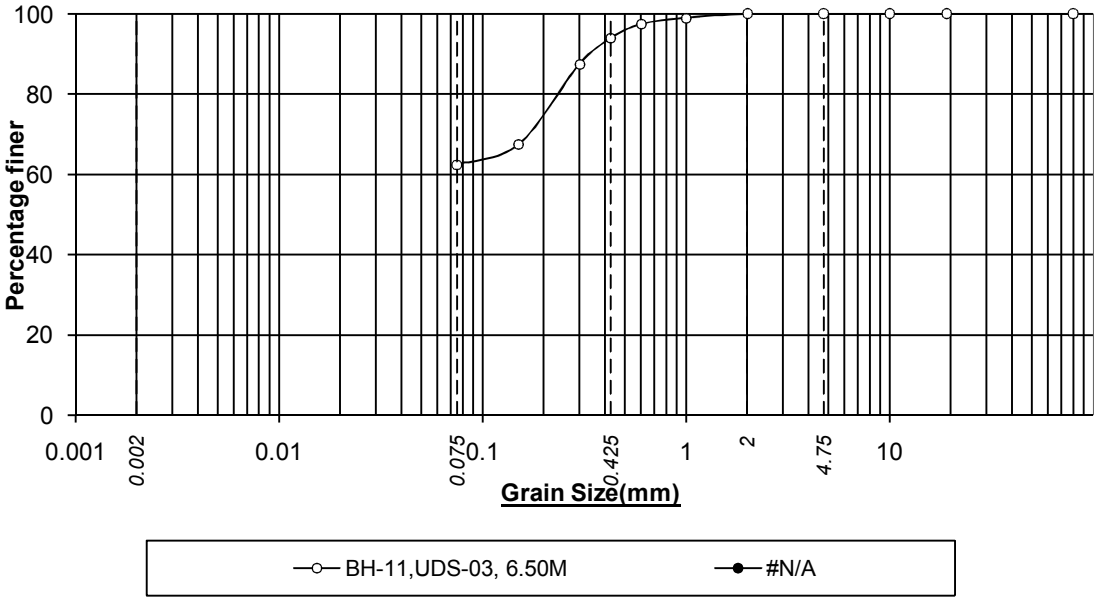
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-11,UDS-01, 2.00M	15.8	58.2	24.0	2.0	0.0	26.0		0.0
BH-11,UDS-02, 4.00M		62.5	31.5	6.0	0.0	37.5		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-11,UDS-03, 6.50M		62.5	31.5	6.0	0.0	37.5		0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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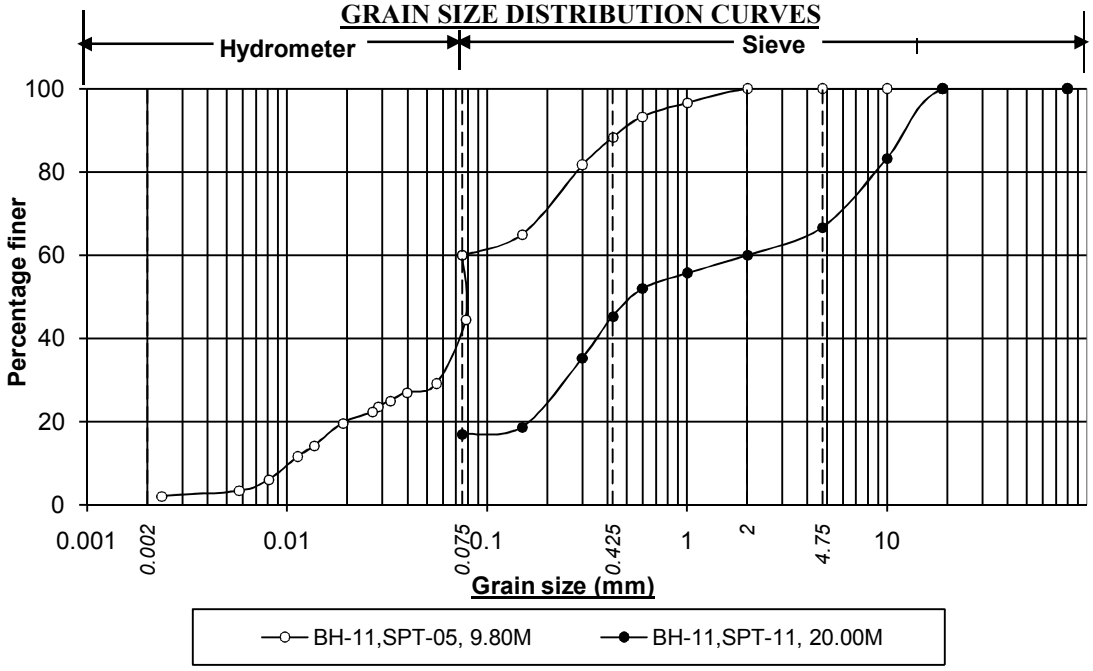
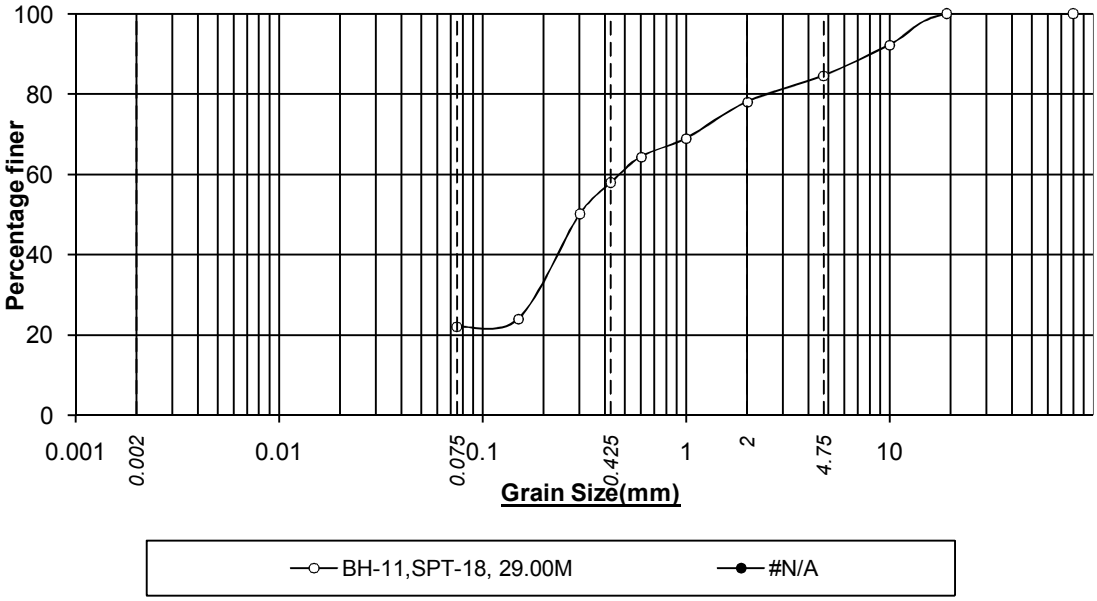
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-11,SPT-05, 9.80M	1.8	58.2	28.3	11.7	0.0	40.0		0.0
BH-11,SPT-11, 20.00M		17.0	28.3	14.7	6.7	49.7		33.3



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-11,SPT-18, 29.00M		22.1	35.8	20.2	6.5	62.5		15.4

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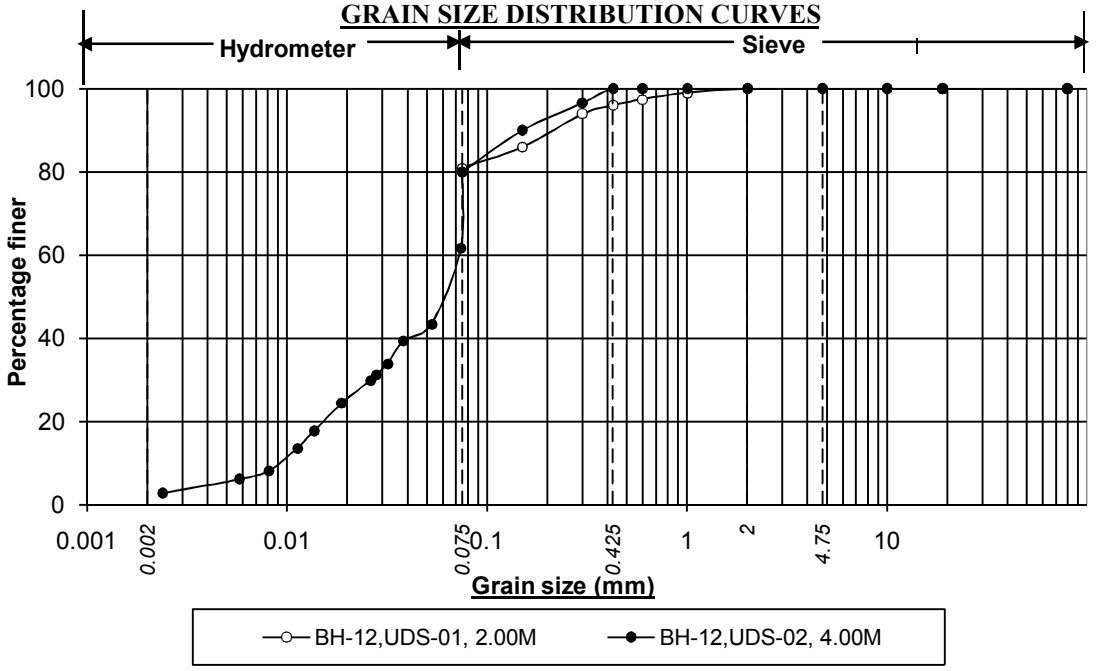
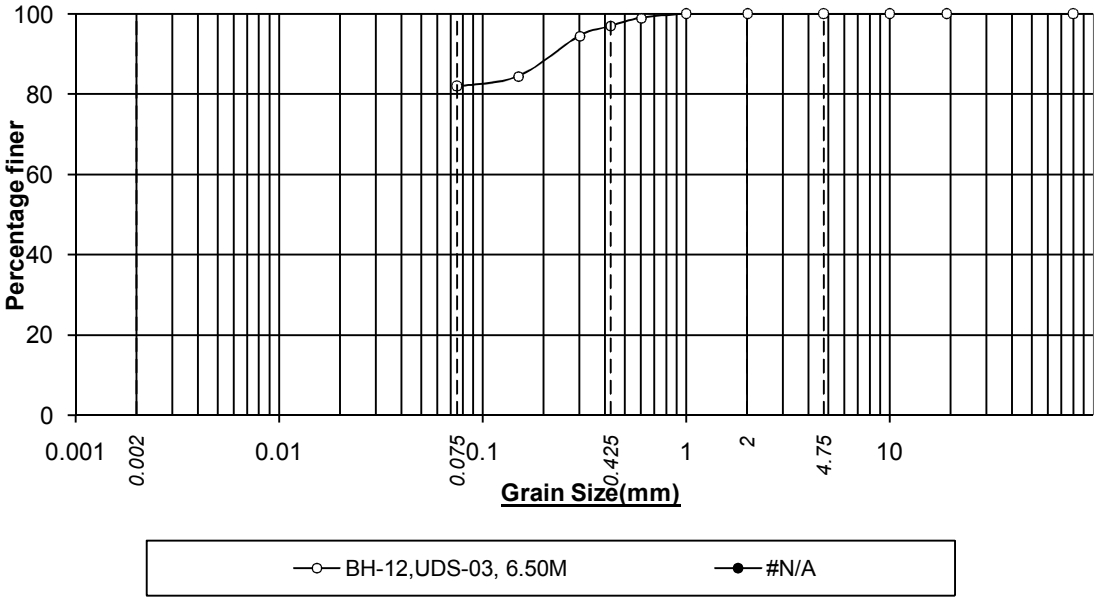
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-12,UDS-01, 2.00M		81.0	15.0	4.0	0.0	19.0		0.0
BH-12,UDS-02, 4.00M	2.0	78.0	20.0	0.0	0.0	20.0		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-12,UDS-03, 6.50M		82.0	15.0	3.0	0.0	18.0		0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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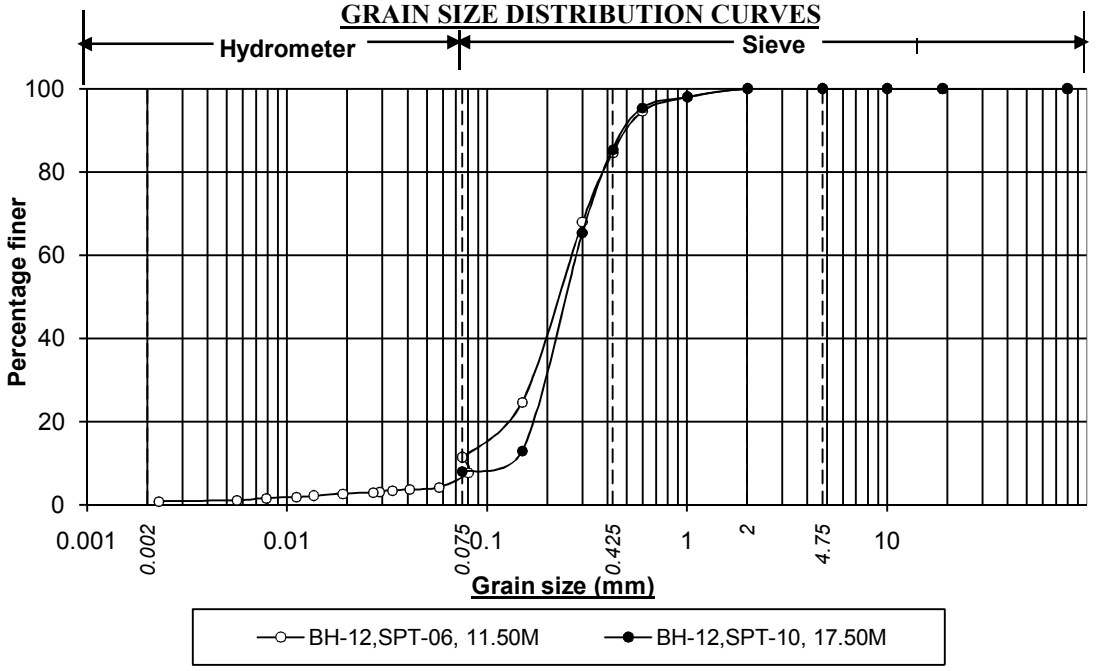
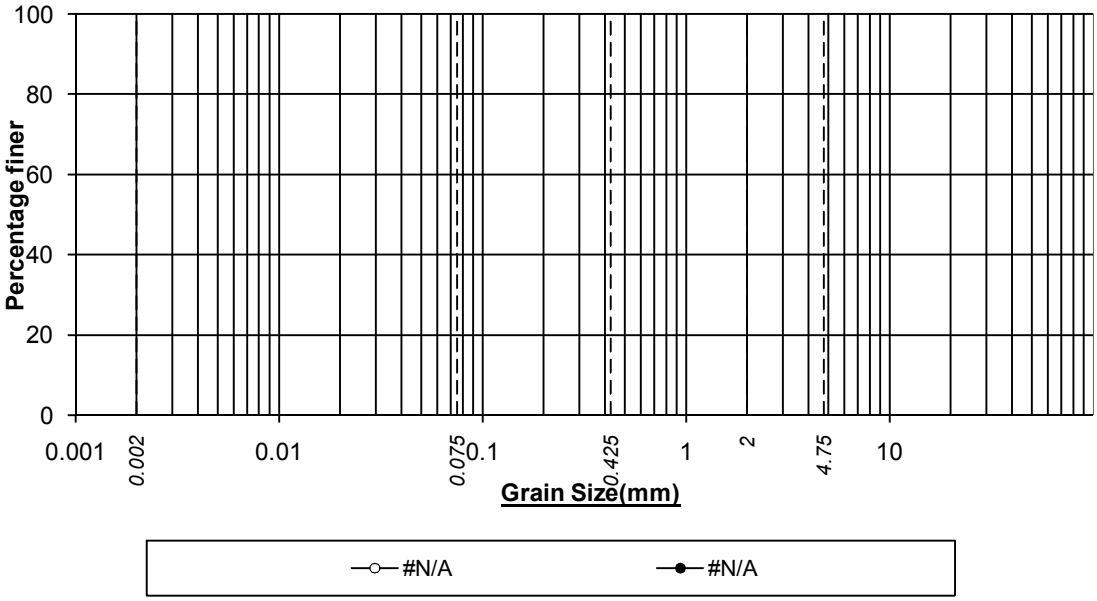
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-12,SPT-06, 11.50M	0.7	10.6	73.4	15.3	0.0	88.7		0.0
BH-12,SPT-10, 17.50M		8.0	77.5	14.5	0.0	92.0	2.084/1.039	0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	Job No. 3369	

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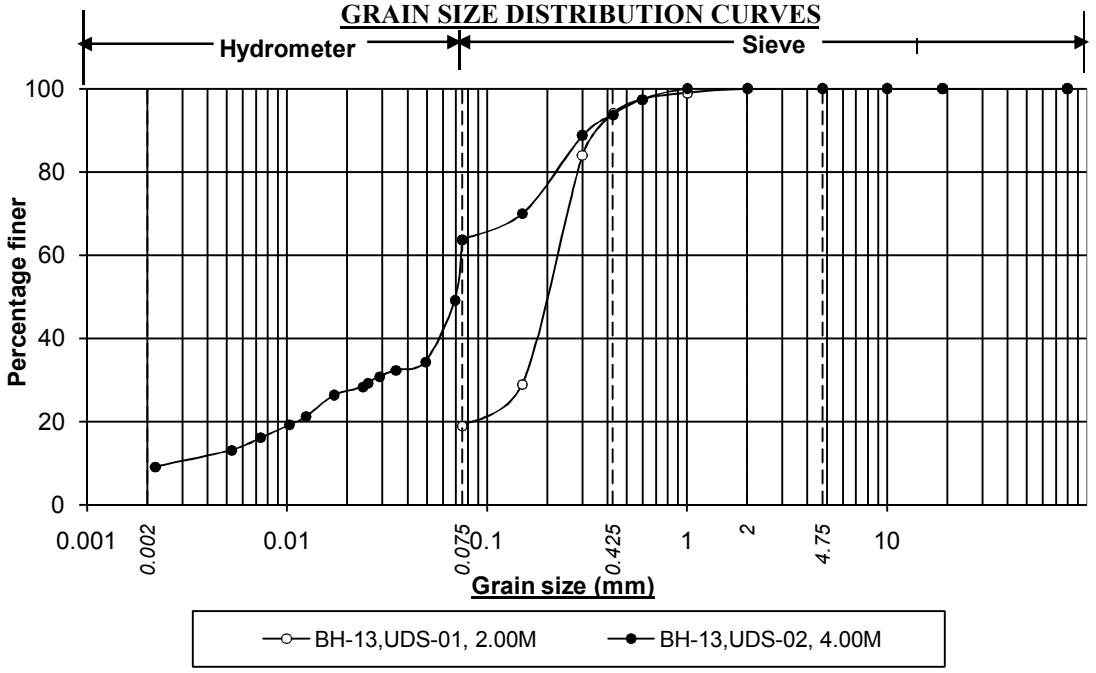
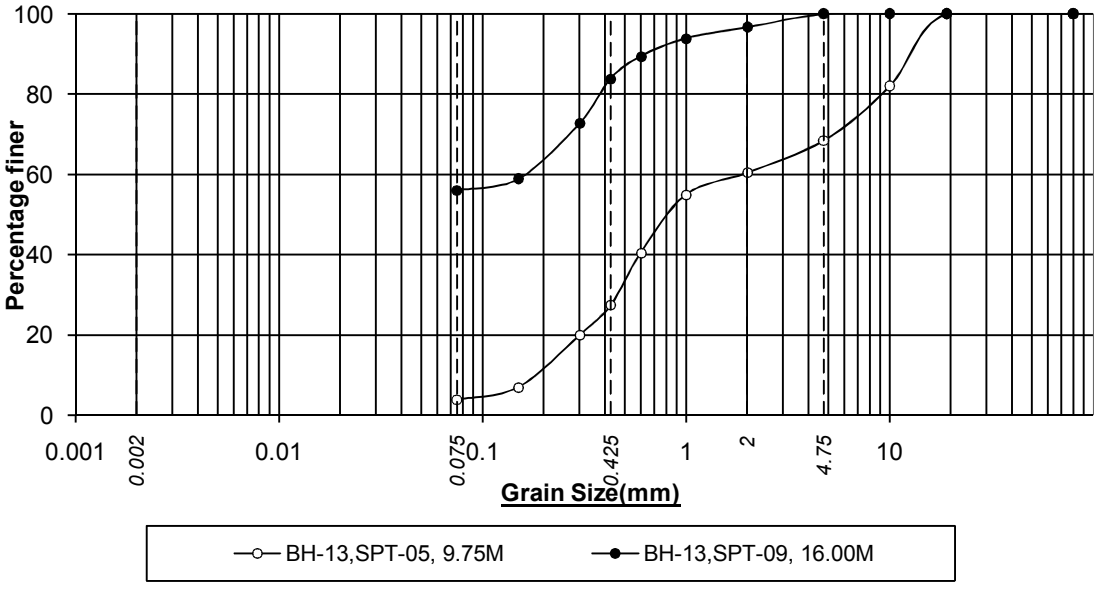
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-13,UDS-01, 2.00M		19.0	75.0	6.0	0.0	81.0		0.0
BH-13,UDS-02, 4.00M	8.7	55.1	29.9	6.3	0.0	36.2		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-13,SPT-05, 9.75M		4.0	23.5	33.0	8.0	64.5	10.303/0.533	31.5
BH-13,SPT-09, 16.00M		56.1	27.8	12.8	3.3	43.9		0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

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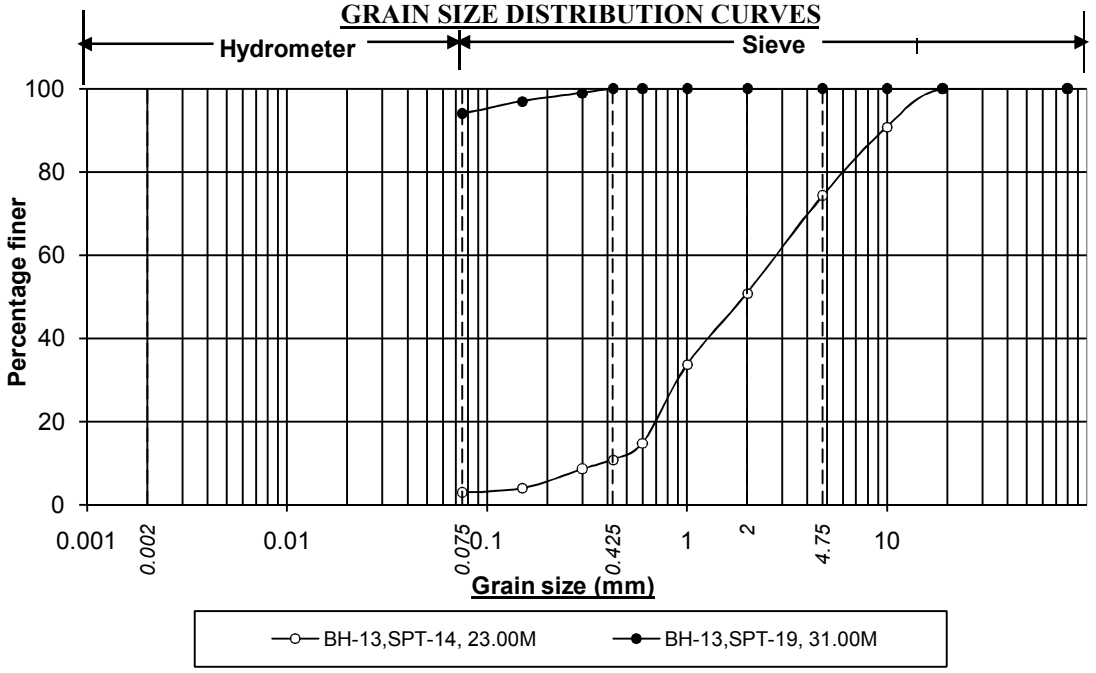
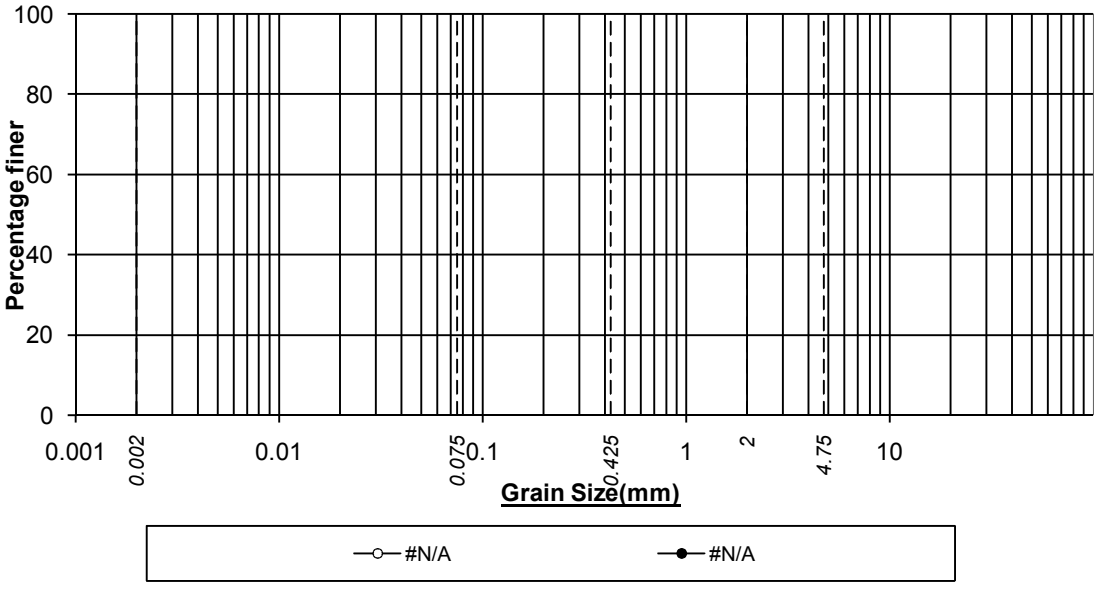


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-13,SPT-14, 23.00M		2.9	8.0	40.0	23.4	71.4	8.147/0.833	25.7
BH-13,SPT-19, 31.00M		94.0	6.0	0.0	0.0	6.0		0.0

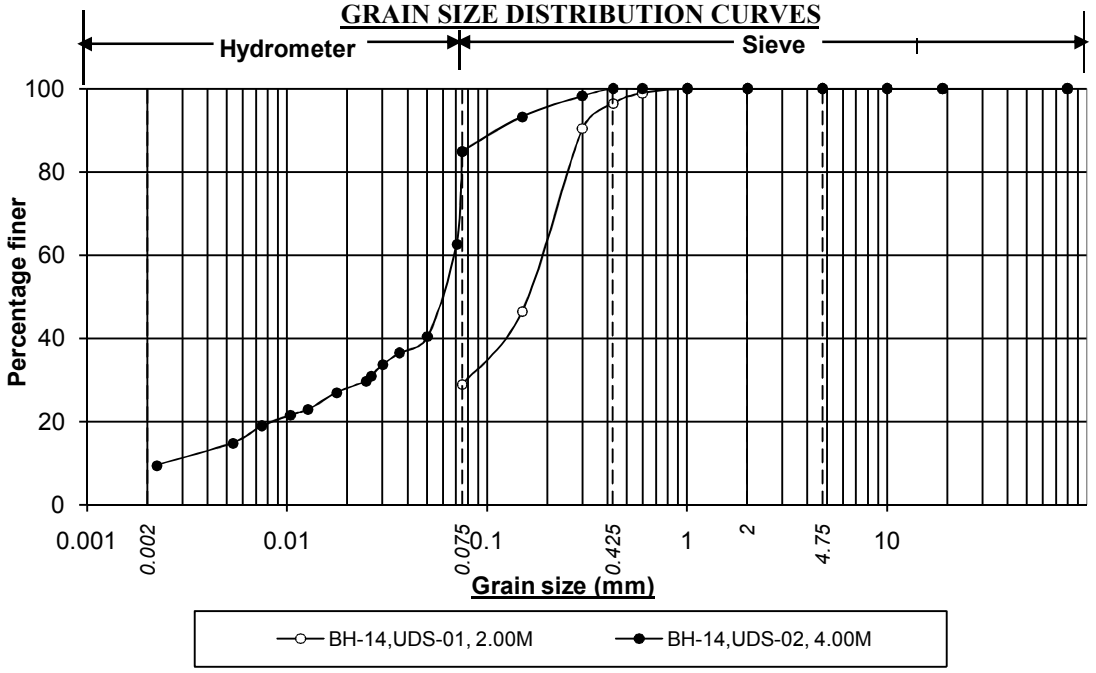


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)

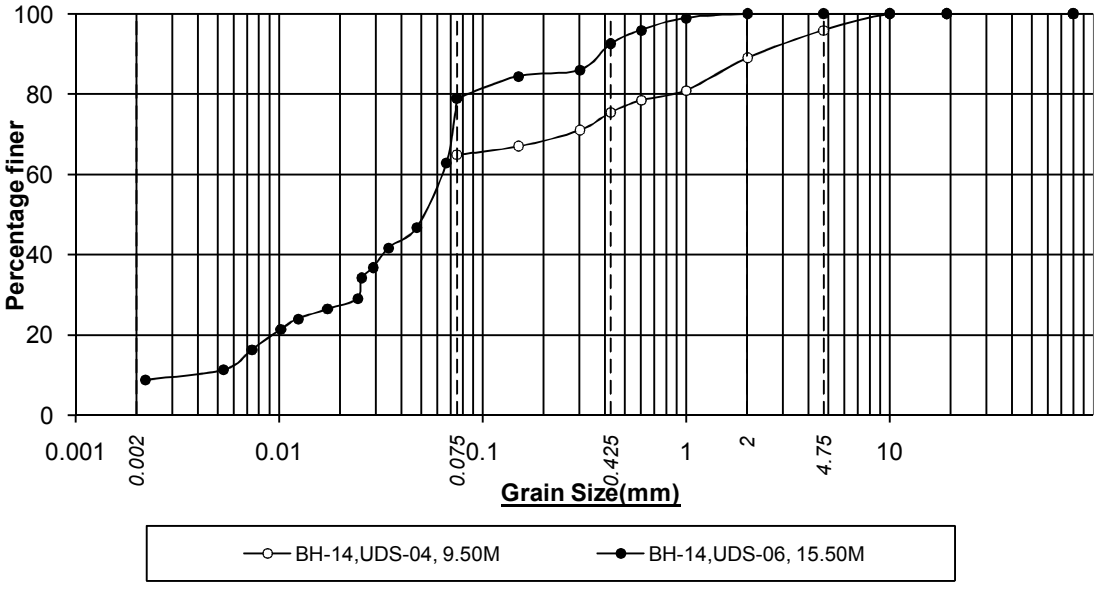
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-14,UDS-01, 2.00M		29.0	67.5	3.5	0.0	71.0		0.0
BH-14,UDS-02, 4.00M	8.8	76.2	15.0	0.0	0.0	15.0		0.0

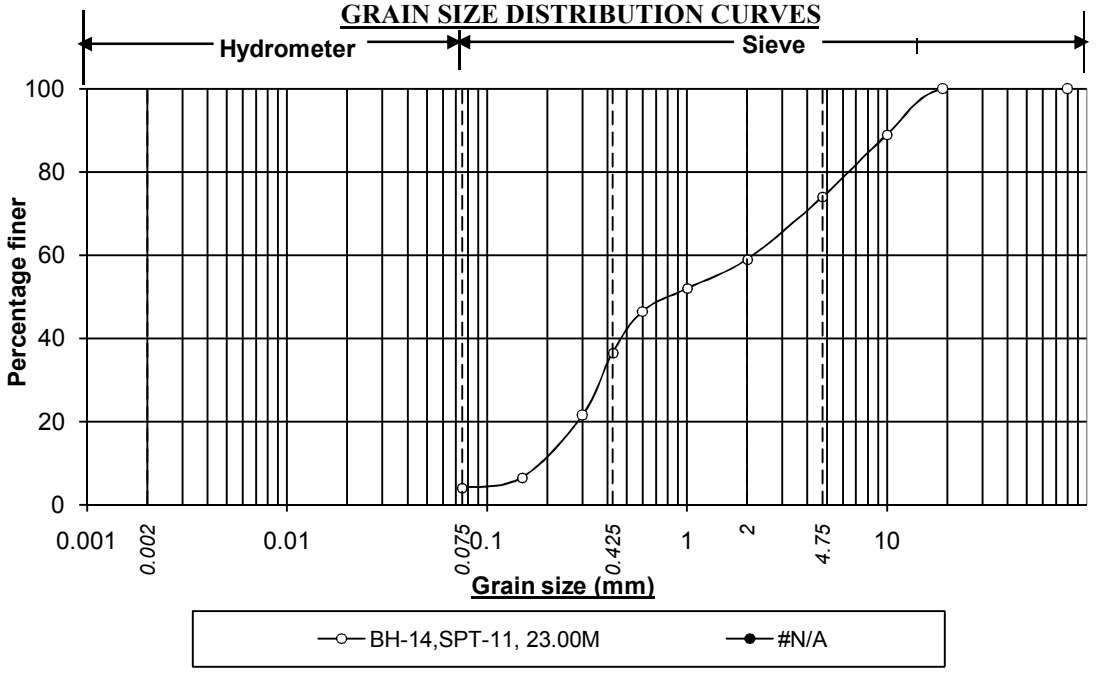


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-14,UDS-04, 9.50M		65.0	10.5	13.5	7.0	31.0		4.0
BH-14,UDS-06, 15.50M	8.6	70.4	13.5	7.5	0.0	21.0		0.0

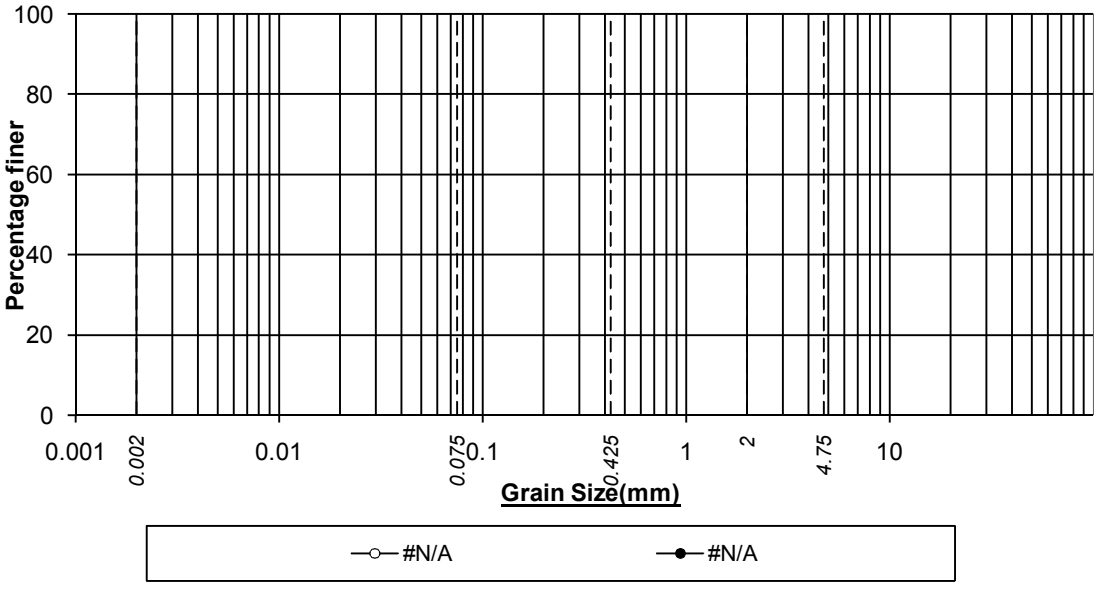
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-14,SPT-11, 23.00M		4.0	32.5	22.5	15.0	70.0	11.614/0.305	26.0

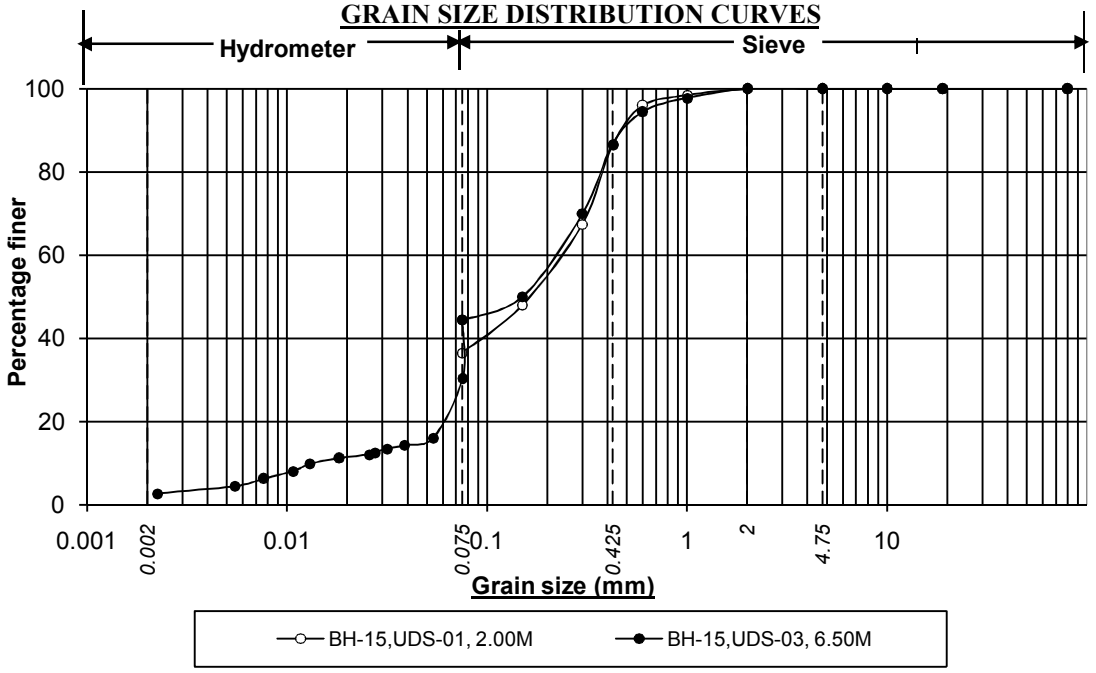


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)

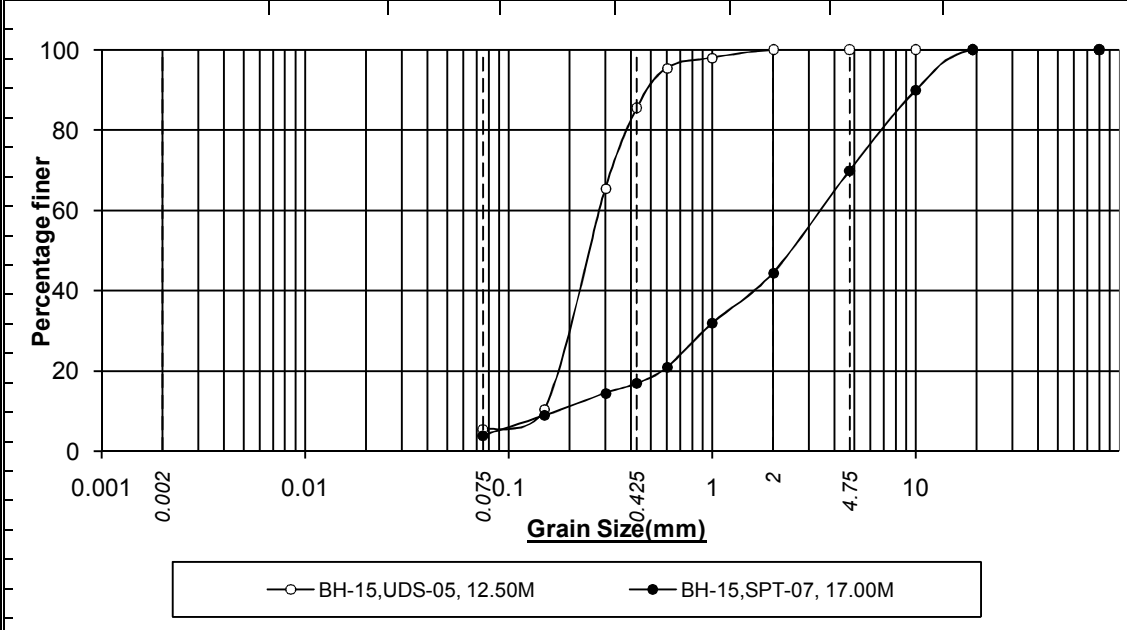
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat	Job No. 3369	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-15,UDS-01, 2.00M		36.5	50.0	13.5	0.0	63.5		0.0
BH-15,UDS-03, 6.50M	2.4	42.0	42.3	13.3	0.0	55.6		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-15,UDS-05, 12.50M		5.5	80.0	14.5	0.0	94.5	1.857/0.926	0.0
BH-15,SPT-07, 17.00M		4.0	13.0	27.5	25.5	66.0	19.906/1.364	30.0

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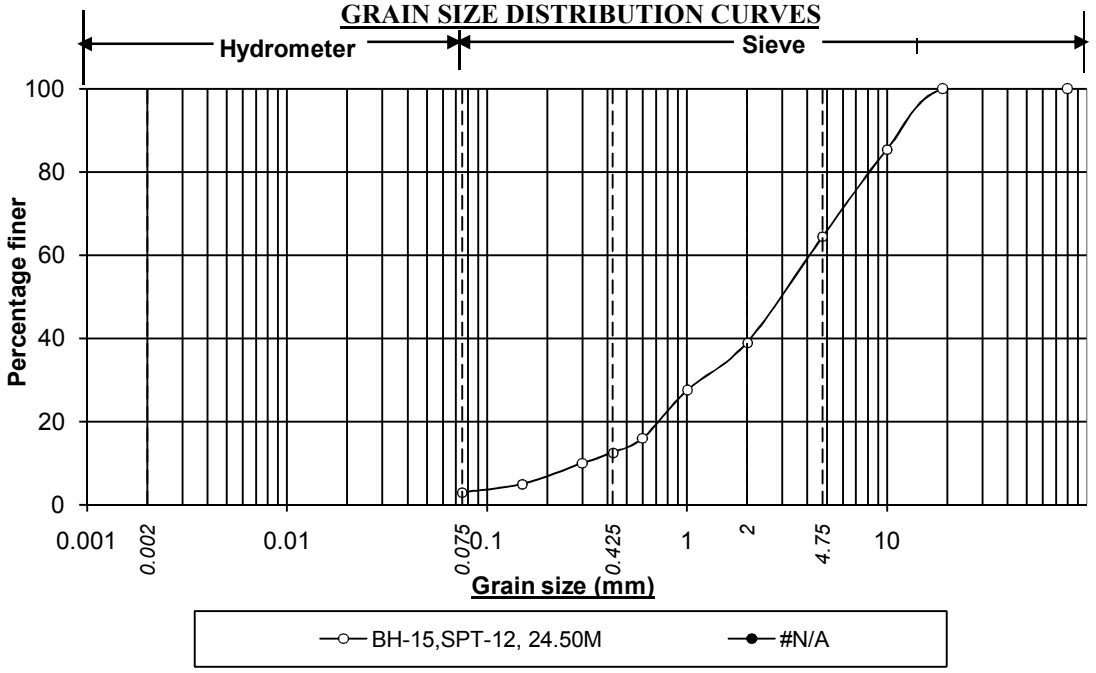
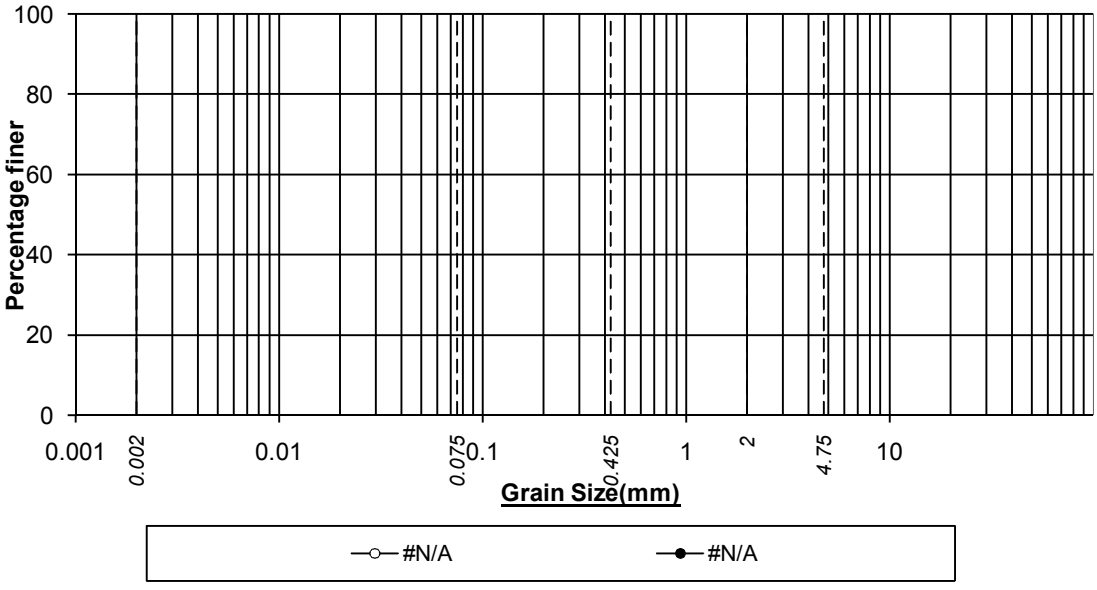
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-15,SPT-12, 24.50M		3.0	9.5	26.5	25.5	61.5	14.791/1.241	35.5

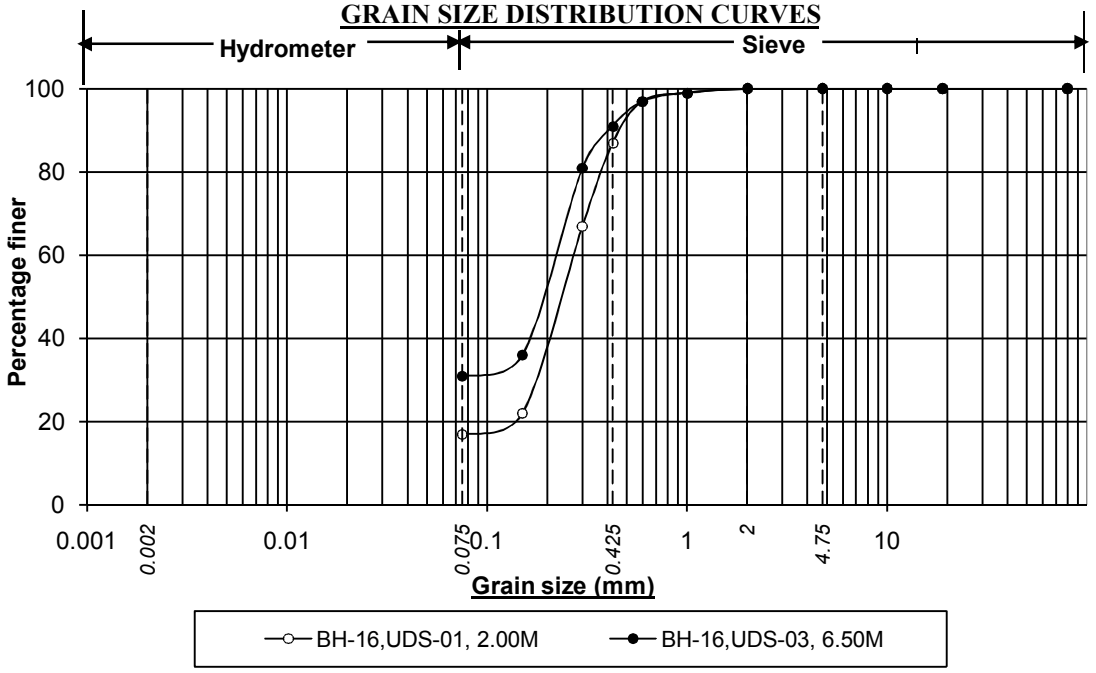


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

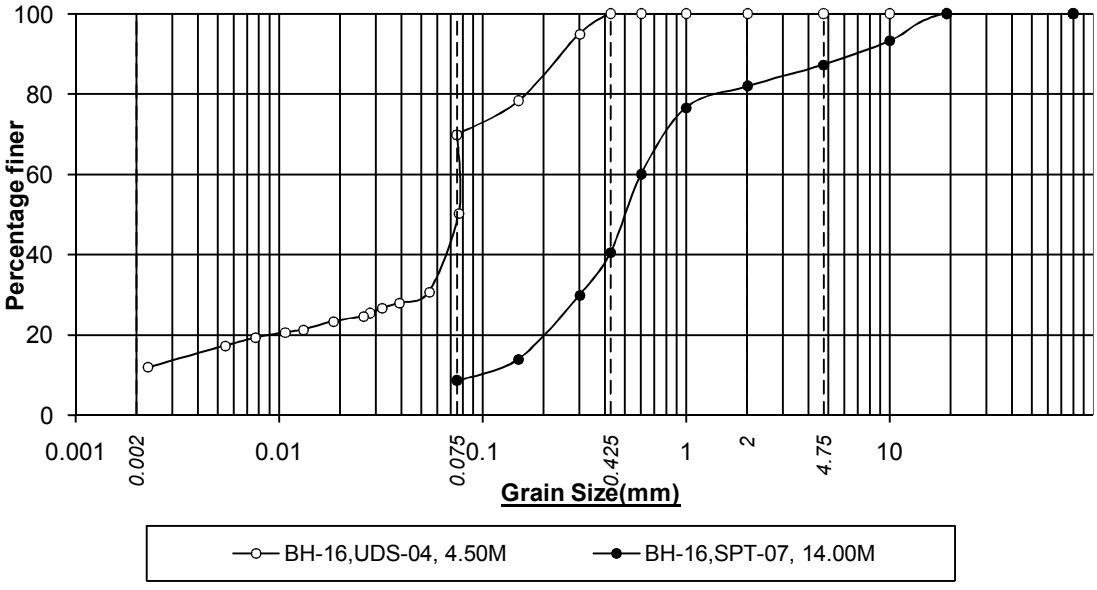
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-16,UDS-01, 2.00M		17.0	70.0	13.0	0.0	83.0		0.0
BH-16,UDS-03, 6.50M		31.0	60.0	9.0	0.0	69.0		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-16,UDS-04, 4.50M	11.3	58.7	30.0	0.0	0.0	30.0		0.0
BH-16,SPT-07, 14.00M		8.7	32.0	41.3	5.3	78.6	5.997/1.506	12.7

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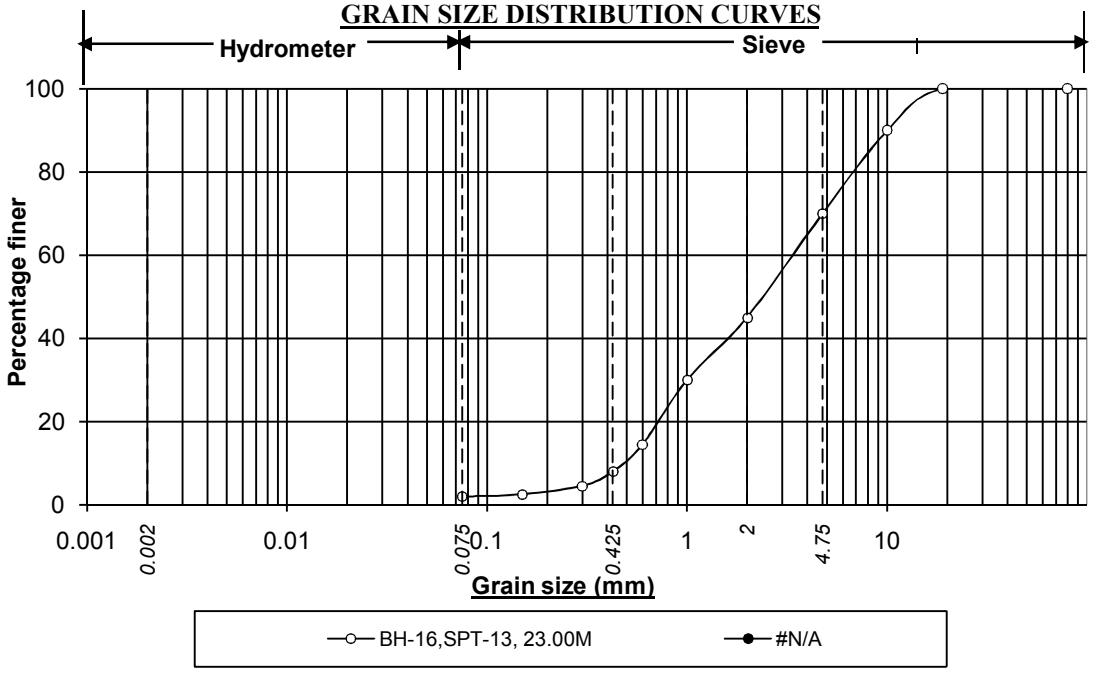
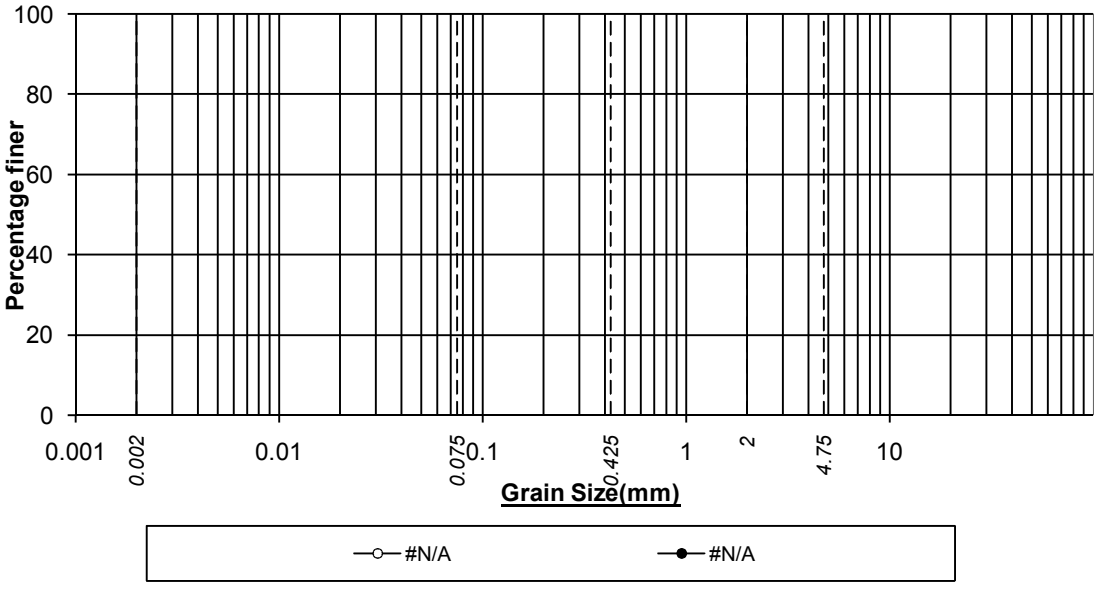
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-16,SPT-13, 23.00M		2.0	6.0	37.0	25.0	68.0	7.294/0.59	30.0

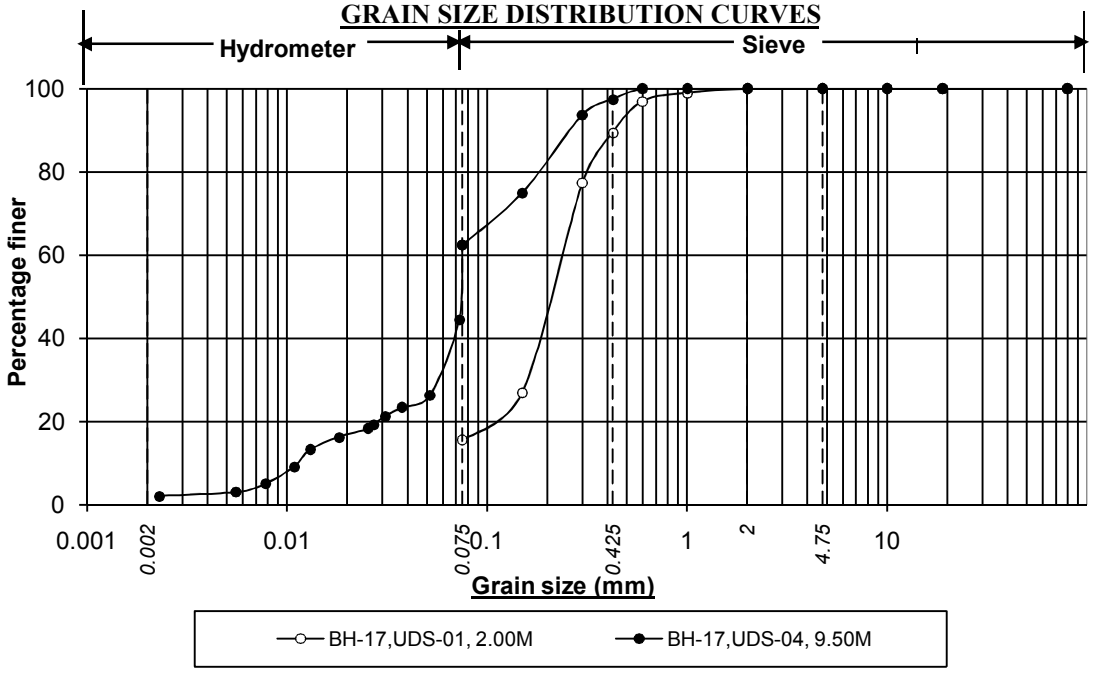


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

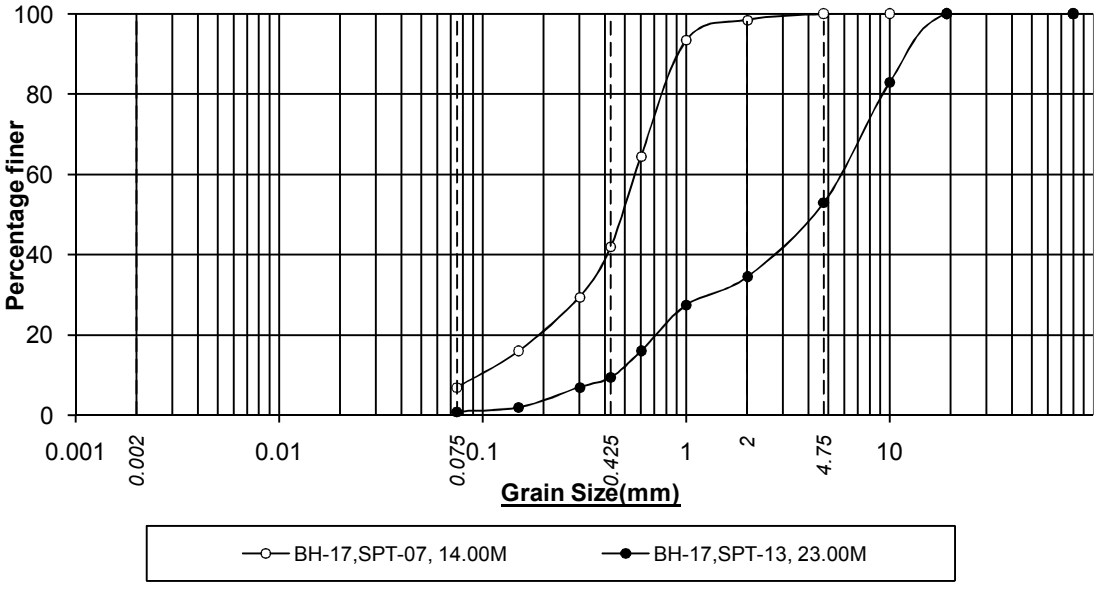
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-17,UDS-01, 2.00M		15.5	74.0	10.5	0.0	84.5		0.0
BH-17,UDS-04, 9.50M	1.9	60.6	35.0	2.5	0.0	37.5		0.0

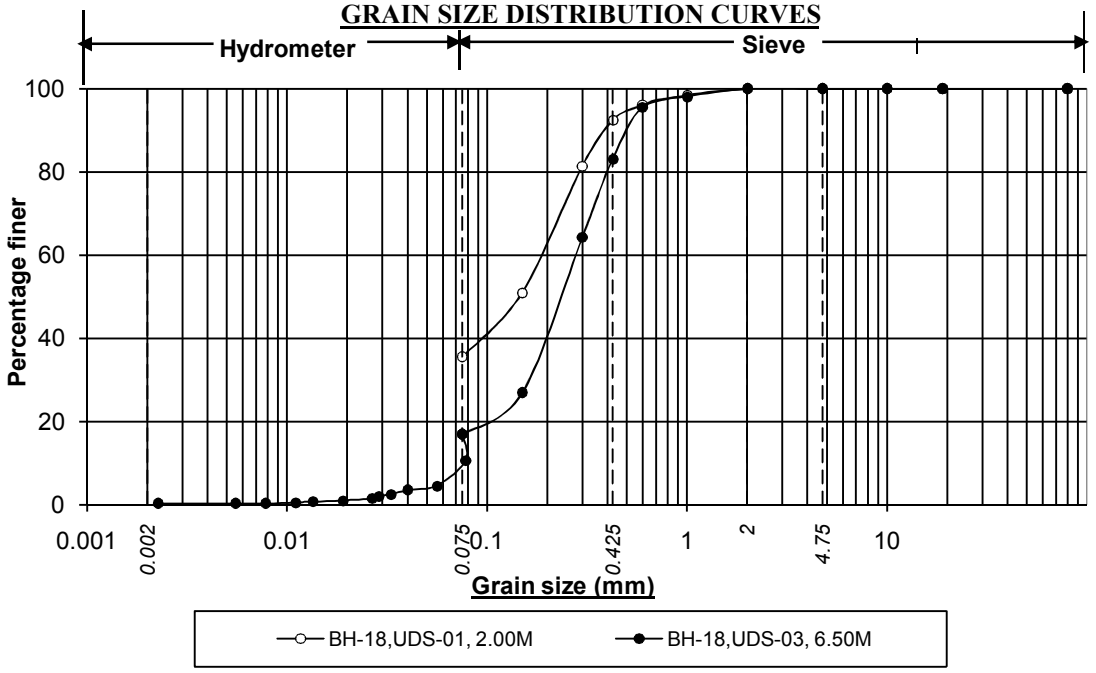


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-17,SPT-07, 14.00M		7.0	35.0	56.5	1.5	93.0	5.956/1.671	0.0
BH-17,SPT-13, 23.00M		1.0	8.5	25.0	18.5	52.0	13.52/0.563	47.0

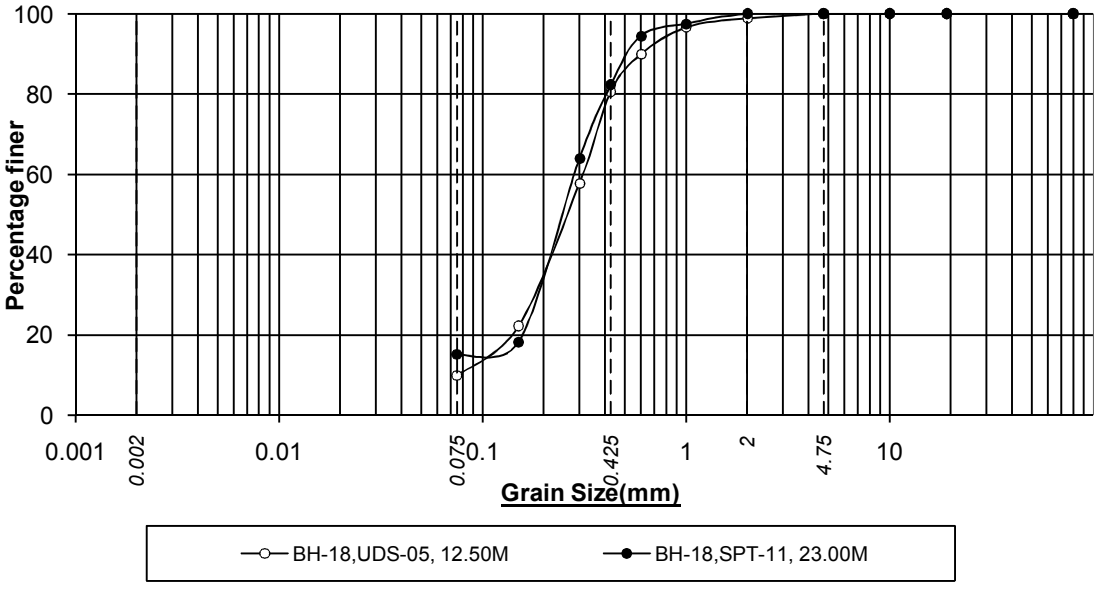
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-18,UDS-01, 2.00M		35.5	57.0	7.5	0.0	64.5		0.0
BH-18,UDS-03, 6.50M	0.2	16.6	66.3	16.9	0.0	83.2		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-18,UDS-05, 12.50M		10.0	70.6	18.3	1.1	90.0	4.111/1.479	0.0
BH-18,SPT-11, 23.00M		15.2	67.1	17.7	0.0	84.8		0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

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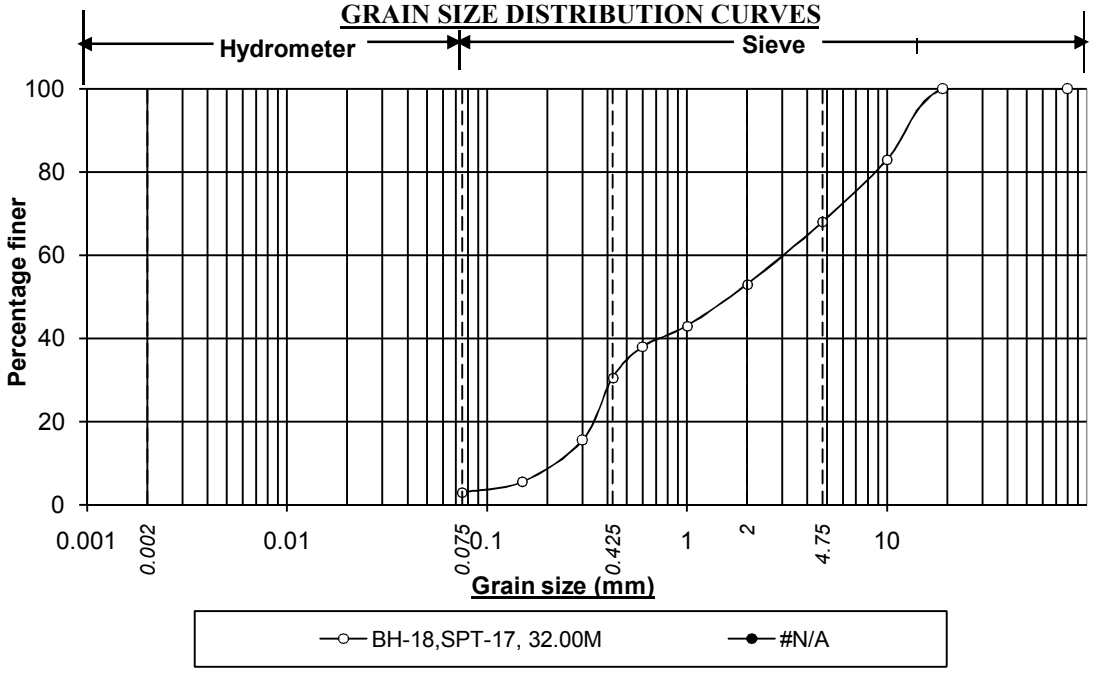
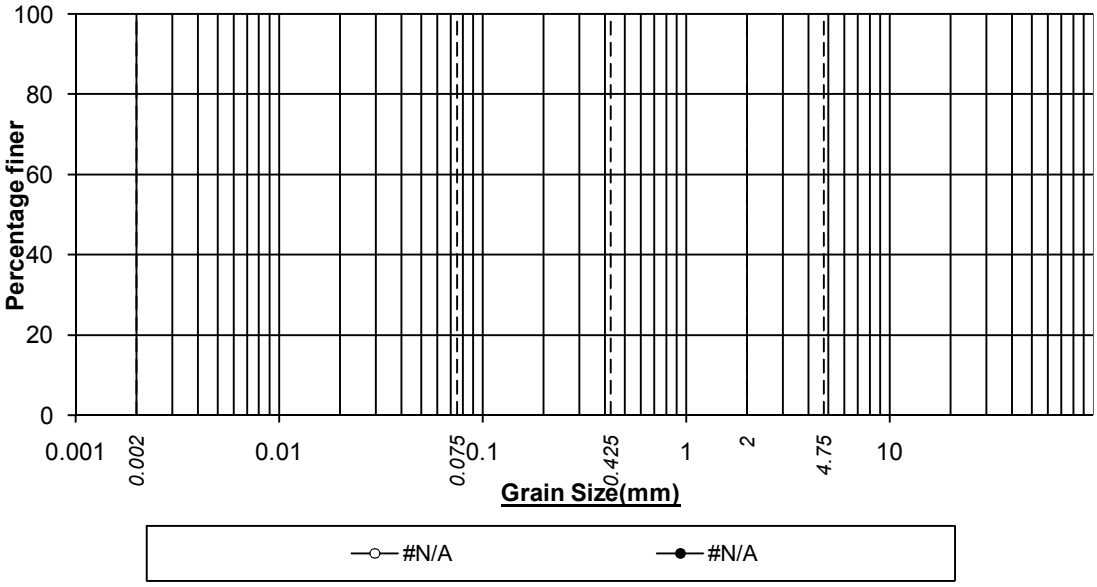
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-18,SPT-17, 32.00M		3.0	27.5	22.5	15.0	65.0	13.772/0.276	32.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

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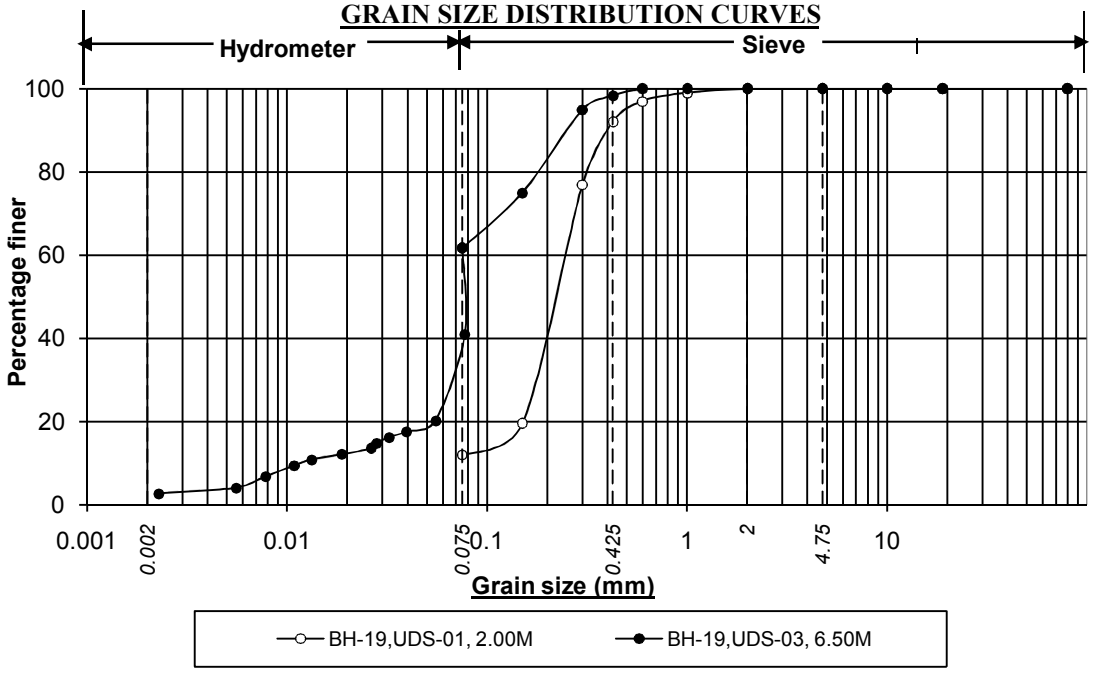
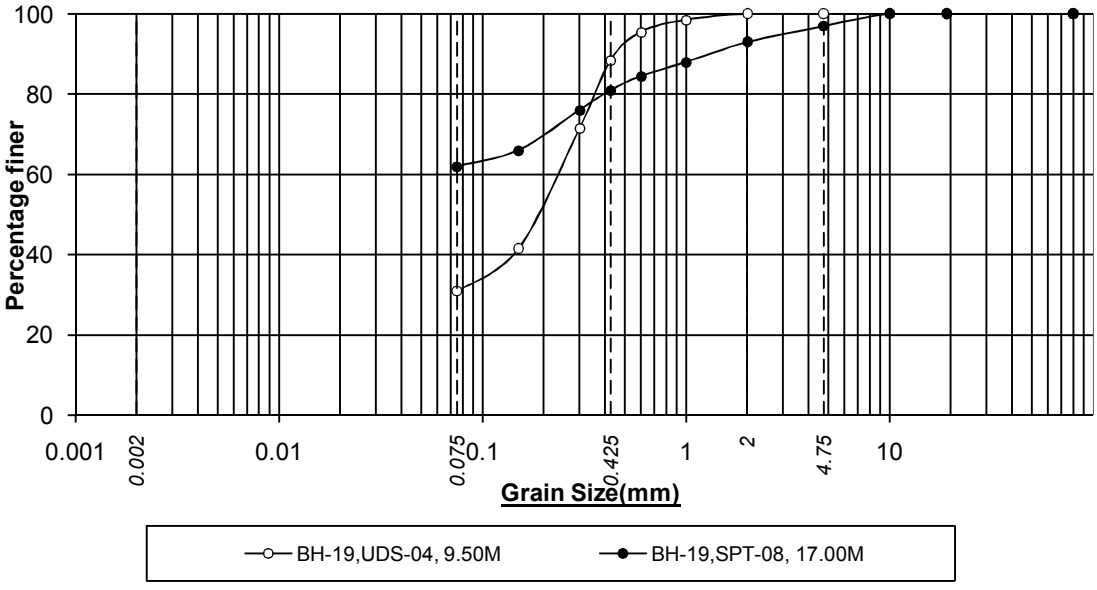
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-19,UDS-01, 2.00M		12.0	80.0	8.0	0.0	88.0		0.0
BH-19,UDS-03, 6.50M	2.5	59.2	36.6	1.7	0.0	38.3		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-19,UDS-04, 9.50M		31.0	57.5	11.5	0.0	69.0		0.0
BH-19,SPT-08, 17.00M		62.0	19.0	12.0	4.0	35.0		3.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat	**Job No. 3369**	

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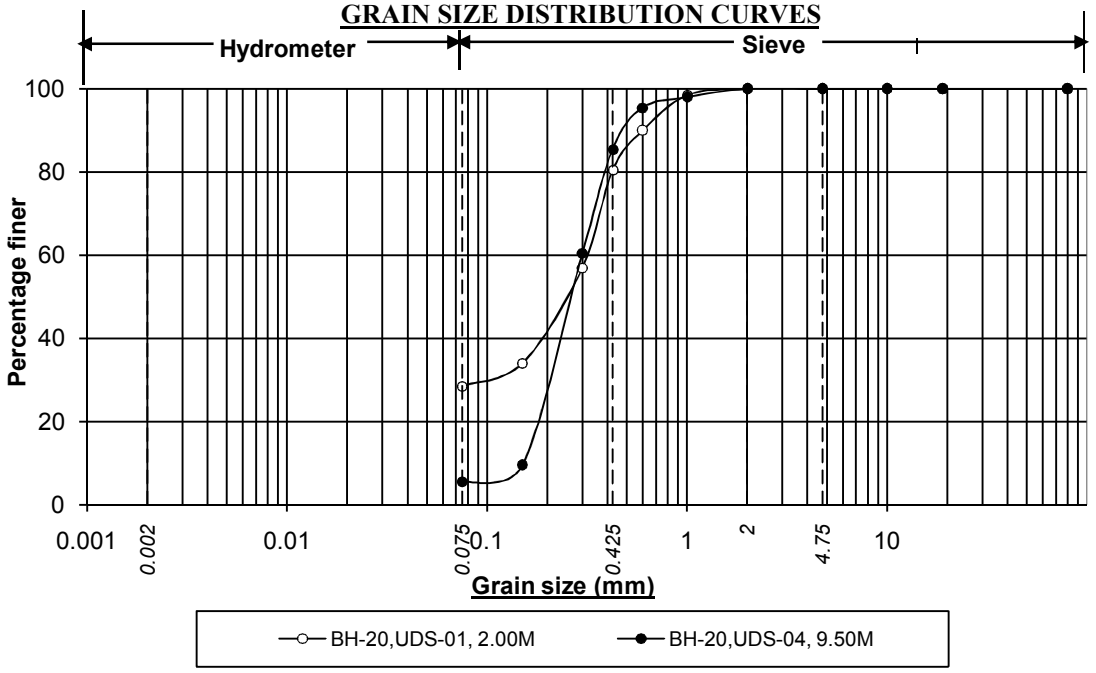
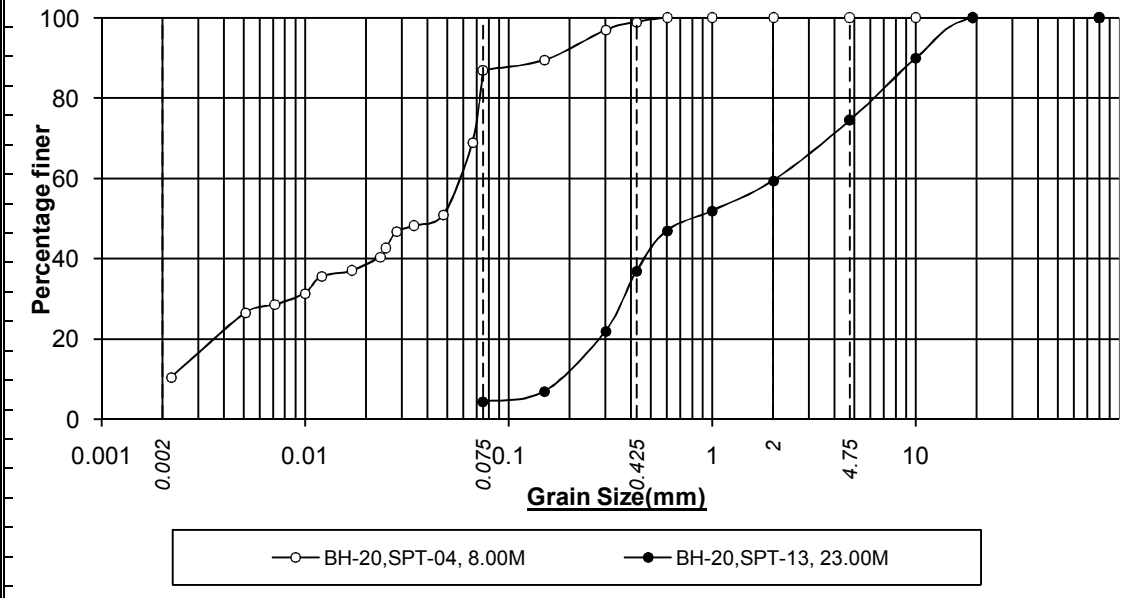
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-20,UDS-01, 2.00M		28.5	52.0	19.5	0.0	71.5		0.0
BH-20,UDS-04, 9.50M		5.5	80.0	14.5	0.0	94.5	1.999/0.914	0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-20,SPT-04, 8.00M	8.7	78.3	12.0	1.0	0.0	13.0		0.0
BH-20,SPT-13, 23.00M		4.5	32.5	22.5	15.0	70.0	11.641/0.343	25.5

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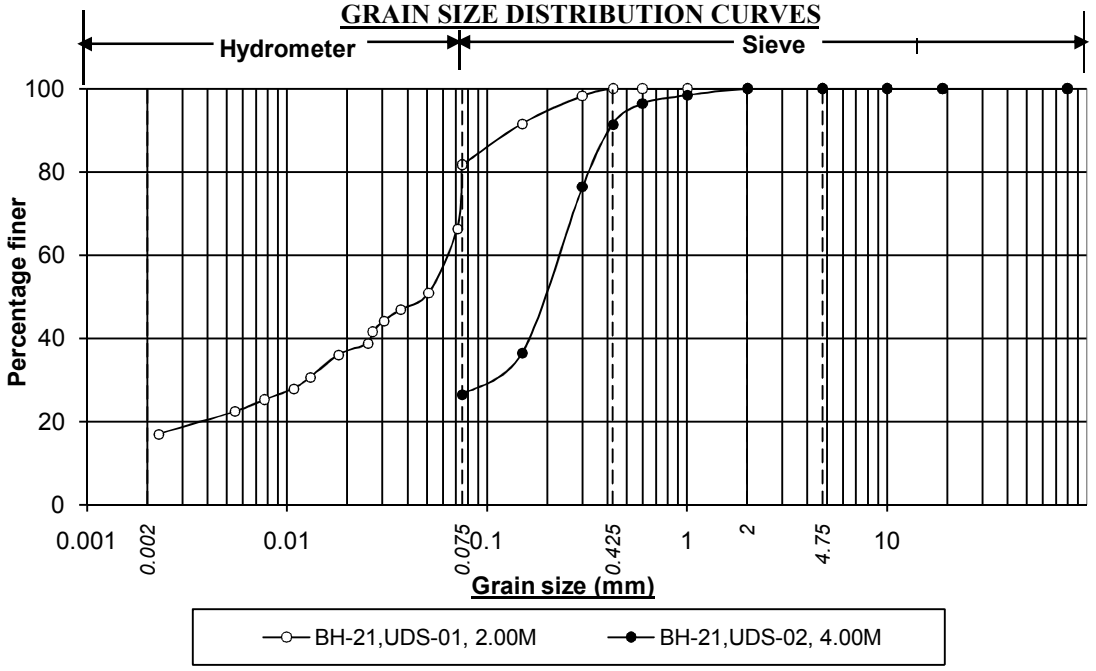
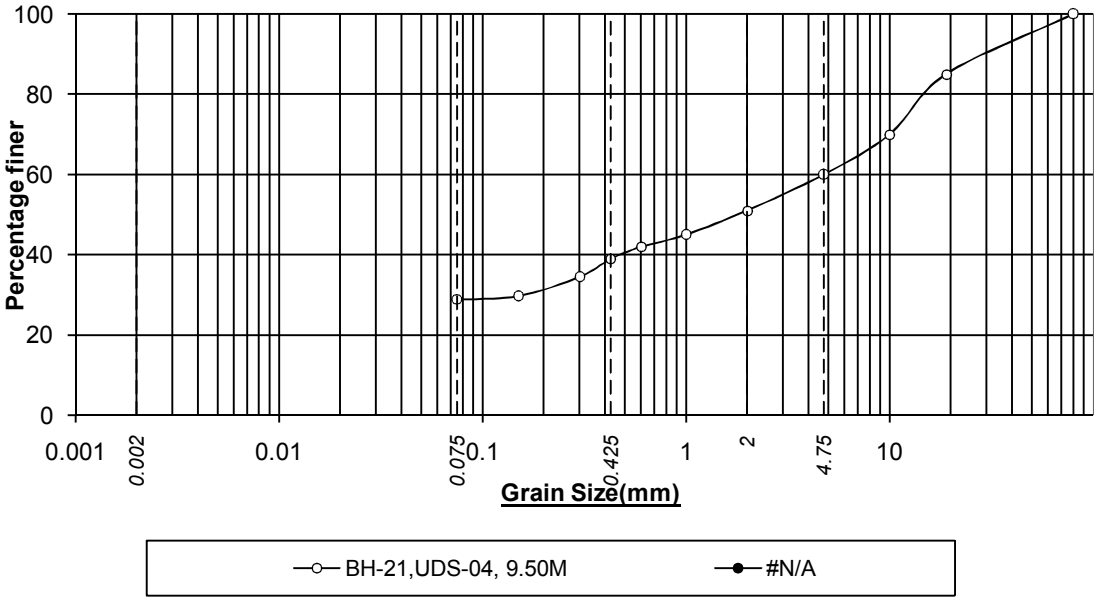
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-21,UDS-01, 2.00M	16.2	65.5	18.3	0.0	0.0	18.3		0.0
BH-21,UDS-02, 4.00M		26.5	65.0	8.5	0.0	73.5		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-21,UDS-04, 9.50M		29.0	10.0	12.0	9.0	31.0		40.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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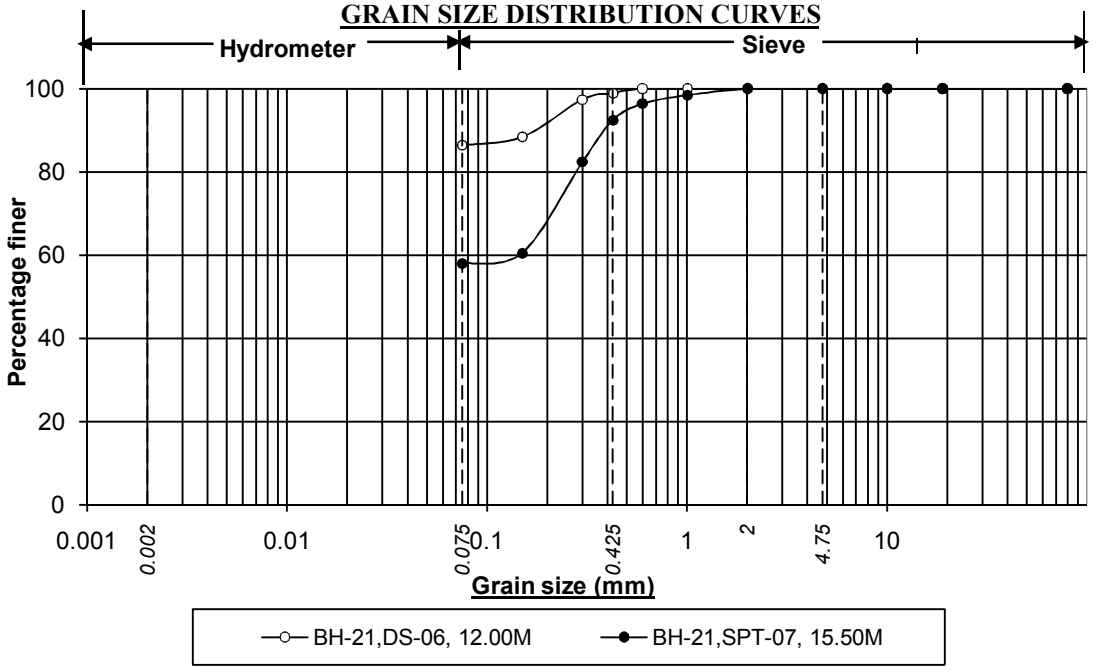
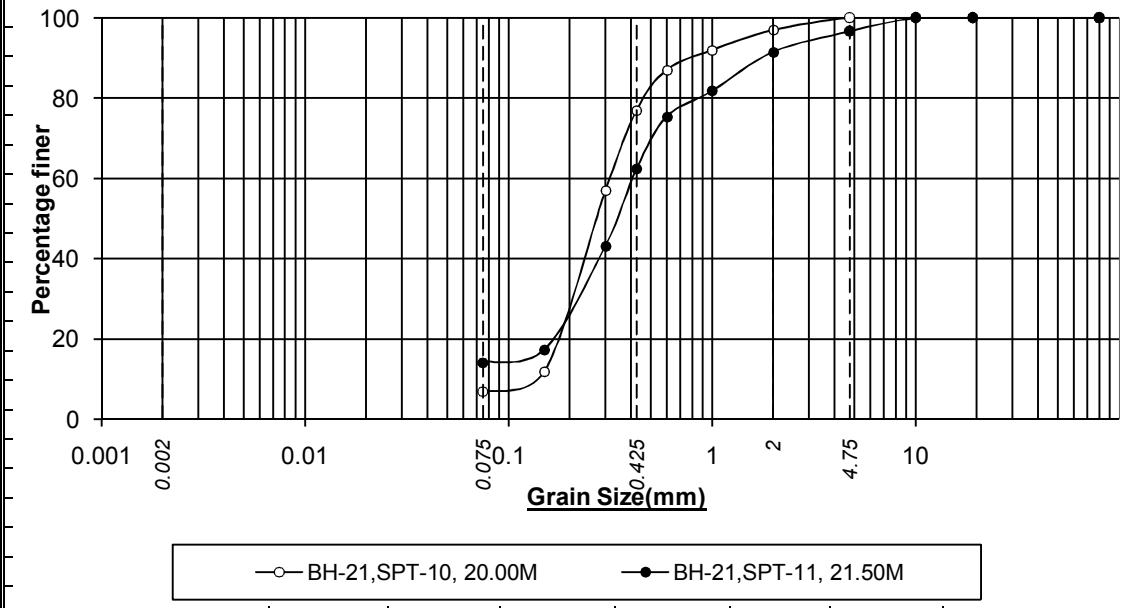
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-21,DS-06, 12.00M		86.5	12.5	1.0	0.0	13.5		0.0
BH-21,SPT-07, 15.50M		58.0	34.5	7.5	0.0	42.0		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-21,SPT-10, 20.00M		7.0	70.0	20.0	3.0	93.0	2.339/0.997	0.0
BH-21,SPT-11, 21.50M		14.2	48.3	29.0	5.2	82.5		3.3

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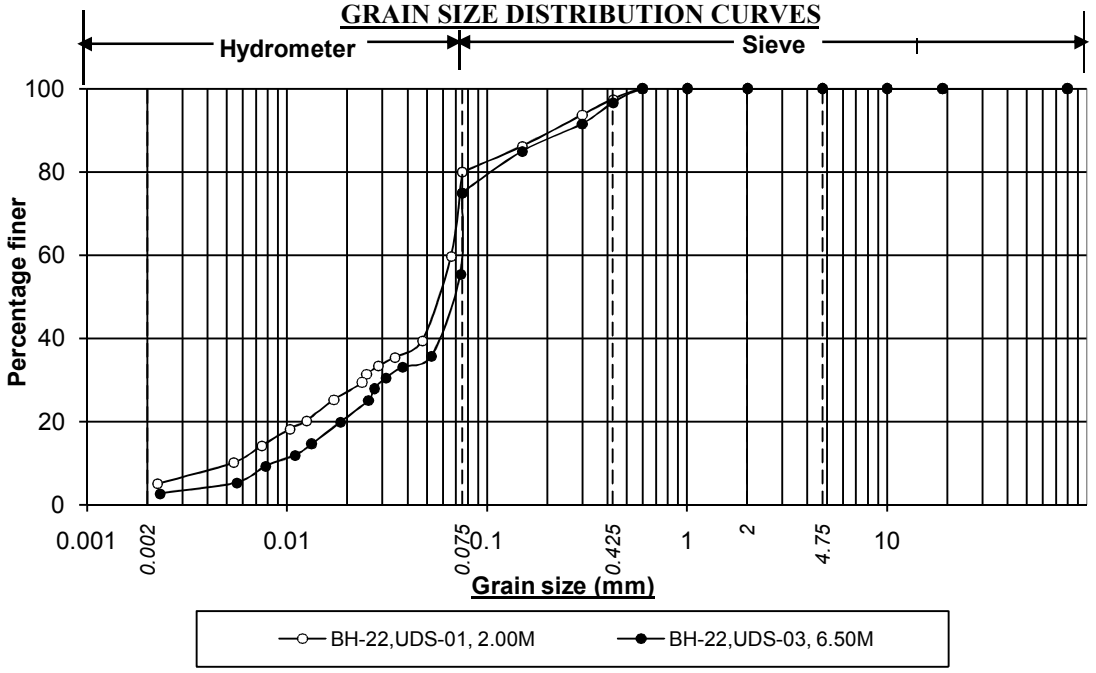
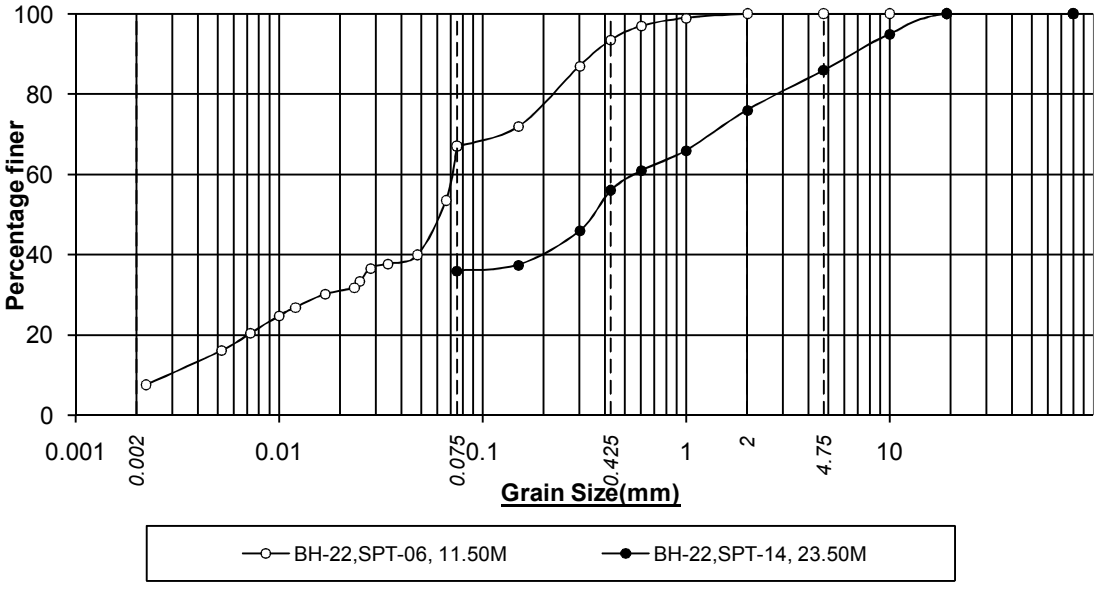
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-22,UDS-01, 2.00M	4.4	75.6	17.5	2.5	0.0	20.0		0.0
BH-22,UDS-03, 6.50M	2.2	72.8	21.7	3.3	0.0	25.0		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-22,SPT-06, 11.50M	6.5	60.5	26.5	6.5	0.0	33.0		0.0
BH-22,SPT-14, 23.50M		36.0	20.0	20.0	10.0	50.0		14.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

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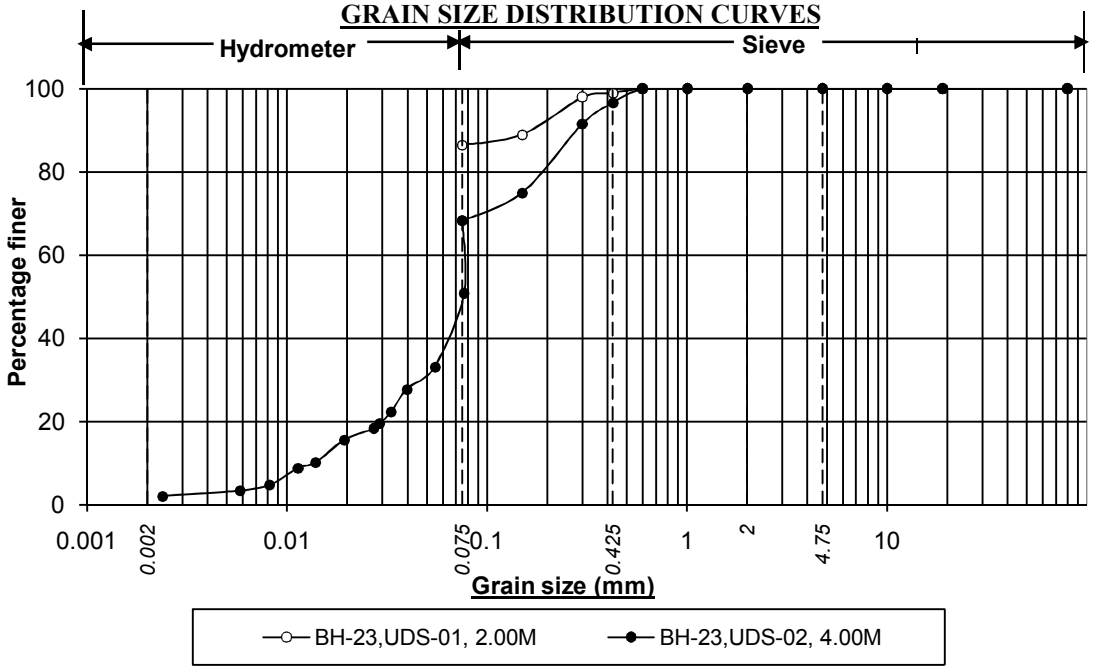
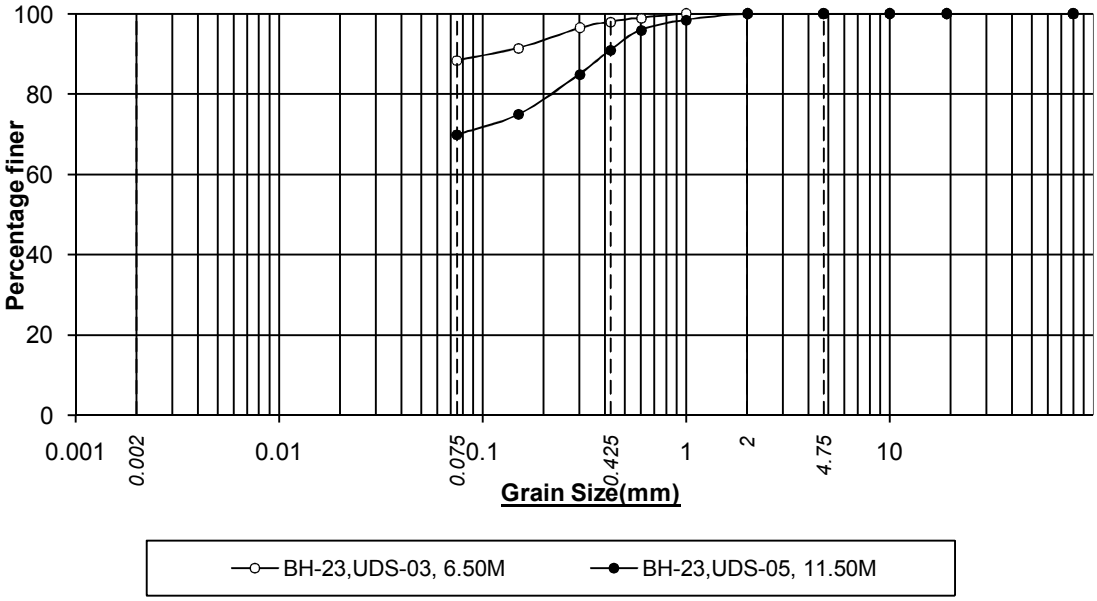
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-23,UDS-01, 2.00M		86.5	12.5	1.0	0.0	13.5		0.0
BH-23,UDS-02, 4.00M	1.8	66.6	28.3	3.3	0.0	31.6		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-23,UDS-03, 6.50M		88.5	9.5	2.0	0.0	11.5		0.0
BH-23,UDS-05, 11.50M		70.0	21.0	9.0	0.0	30.0		0.0

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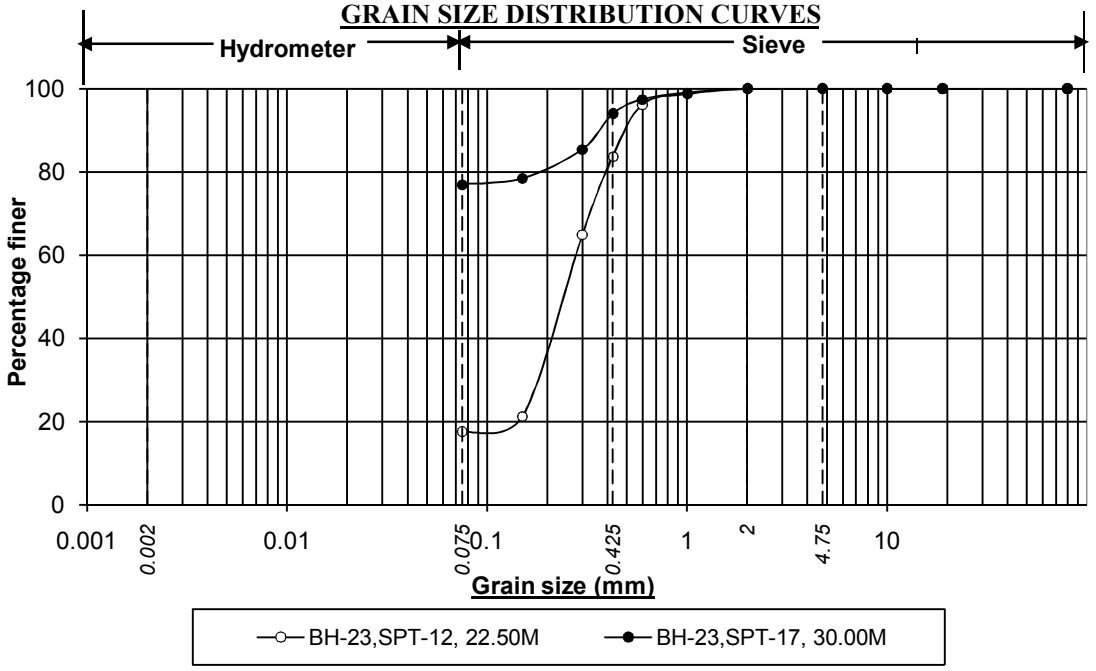
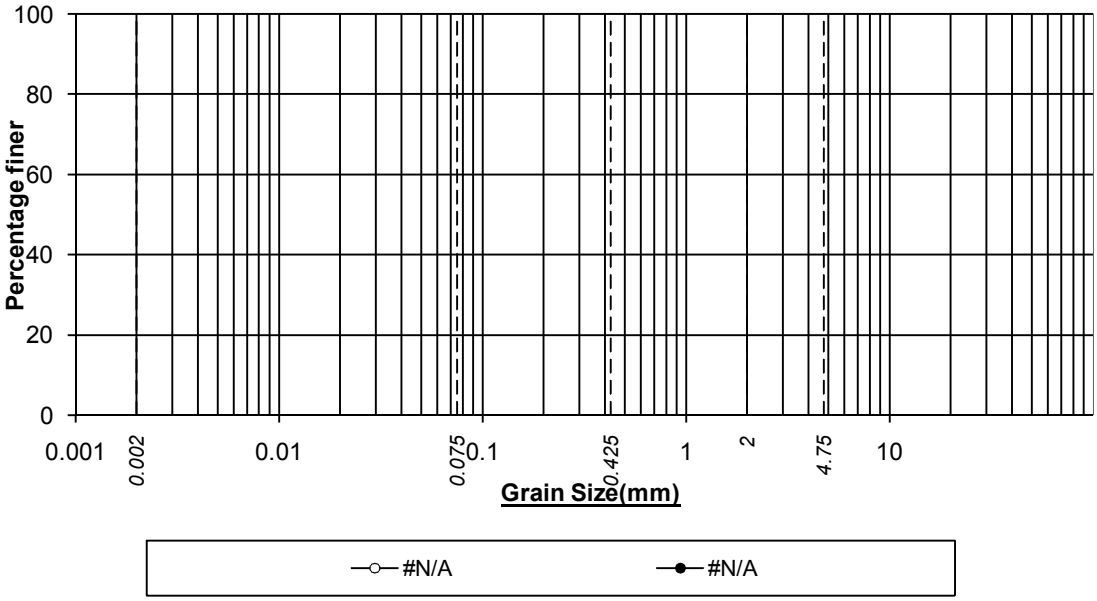
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-23,SPT-12, 22.50M		17.5	66.2	16.3	0.0	82.5		0.0
BH-23,SPT-17, 30.00M		77.0	17.0	6.0	0.0	23.0		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

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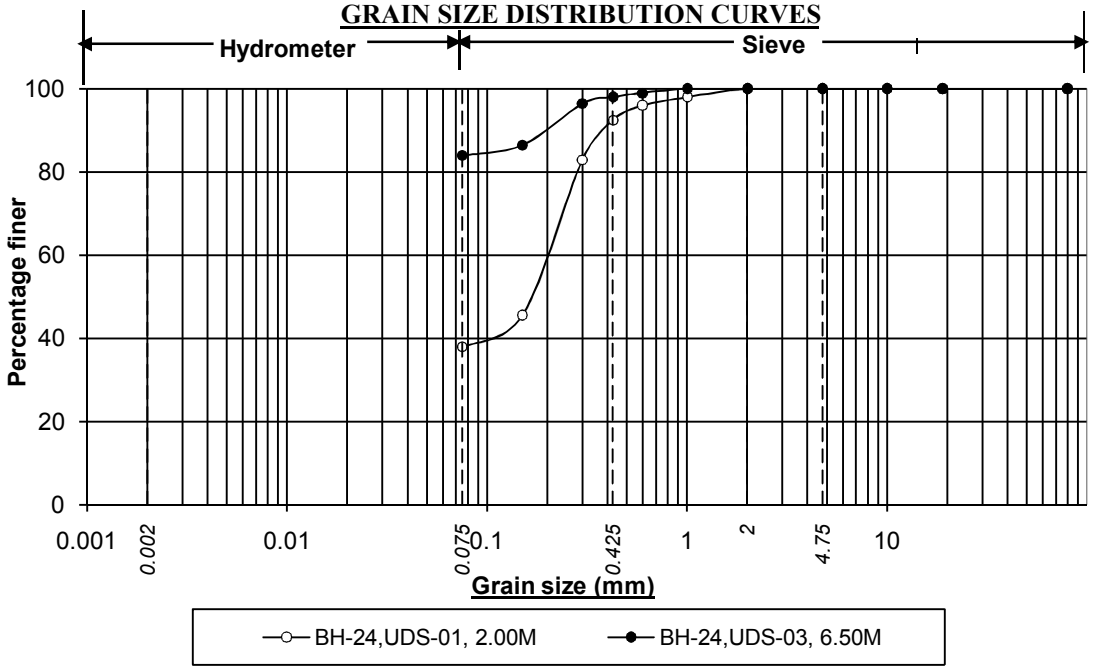
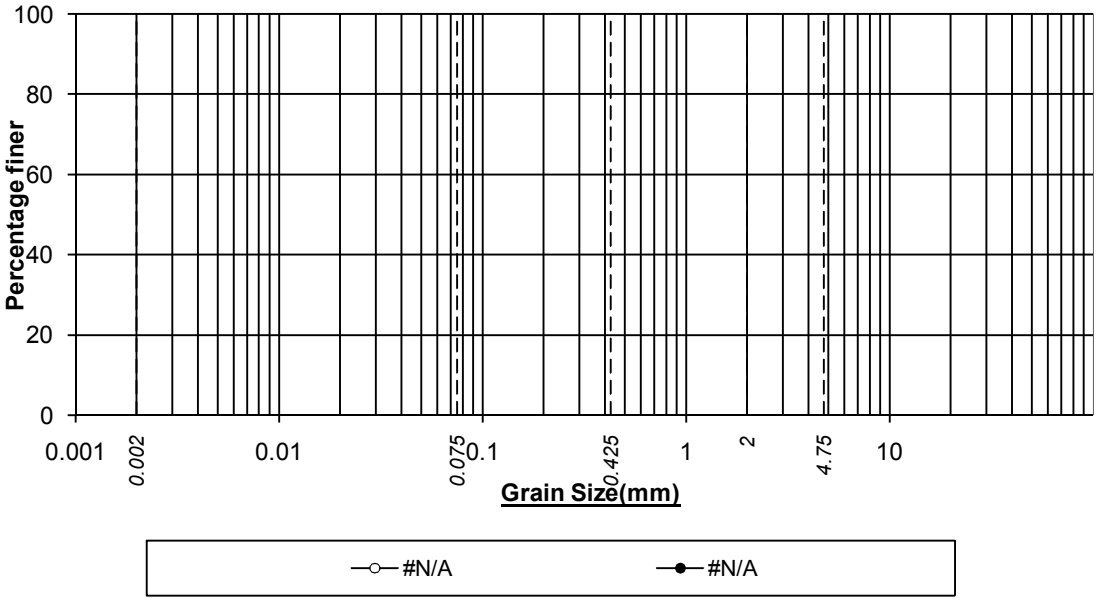
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-24,UDS-01, 2.00M		38.0	54.5	7.5	0.0	62.0		0.0
BH-24,UDS-03, 6.50M		84.0	14.0	2.0	0.0	16.0		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	**Job No. 3369**	

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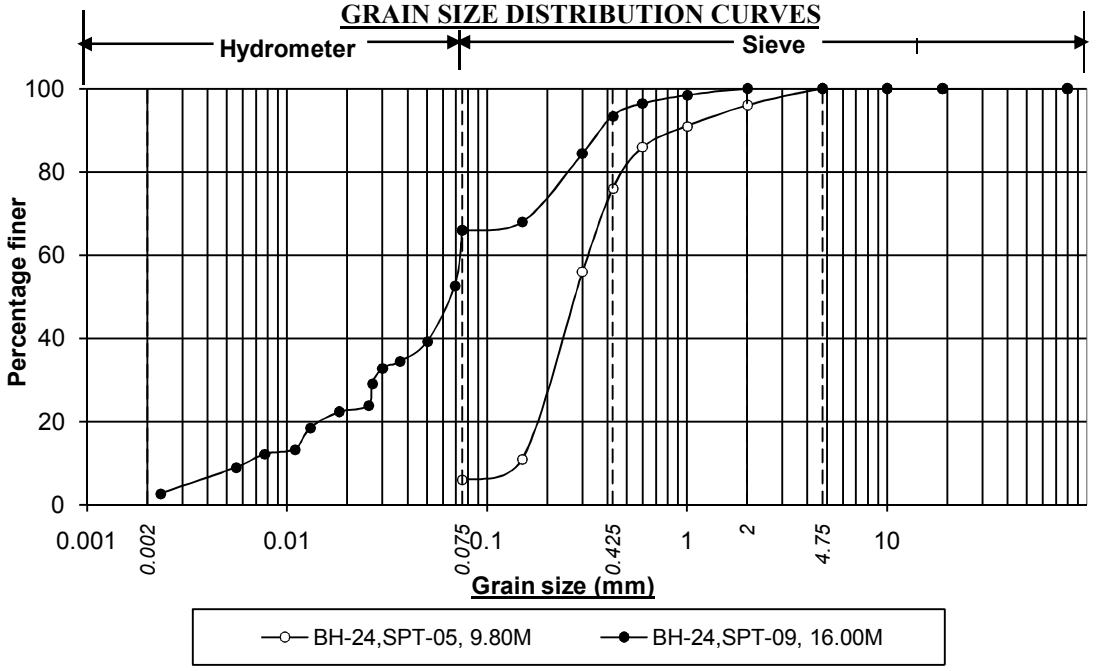
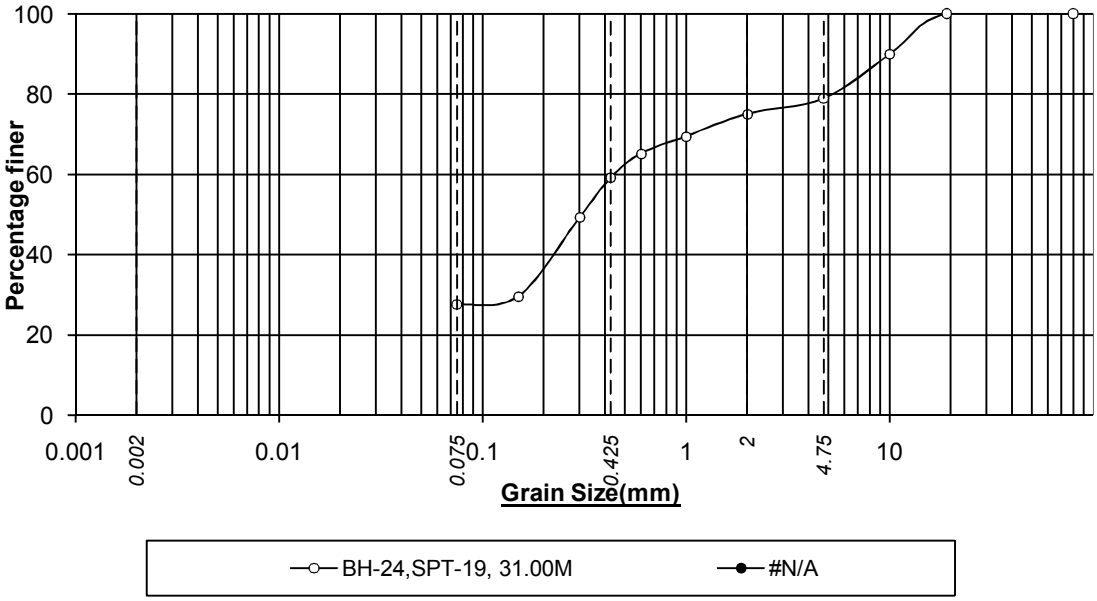
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-24,SPT-05, 9.80M		6.0	70.0	20.0	4.0	94.0	2.113/0.901	0.0
BH-24,SPT-09, 16.00M	1.5	64.5	27.5	6.5	0.0	34.0		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-24,SPT-19, 31.00M		27.7	31.5	15.8	4.0	51.3		21.0

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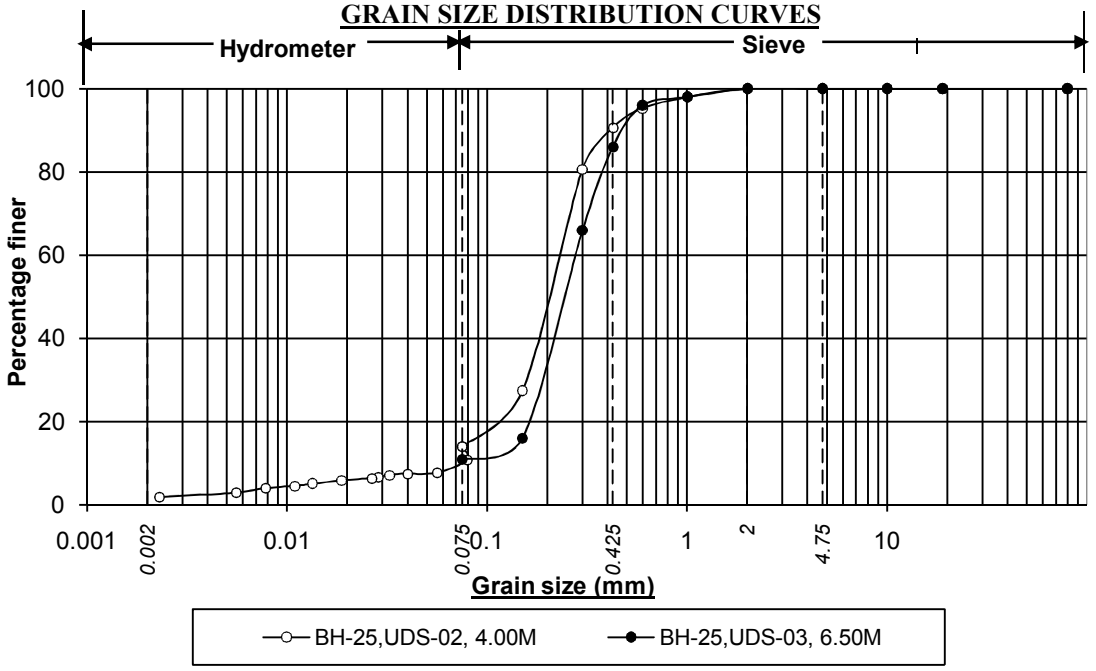
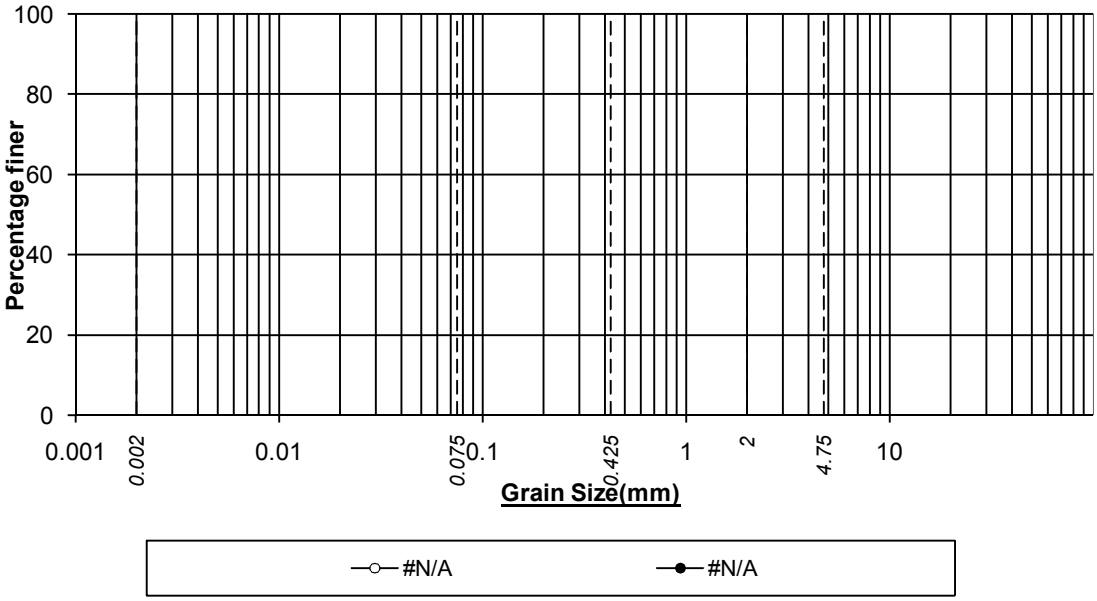
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-25,UDS-02, 4.00M	1.7	12.3	76.7	9.3	0.0	86.0		0.0
BH-25,UDS-03, 6.50M		11.0	75.0	14.0	0.0	89.0		0.0

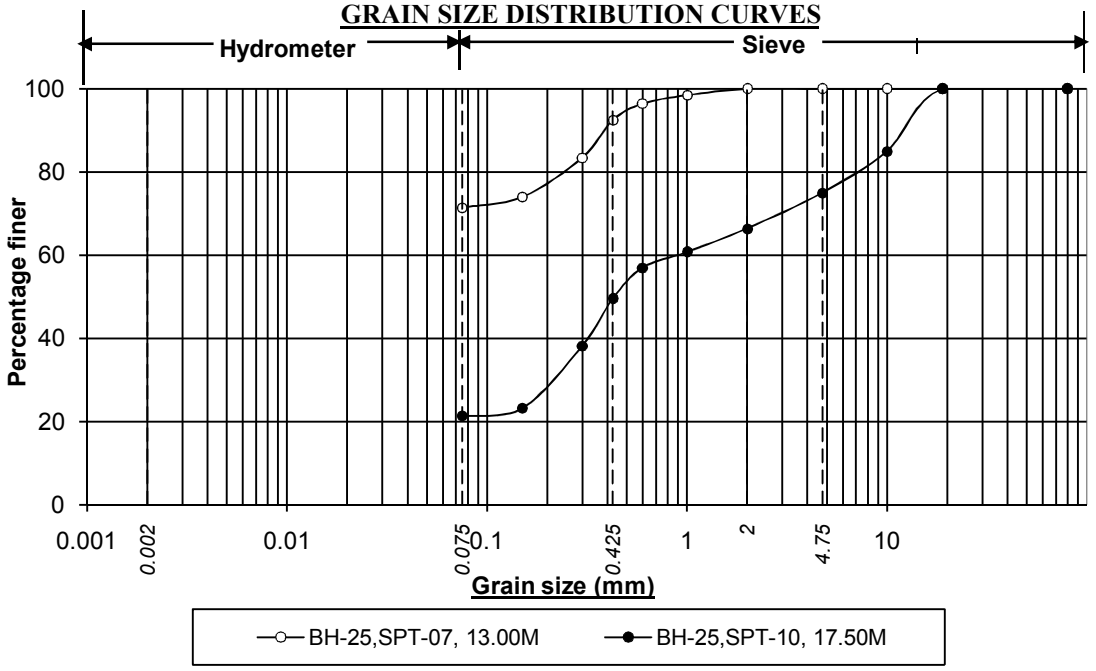


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)

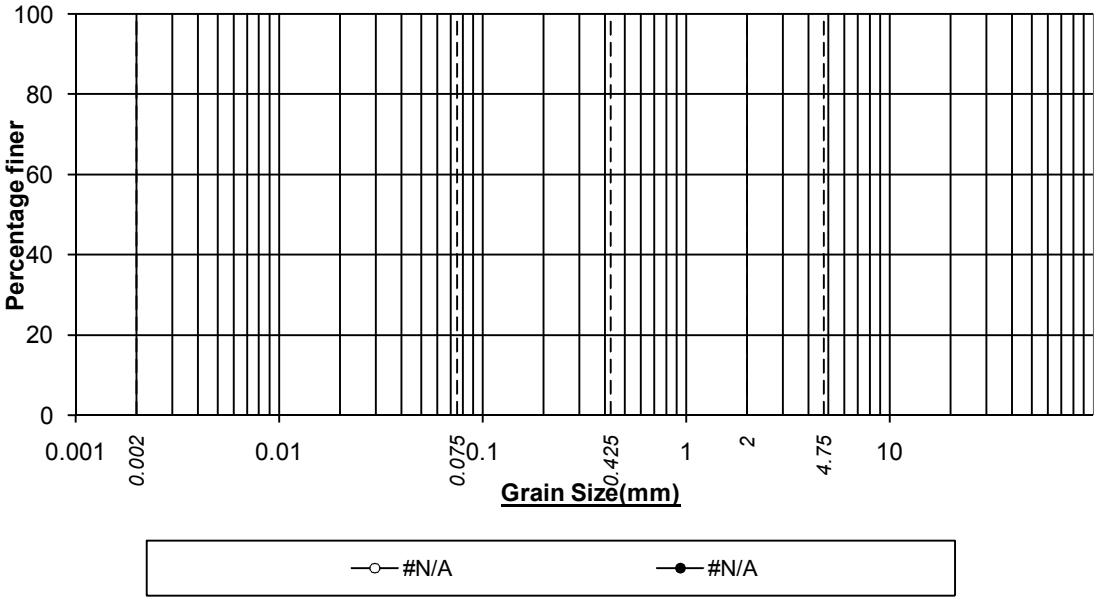
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-25,SPT-07, 13.00M		71.5	21.0	7.5	0.0	28.5		0.0
BH-25,SPT-10, 17.50M		21.4	28.1	16.9	8.6	53.6		25.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

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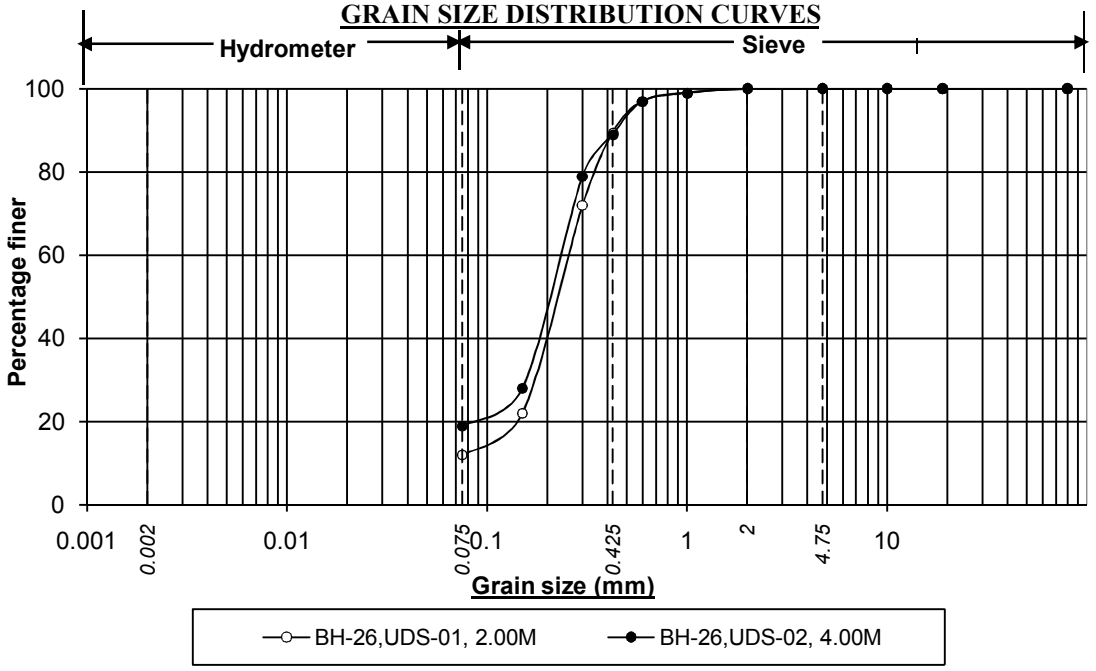
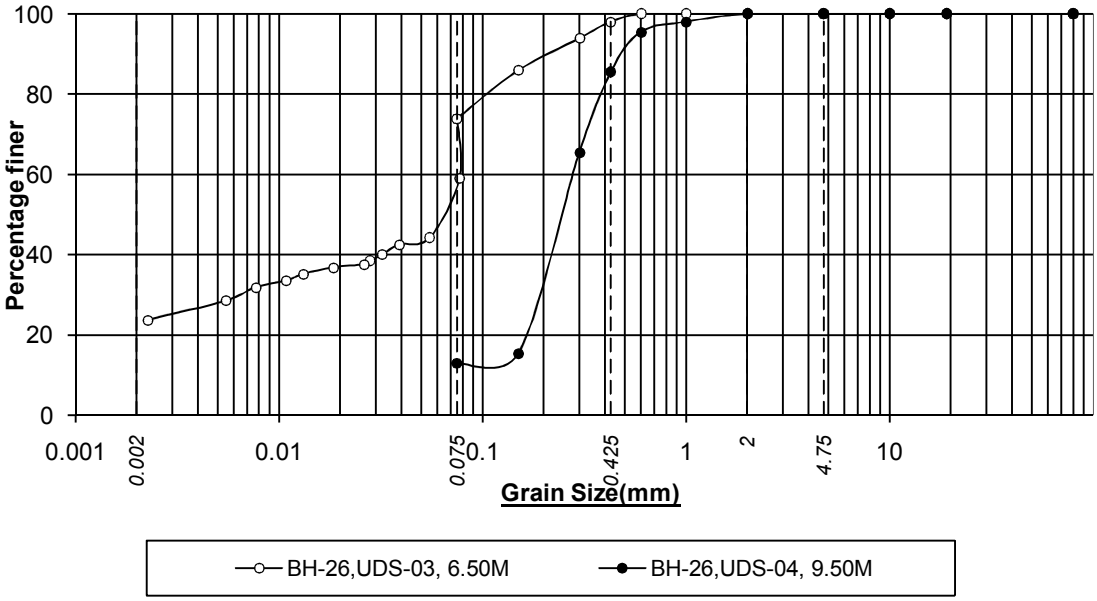
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-26,UDS-01, 2.00M		12.0	77.5	10.5	0.0	88.0		0.0
BH-26,UDS-02, 4.00M		19.0	70.0	11.0	0.0	81.0		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-26,UDS-03, 6.50M	23.0	51.0	24.0	2.0	0.0	26.0		0.0
BH-26,UDS-04, 9.50M		13.0	72.5	14.5	0.0	87.0		0.0

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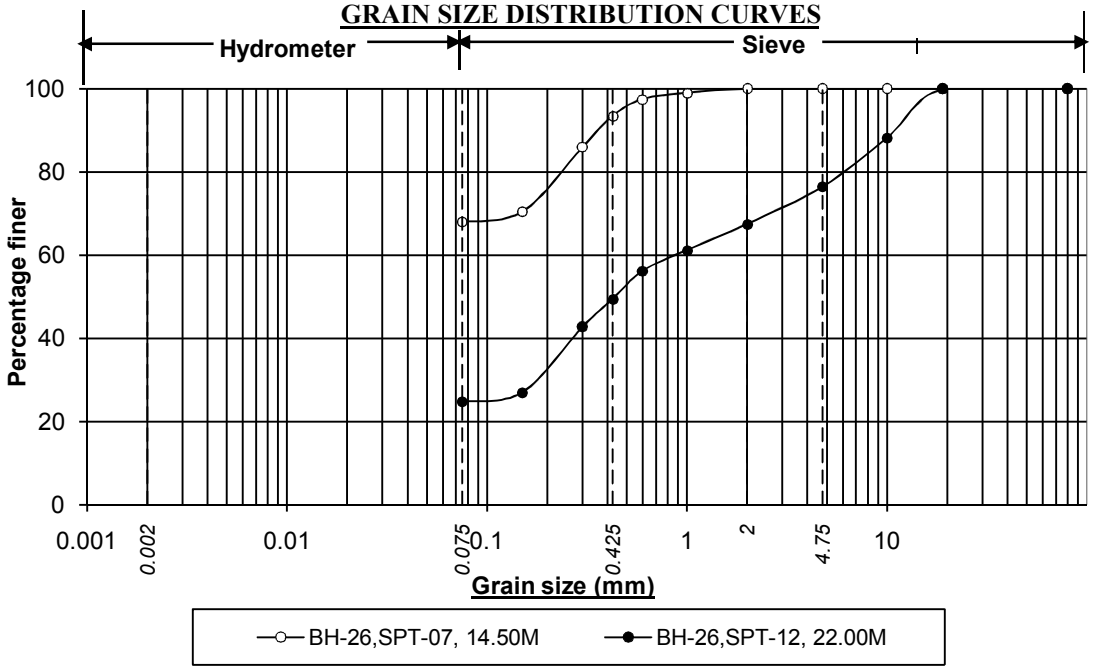
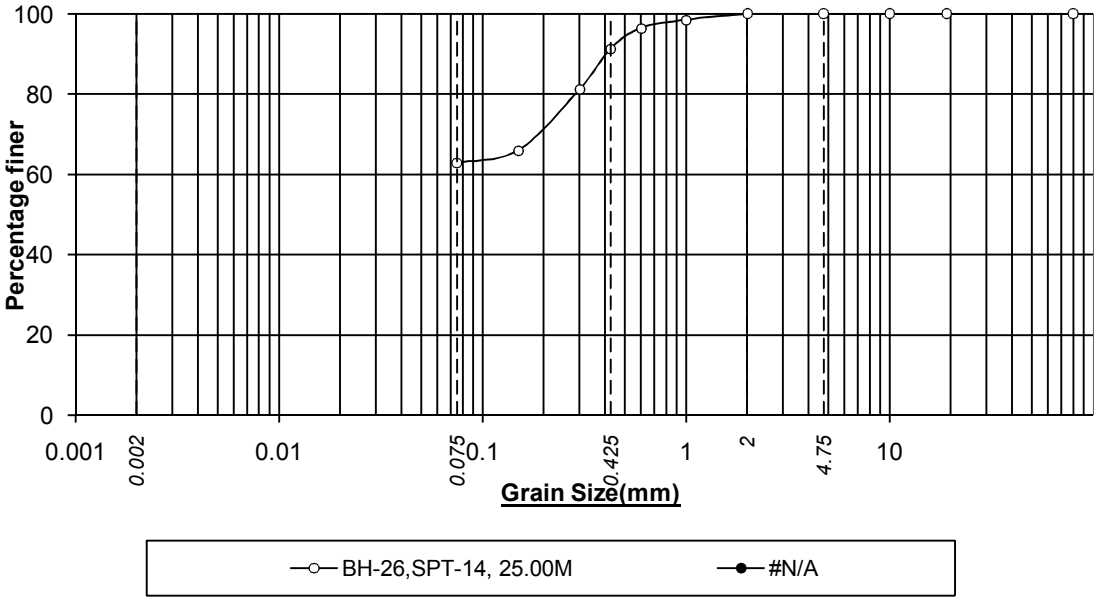
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-26,SPT-07, 14.50M		68.0	25.5	6.5	0.0	32.0		0.0
BH-26,SPT-12, 22.00M		24.7	24.8	18.0	9.0	51.8		23.5



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-26,SPT-14, 25.00M		62.9	28.5	8.6	0.0	37.1		0.0

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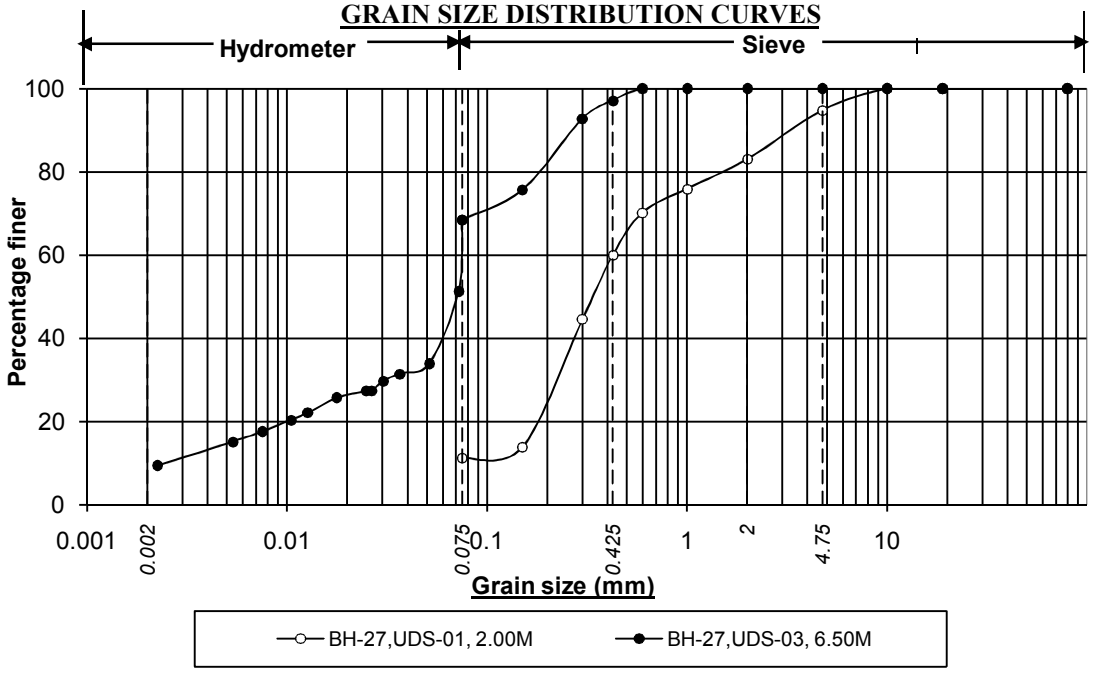
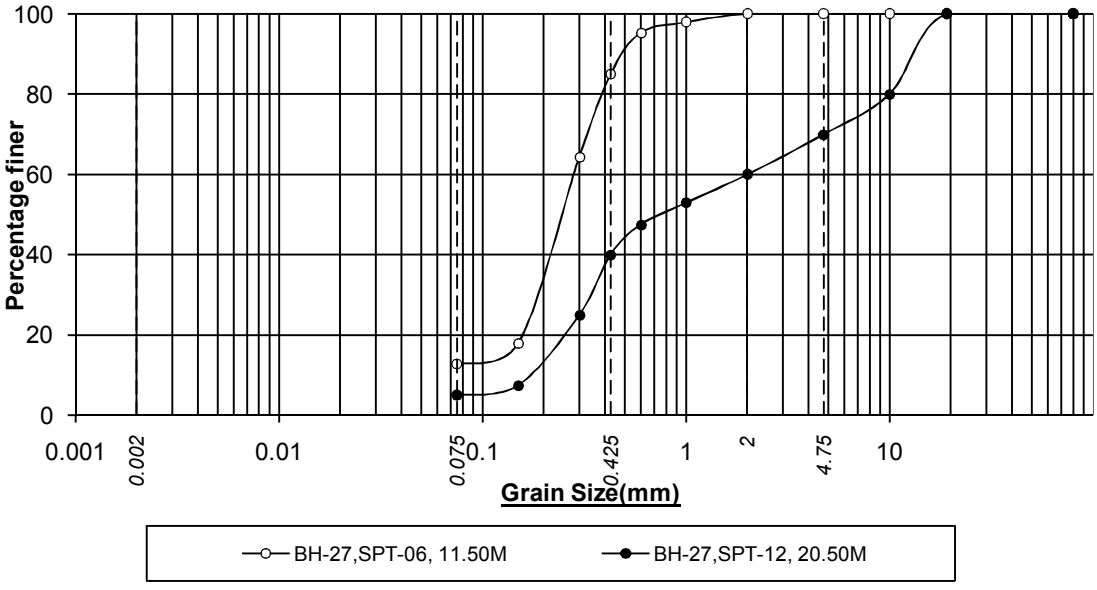
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-27,UDS-01, 2.00M		11.3	48.7	23.1	11.8	83.6		5.1
BH-27,UDS-03, 6.50M	8.6	60.0	28.5	2.9	0.0	31.4		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-27,SPT-06, 11.50M		12.9	72.2	14.9	0.0	87.1		0.0
BH-27,SPT-12, 20.50M		5.0	35.0	20.0	10.0	65.0	11.721/0.325	30.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No.**

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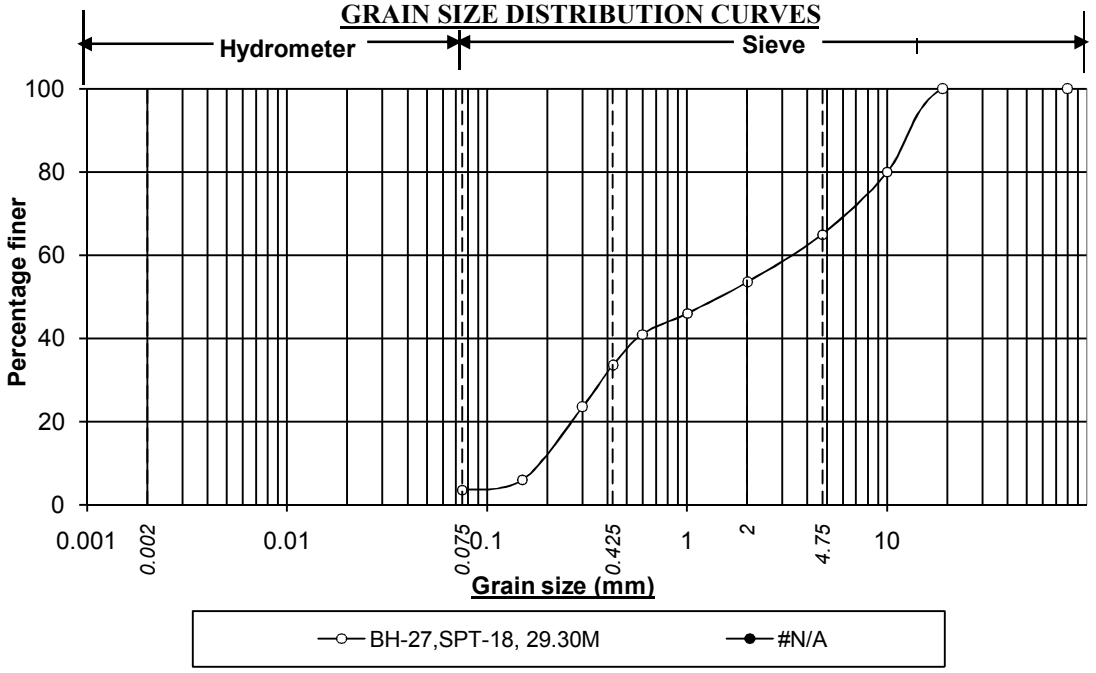
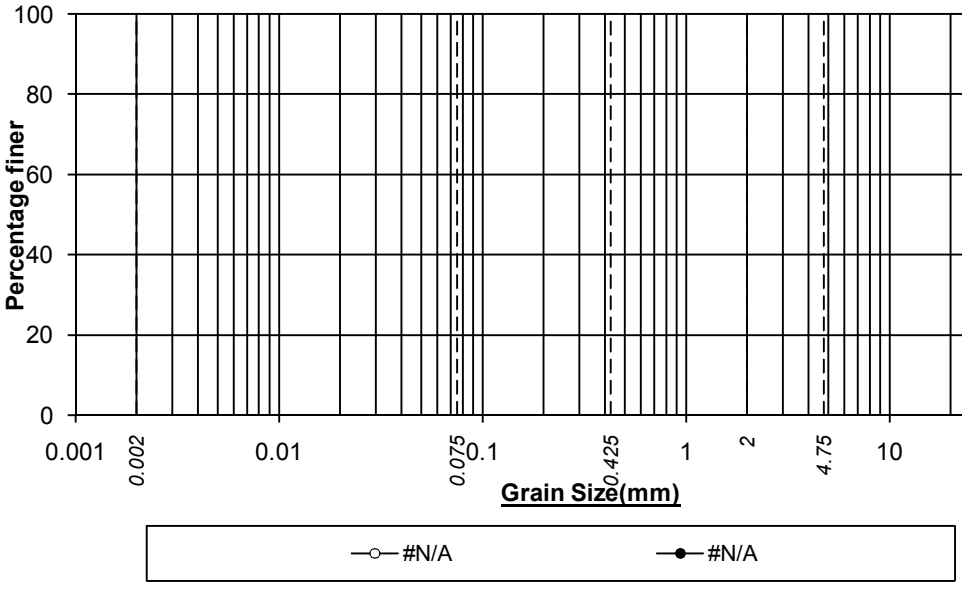
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-27,SPT-18, 29.30M		3.5	30.0	20.0	11.5	61.5	17.906/0.241	35.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat	**Job No. 3369**	

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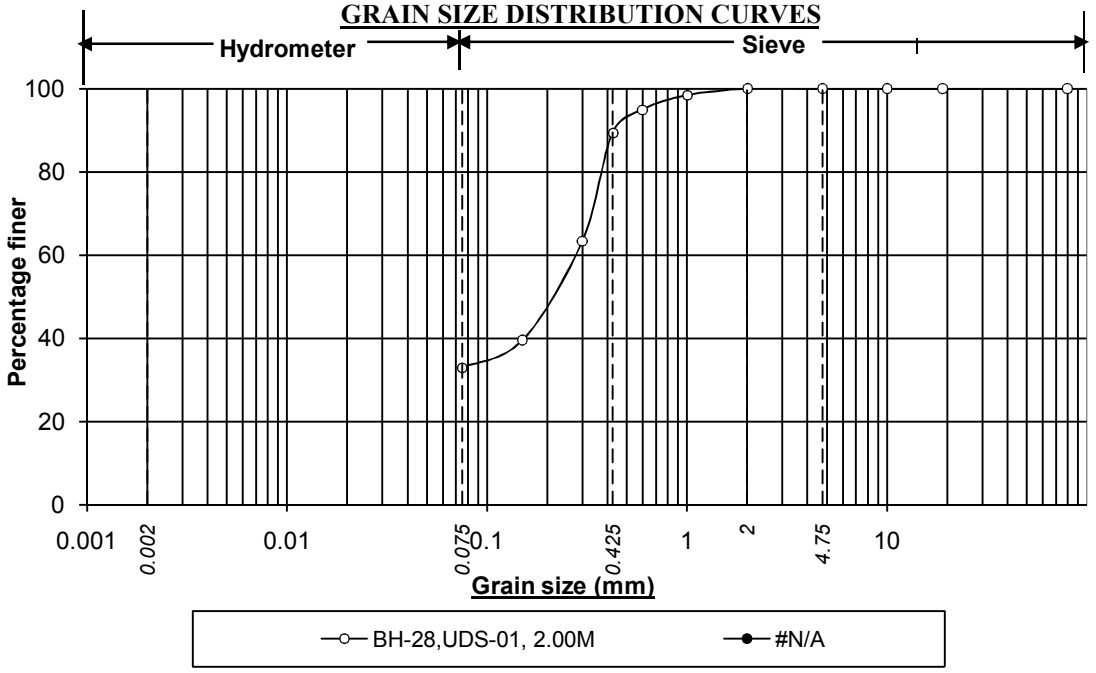
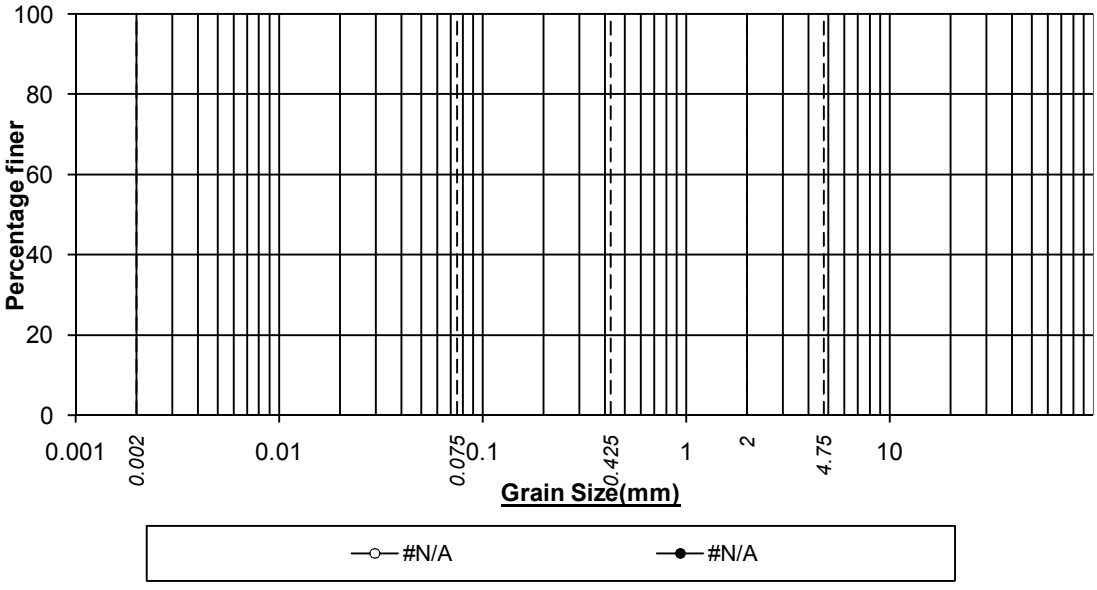
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-28,UDS-01, 2.00M		33.0	56.5	10.5	0.0	67.0		0.0

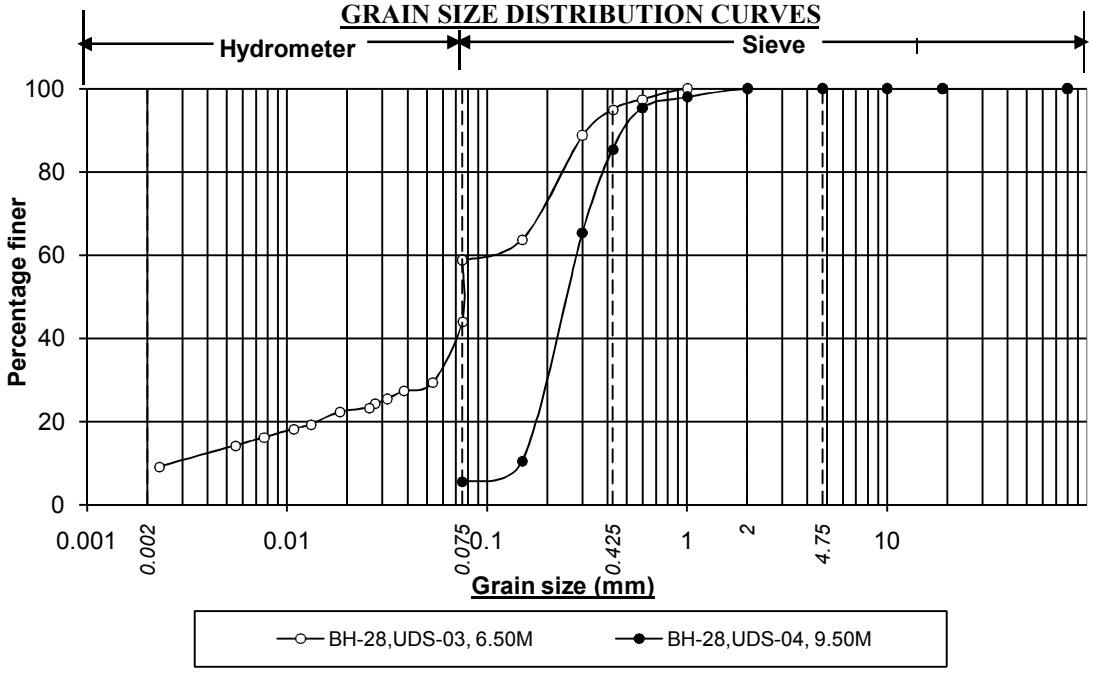


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

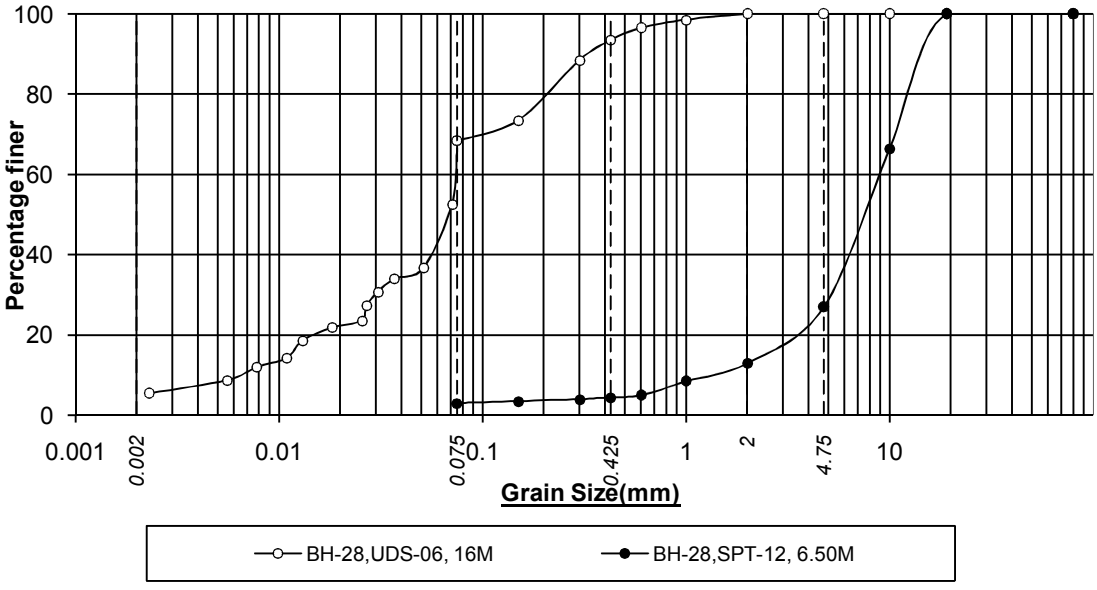
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-28,UDS-03, 6.50M	8.3	50.4	36.3	5.0	0.0	41.3		0.0
BH-28,UDS-04, 9.50M		5.5	80.0	14.5	0.0	94.5	1.823/0.966	0.0

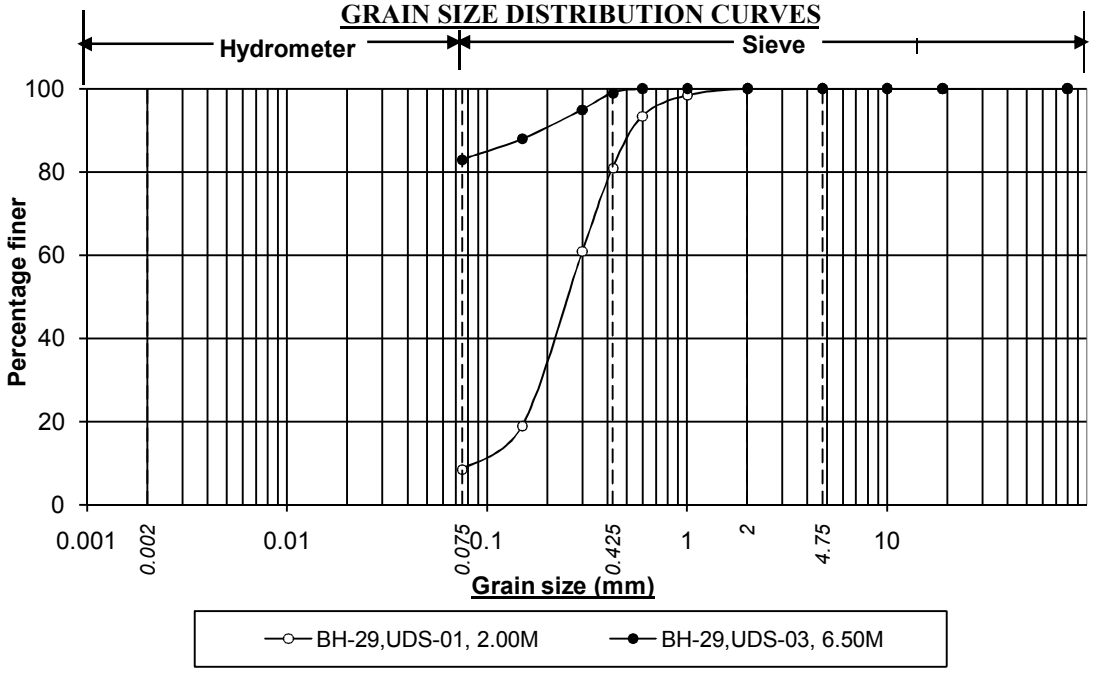


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-28,UDS-06, 16M	5.0	63.5	25.0	6.5	0.0	31.5		0.0
BH-28,SPT-12, 6.50M		3.0	1.5	8.5	14.0	24.0	6.714/2.172	73.0

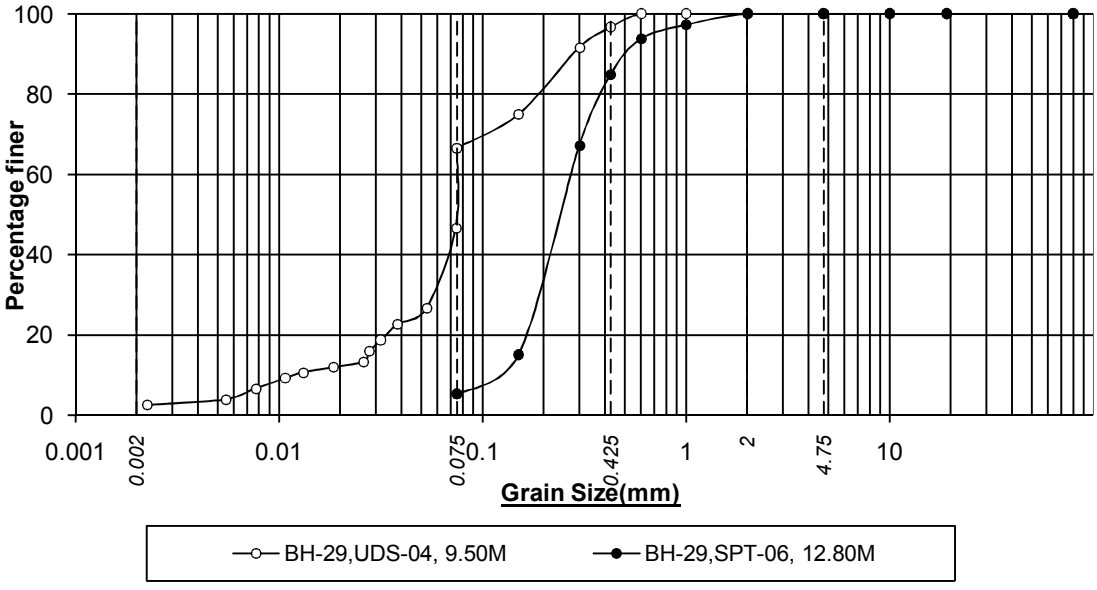
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-29,UDS-01, 2.00M		8.5	72.5	19.0	0.0	91.5	3.819/1.506	0.0
BH-29,UDS-03, 6.50M		83.0	16.0	1.0	0.0	17.0		0.0

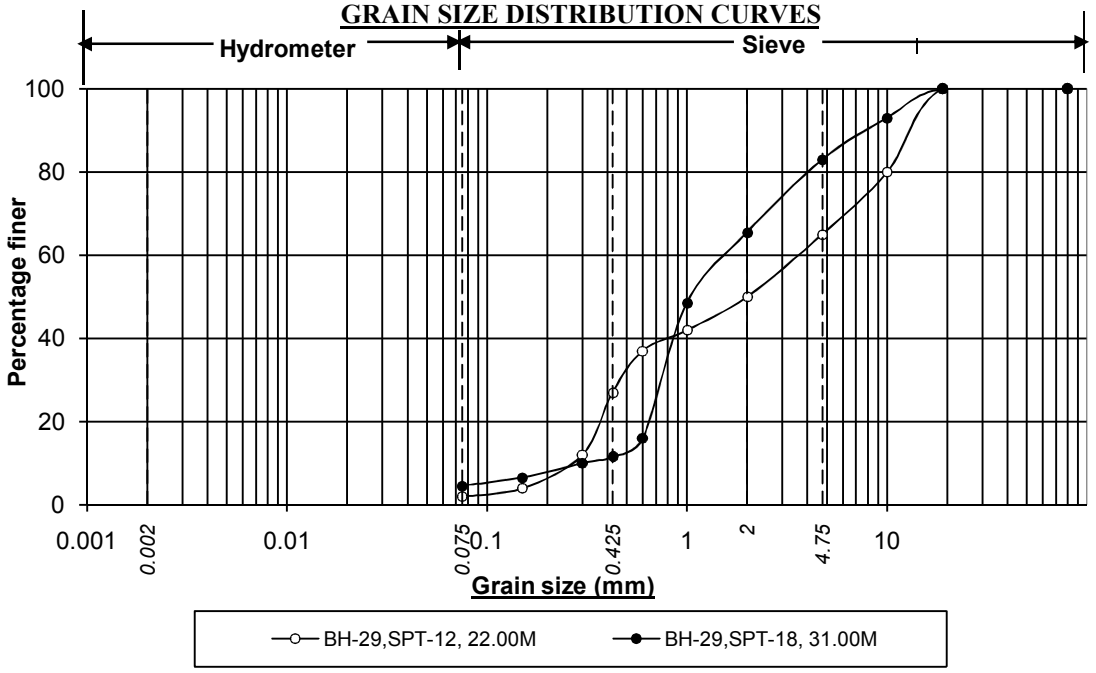


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-29,UDS-04, 9.50M	2.5	64.2	30.0	3.3	0.0	33.3		0.0
BH-29,SPT-06, 12.80M		5.3	79.7	15.0	0.0	94.7	2.094/1.083	0.0

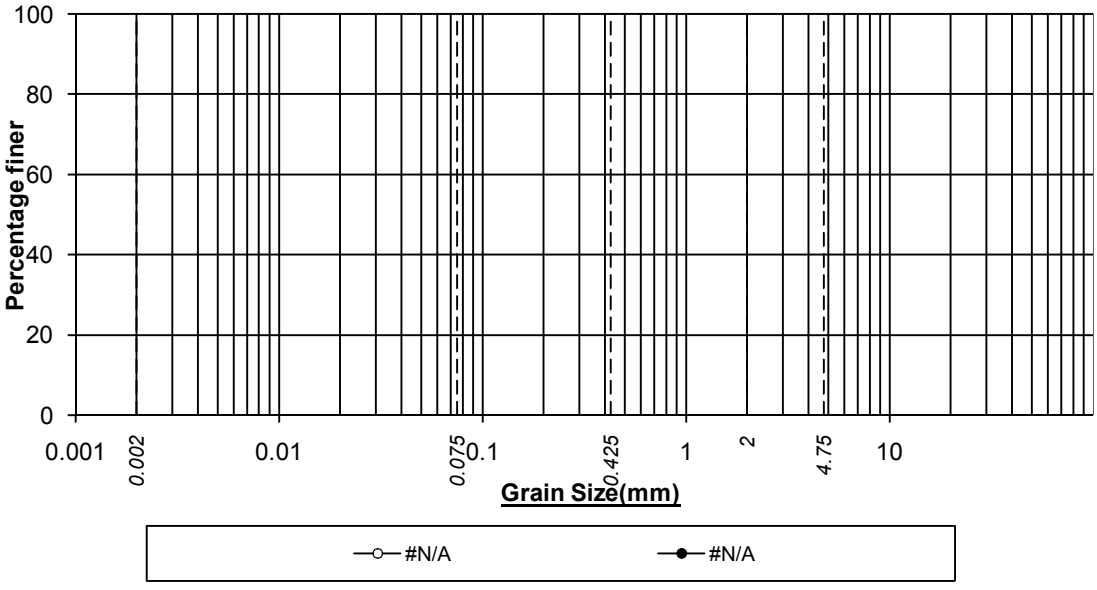
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-29,SPT-12, 22.00M		2.0	25.0	23.0	15.0	63.0	13.427/0.209	35.0
BH-29,SPT-18, 31.00M		4.5	7.0	54.0	17.5	78.5	5/1.129	17.0

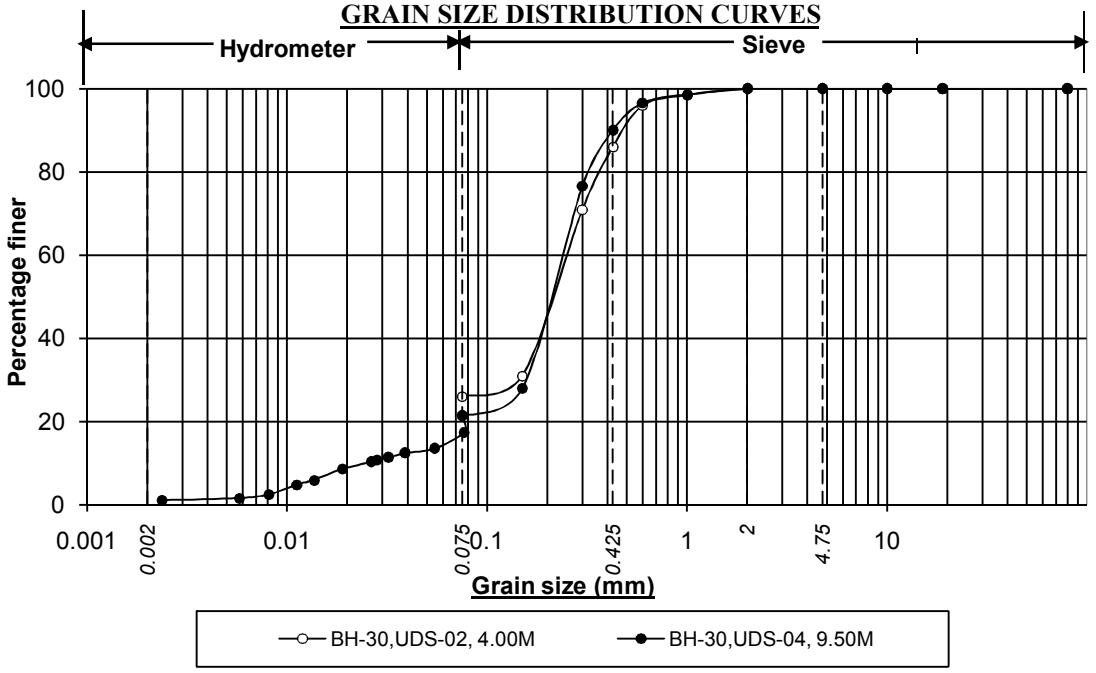


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

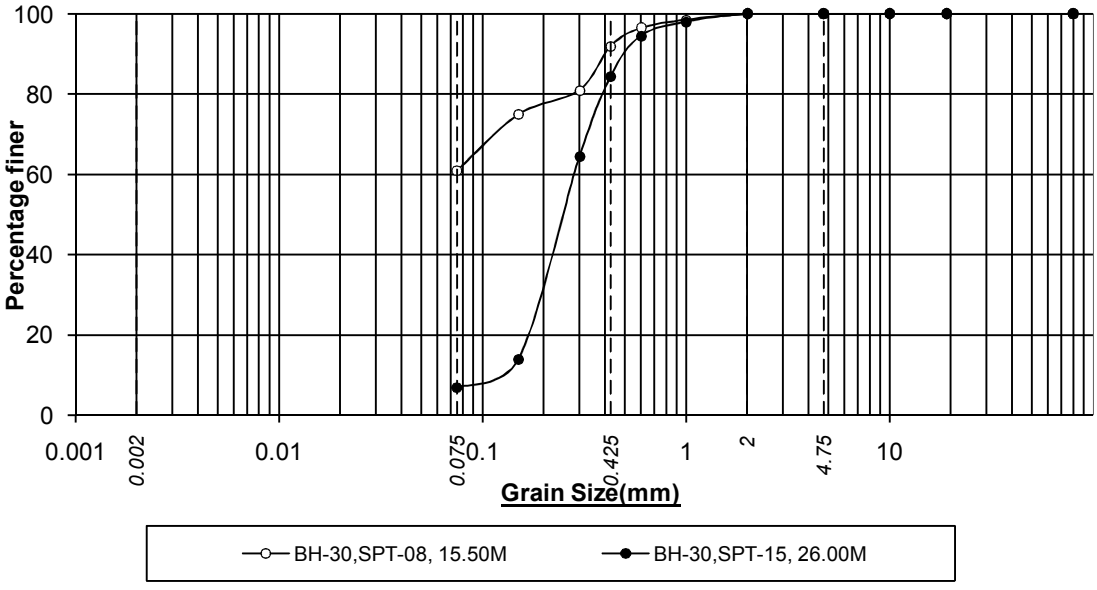
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-30,UDS-02, 4.00M		26.0	60.0	14.0	0.0	74.0		0.0
BH-30,UDS-04, 9.50M	1.0	20.4	68.6	10.0	0.0	78.6		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-30,SPT-08, 15.50M		61.0	31.0	8.0	0.0	39.0		0.0
BH-30,SPT-15, 26.00M		7.0	77.5	15.5	0.0	93.0	2.269/1.153	0.0

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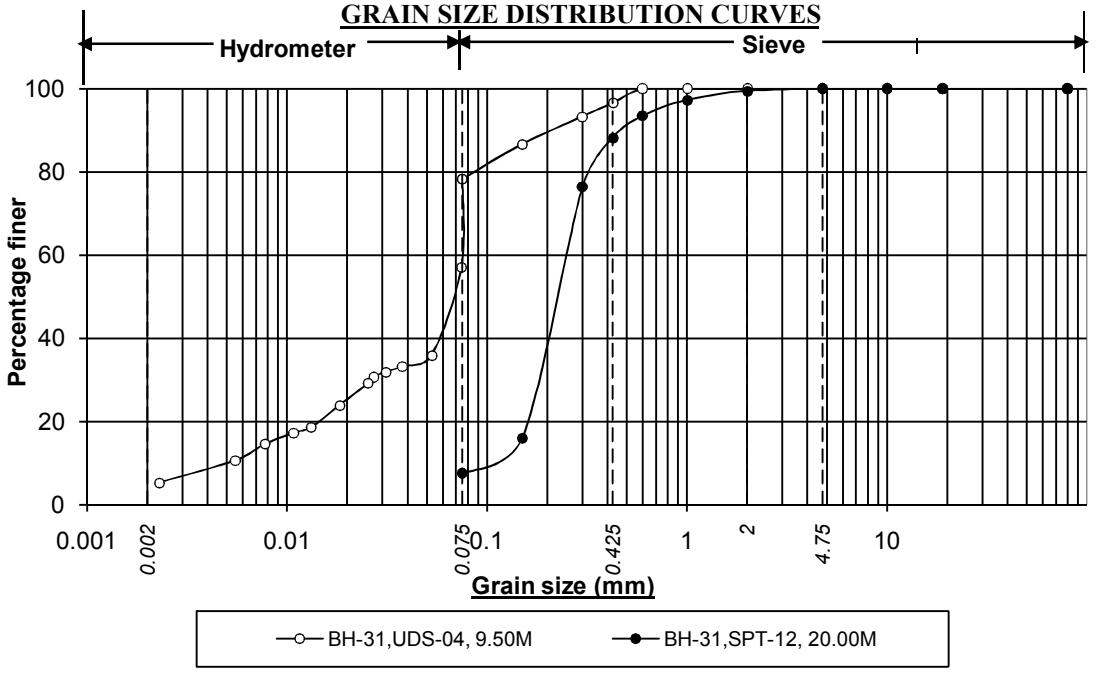
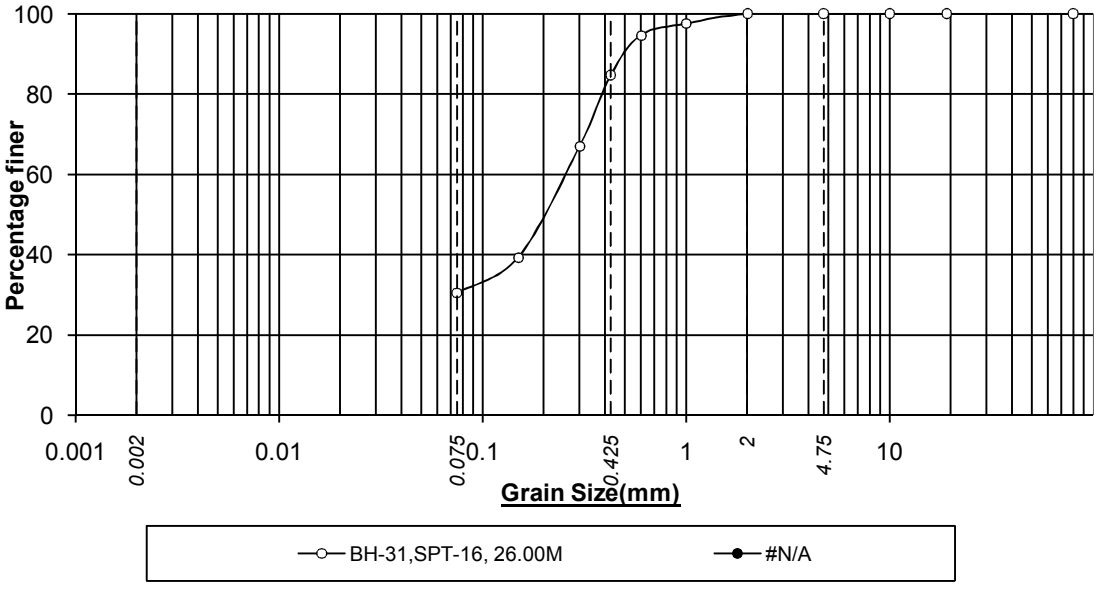
Sheet No.:

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-31,UDS-04, 9.50M	4.5	73.9	18.3	3.3	0.0	21.6		0.0
BH-31,SPT-12, 20.00M		7.5	80.8	11.2	0.5	92.5	2.213/1.216	0.0

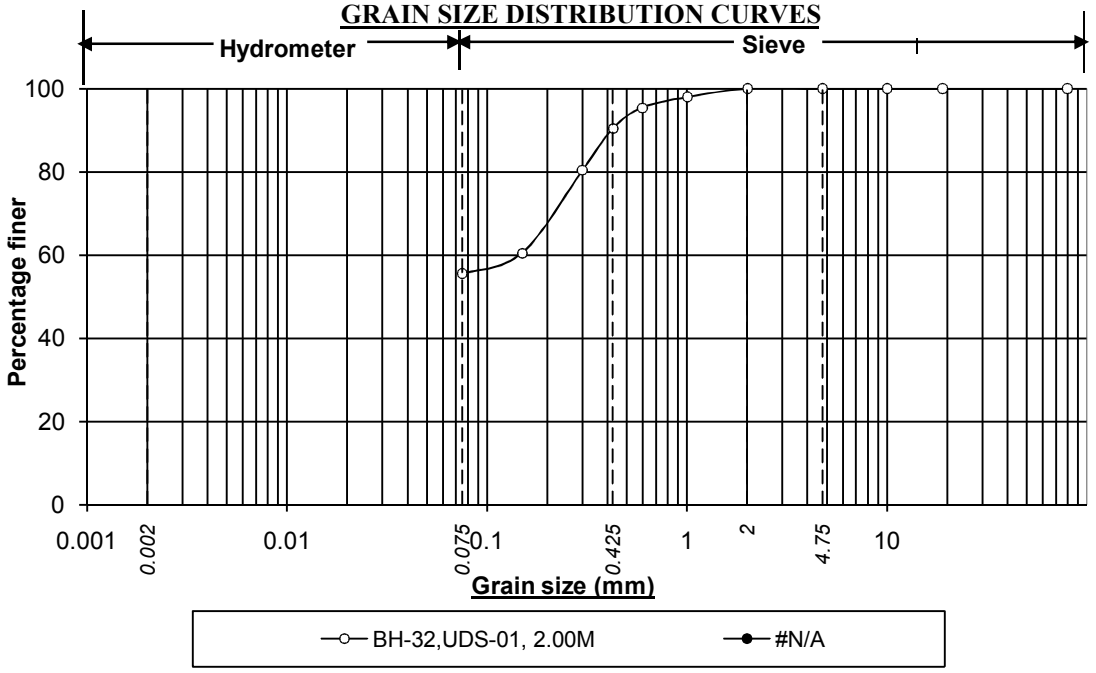


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-31,SPT-16, 26.00M		30.6	54.1	15.3	0.0	69.4		0.0

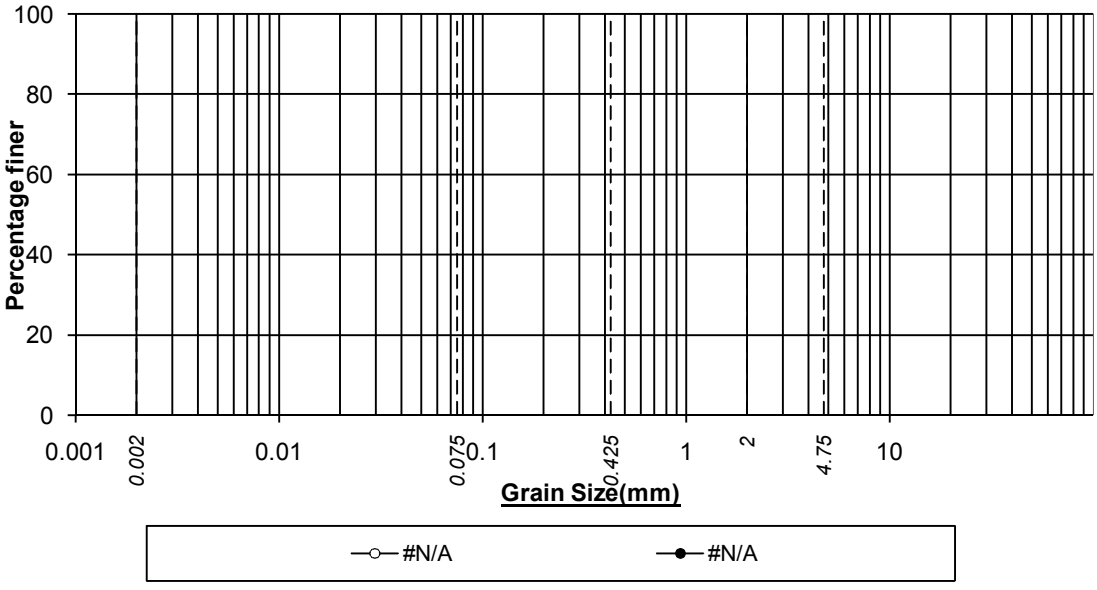
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-32,UDS-01, 2.00M		55.5	35.0	9.5	0.0	44.5		0.0

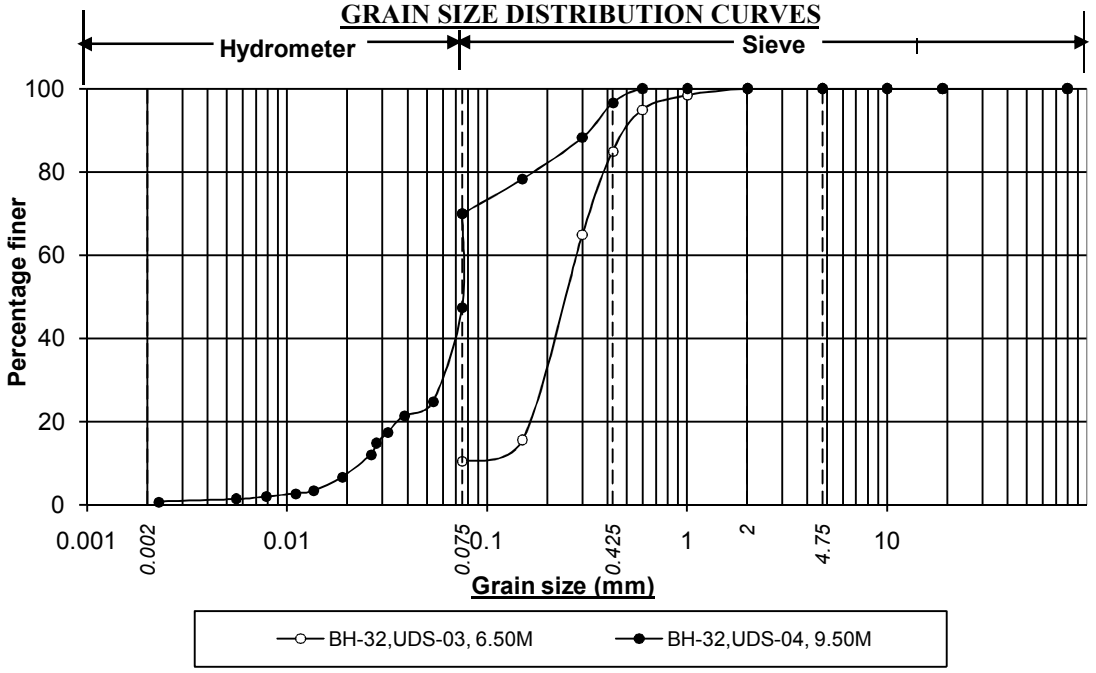


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)

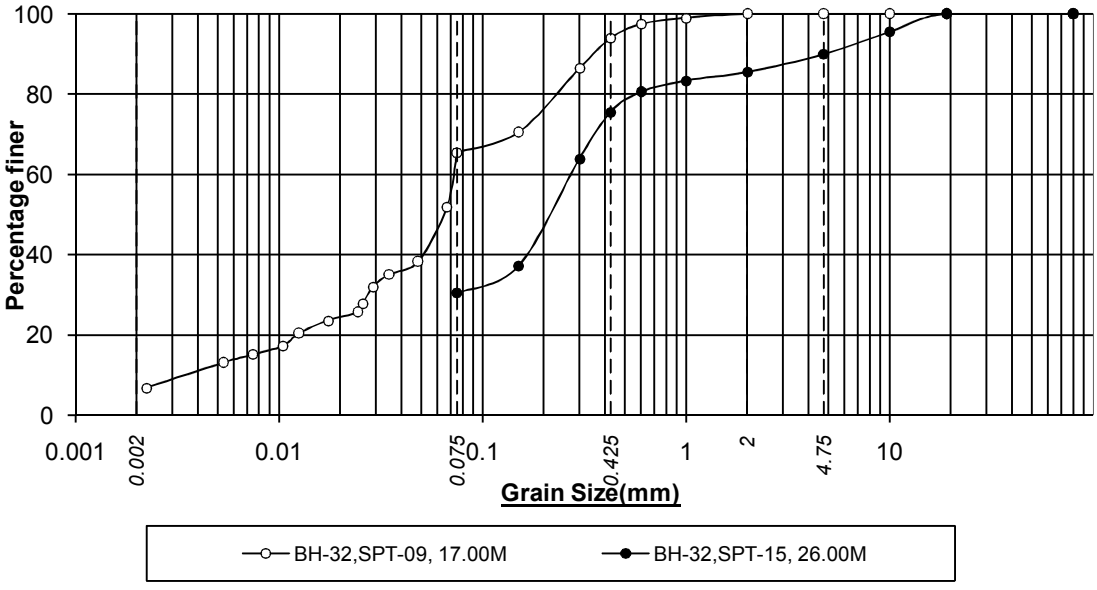
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-32,UDS-03, 6.50M		10.5	74.5	15.0	0.0	89.5	3.775/1.918	0.0
BH-32,UDS-04, 9.50M	0.6	69.4	26.7	3.3	0.0	30.0		0.0

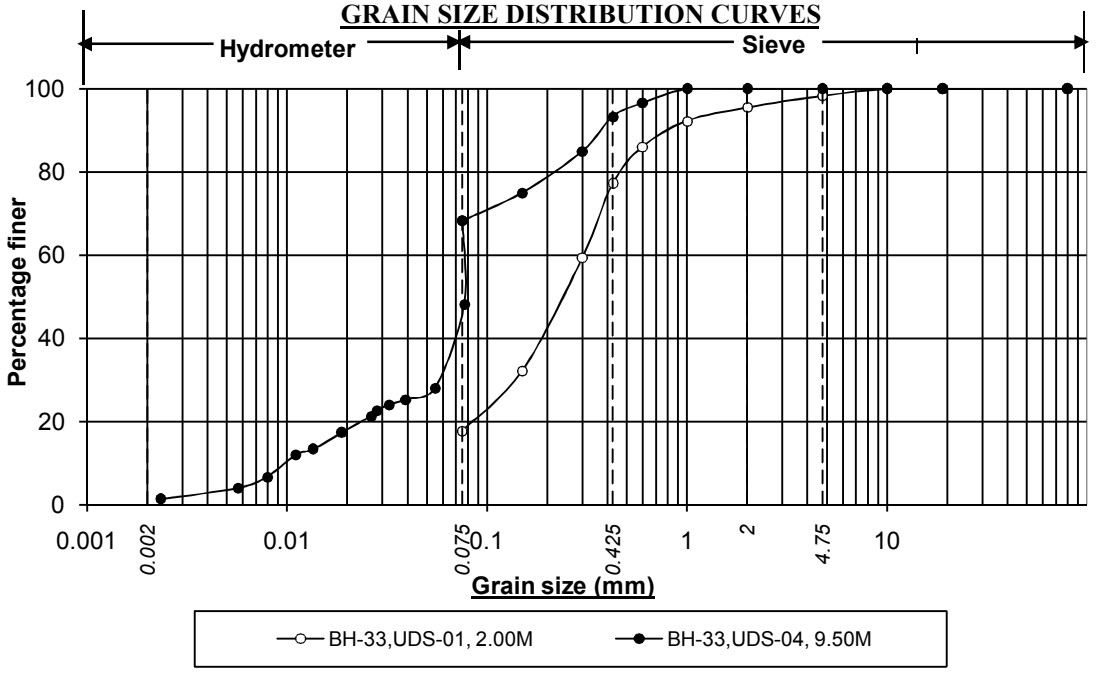


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-32,SPT-09, 17.00M	6.0	59.5	28.5	6.0	0.0	34.5		0.0
BH-32,SPT-15, 26.00M		30.6	45.0	10.0	4.4	59.4		10.0

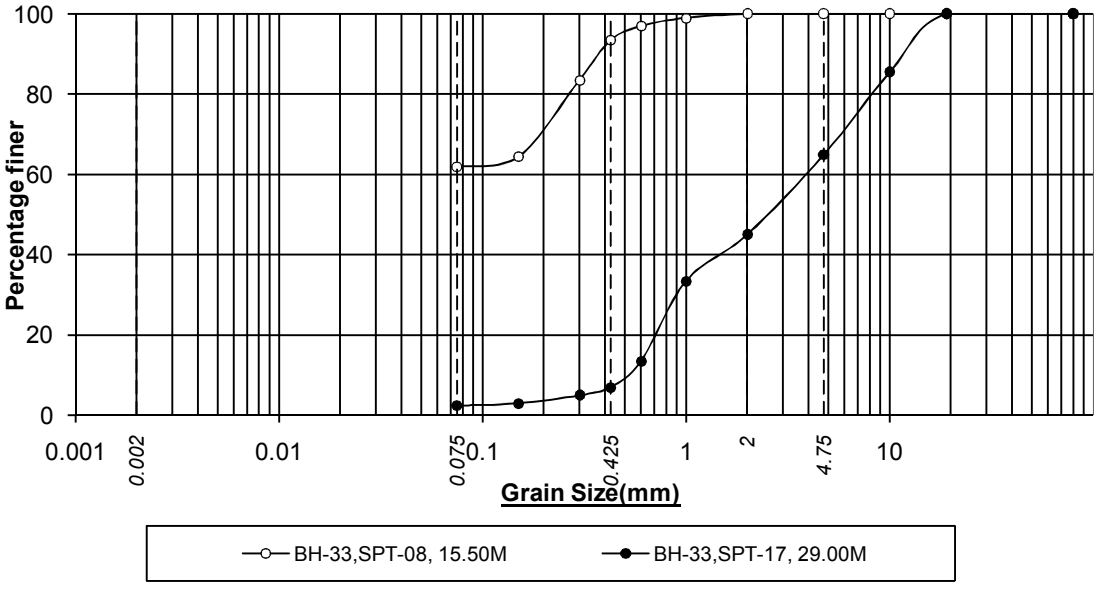
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	Total sand	Cu/Cc	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-33,UDS-01, 2.00M		17.8	59.4	18.3	2.8	80.5		1.7
BH-33,UDS-04, 9.50M	0.9	67.5	24.9	6.7	0.0	31.6		0.0

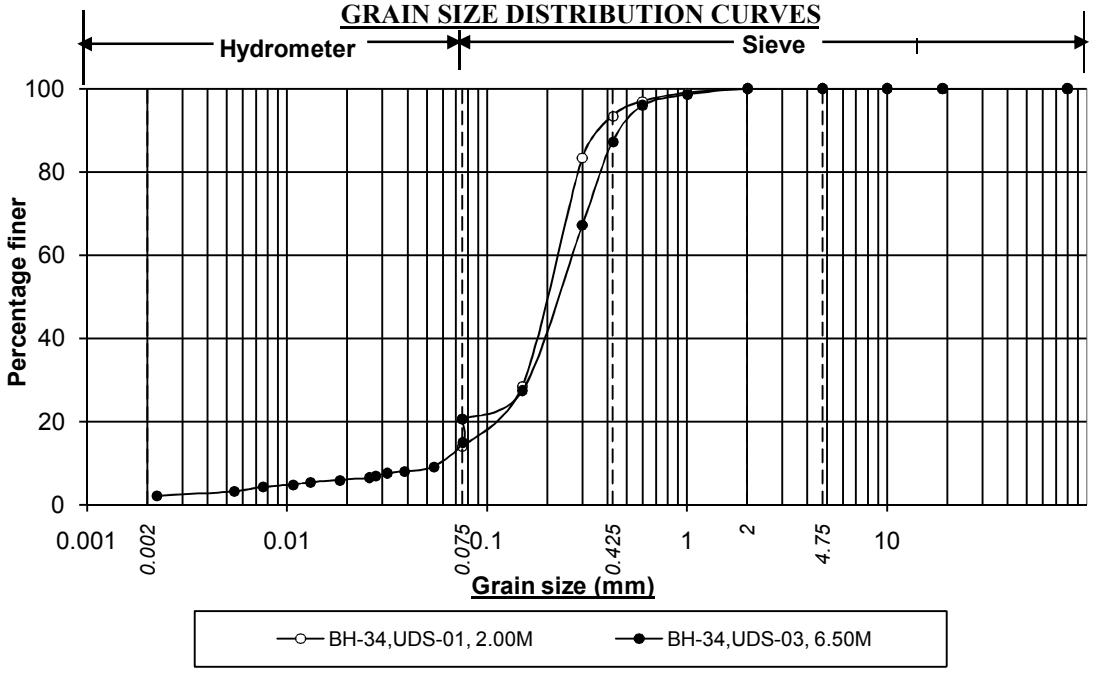


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	Total sand	Cu/Cc	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-33,SPT-08, 15.50M		62.0	31.5	6.5	0.0	38.0		0.0
BH-33,SPT-17, 29.00M		2.5	4.5	38.0	20.0	62.5	7.533/0.41	35.0

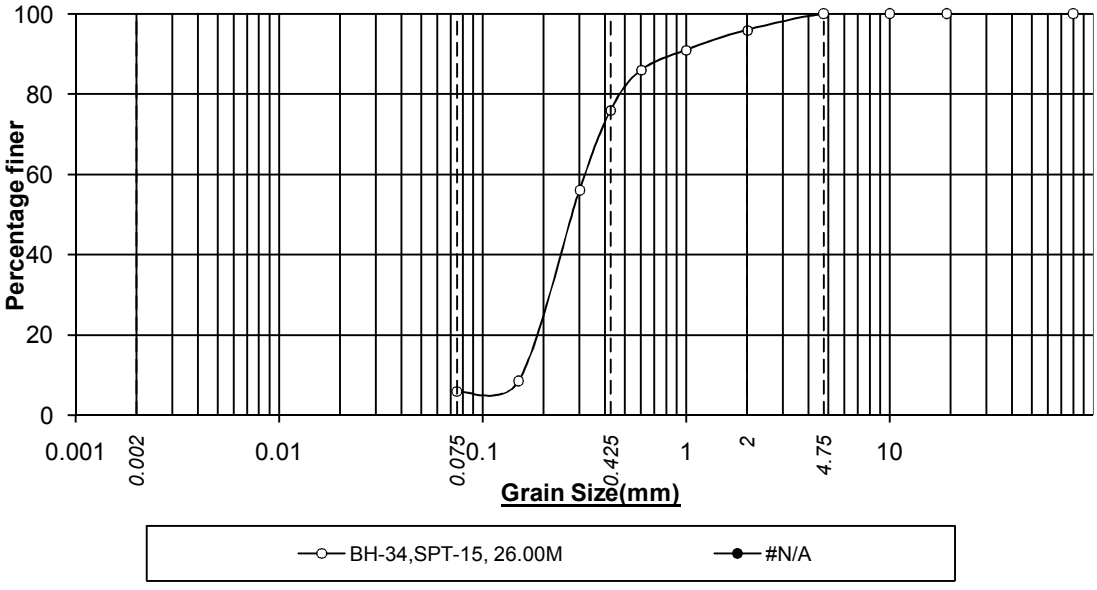
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat — **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-34,UDS-01, 2.00M		14.0	79.5	6.5	0.0	86.0		0.0
BH-34,UDS-03, 6.50M	2.0	18.7	66.6	12.7	0.0	79.3		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-34,SPT-15, 26.00M		6.0	70.0	20.0	4.0	94.0	2.172/0.931	0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

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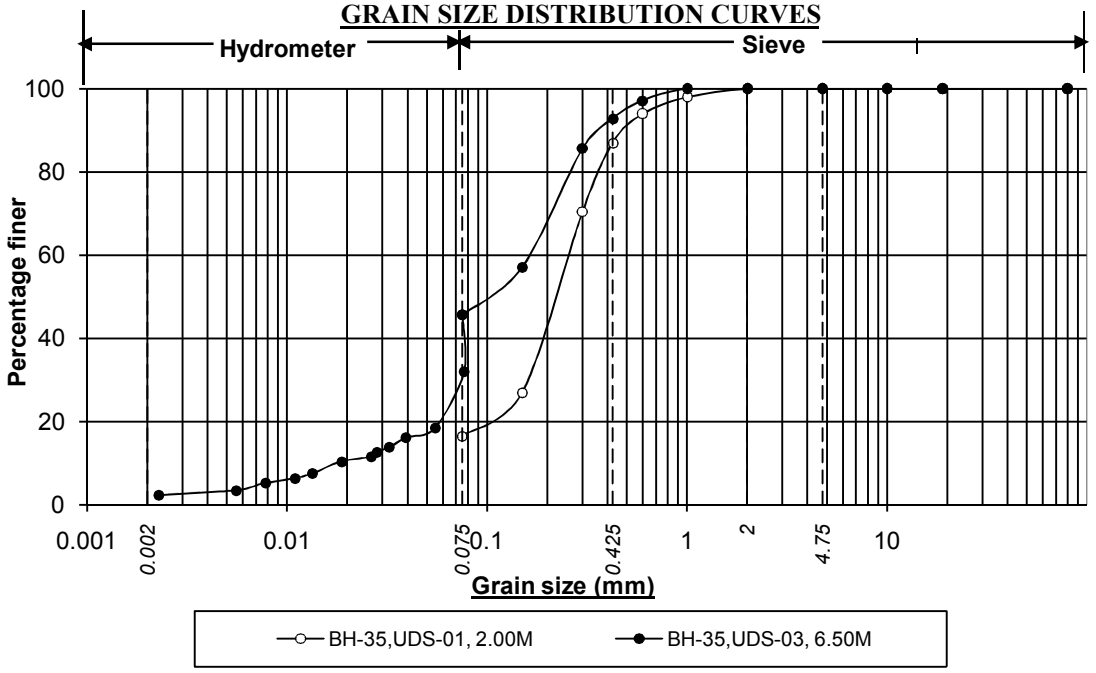
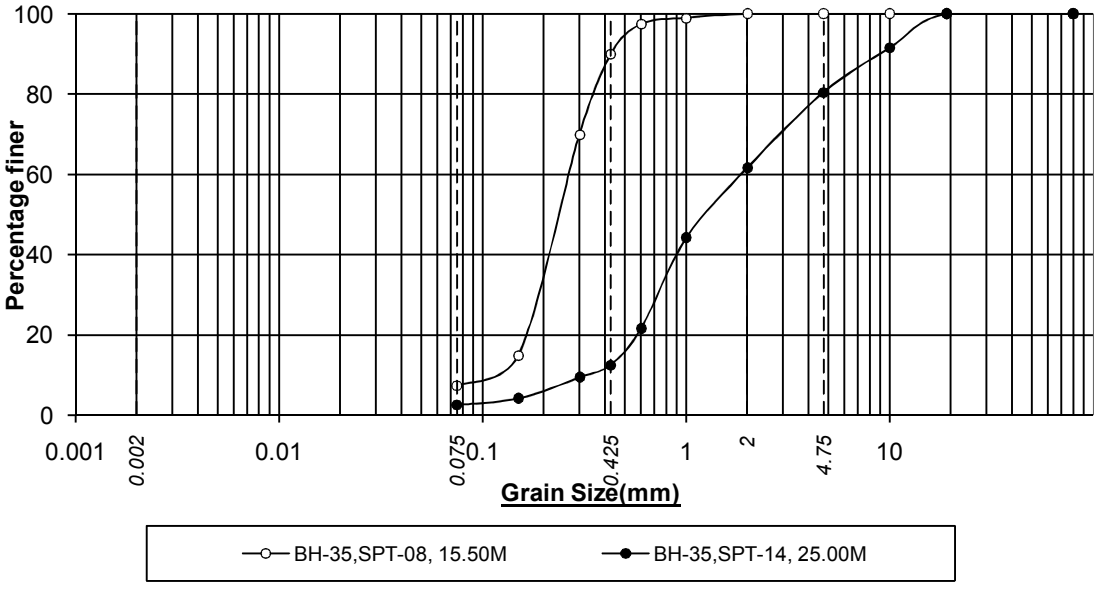
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-35,UDS-01, 2.00M		16.5	70.5	13.0	0.0	83.5		0.0
BH-35,UDS-03, 6.50M	2.1	43.6	47.2	7.1	0.0	54.3		0.0

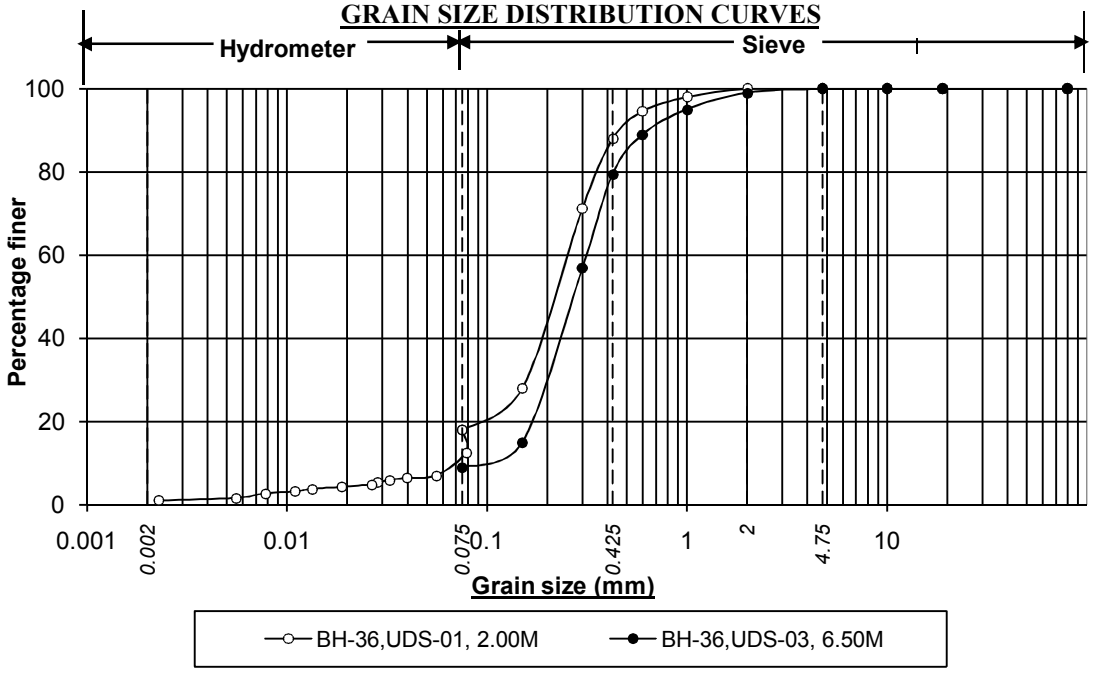


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-35,SPT-08, 15.50M		7.5	82.5	10.0	0.0	92.5	2.218/1.111	0.0
BH-35,SPT-14, 25.00M		2.6	10.1	48.9	18.9	77.9	6.652/0.914	19.5

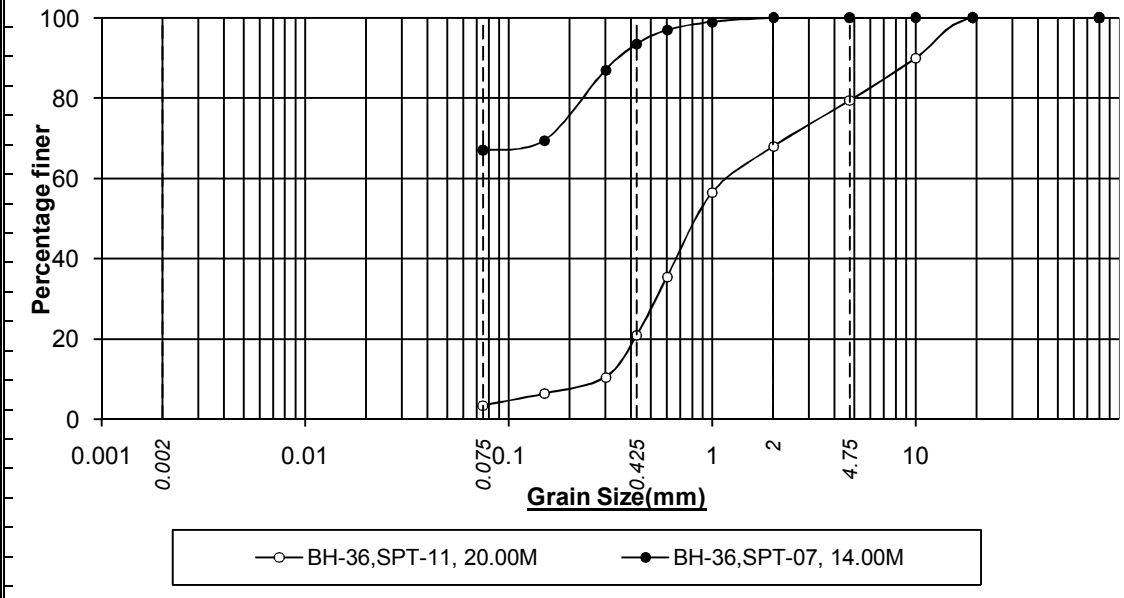
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat — **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-36,UDS-01, 2.00M	1.0	17.0	70.0	12.0	0.0	82.0		0.0
BH-36,UDS-03, 6.50M		9.0	70.5	19.5	1.0	91.0	3.054/1.166	0.0

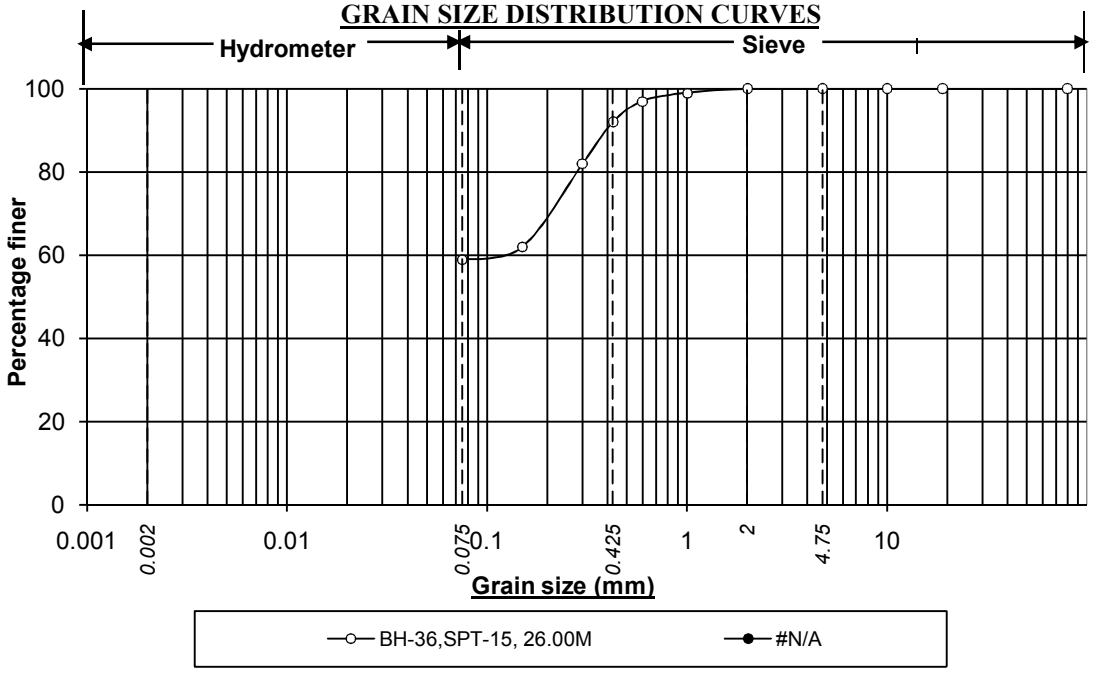


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-36,SPT-11, 20.00M		3.5	17.5	47.0	11.5	76.0	3.793/0.803	20.5
BH-36,SPT-07, 14.00M		67.0	26.5	6.5	0.0	33.0		0.0

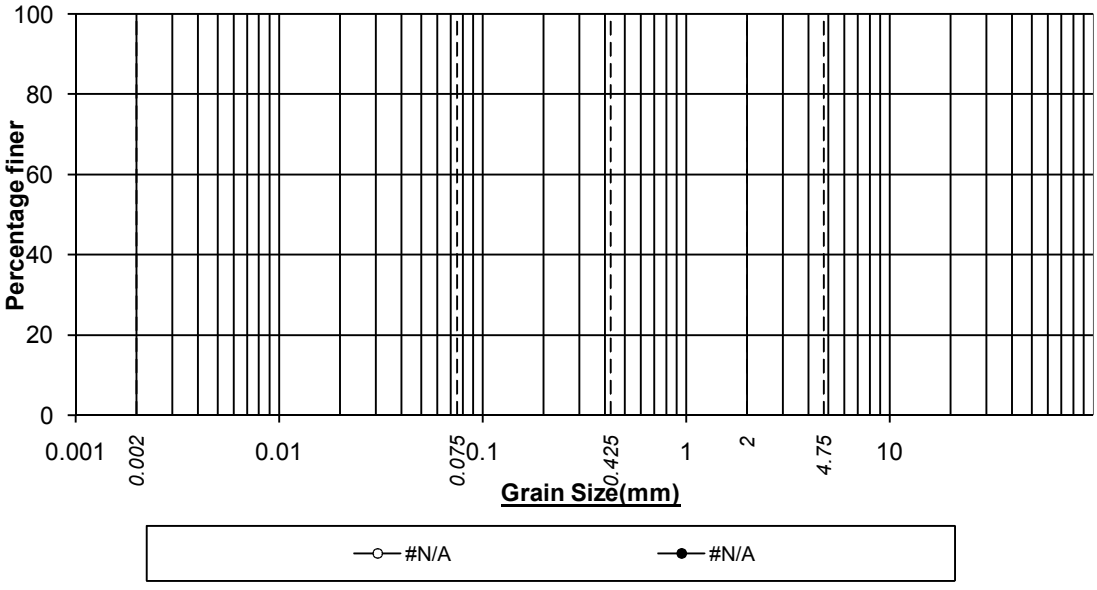
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat — **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-36,SPT-15, 26.00M		59.0	33.0	8.0	0.0	41.0		0.0

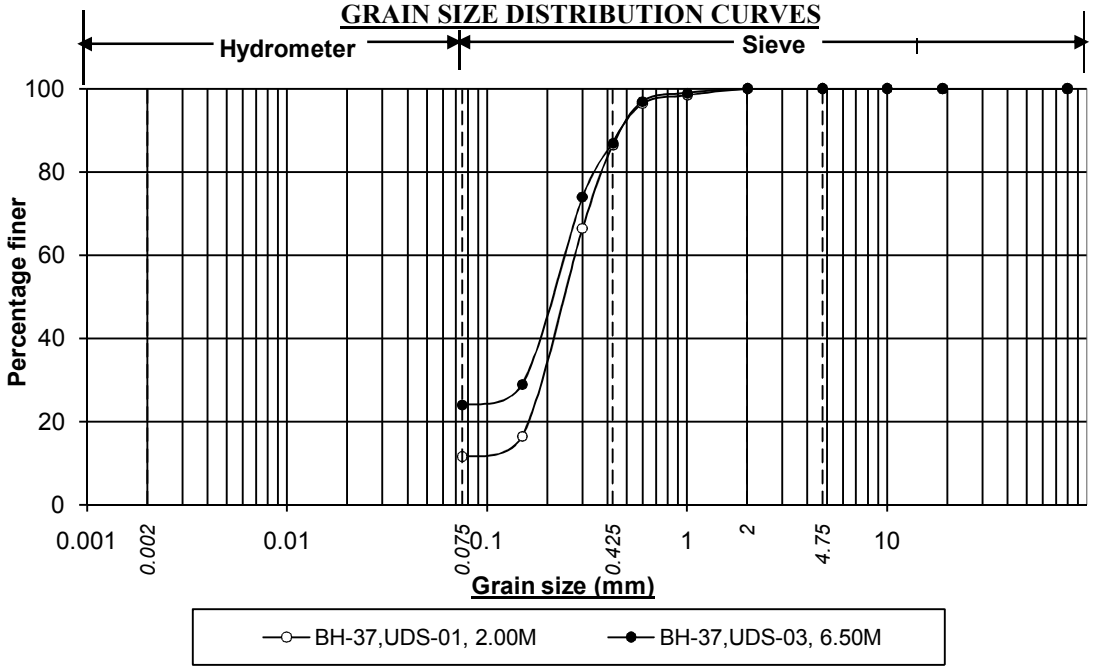


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

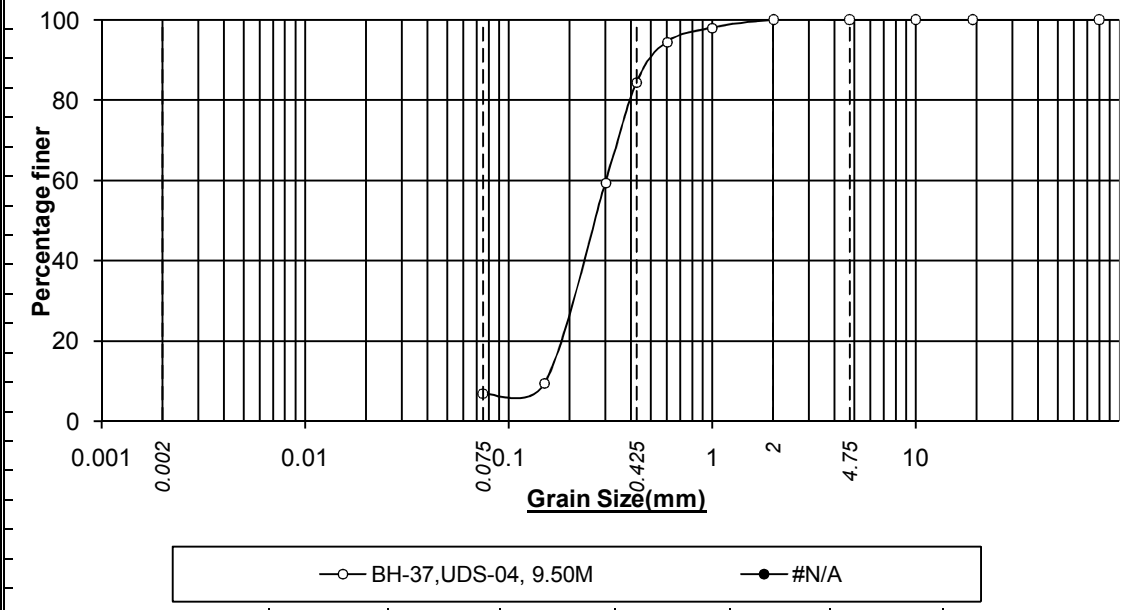
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-37,UDS-01, 2.00M		11.5	75.0	13.5	0.0	88.5		0.0
BH-37,UDS-03, 6.50M		24.0	63.0	13.0	0.0	76.0		0.0

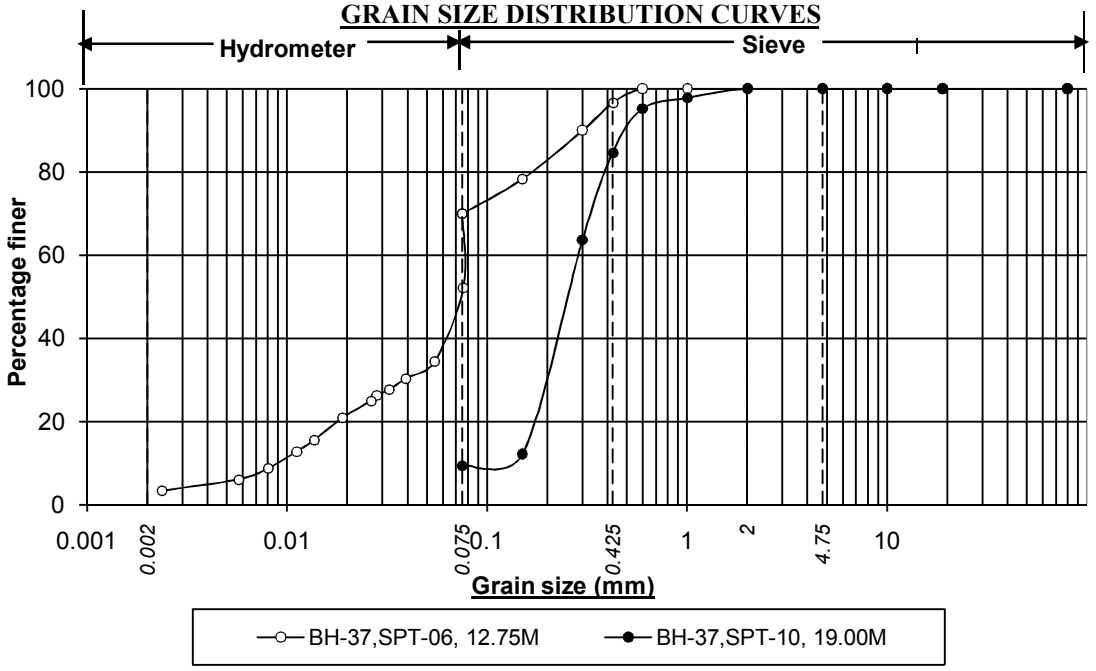


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-37,UDS-04, 9.50M		7.0	77.5	15.5	0.0	93.0	1.954/1.044	0.0

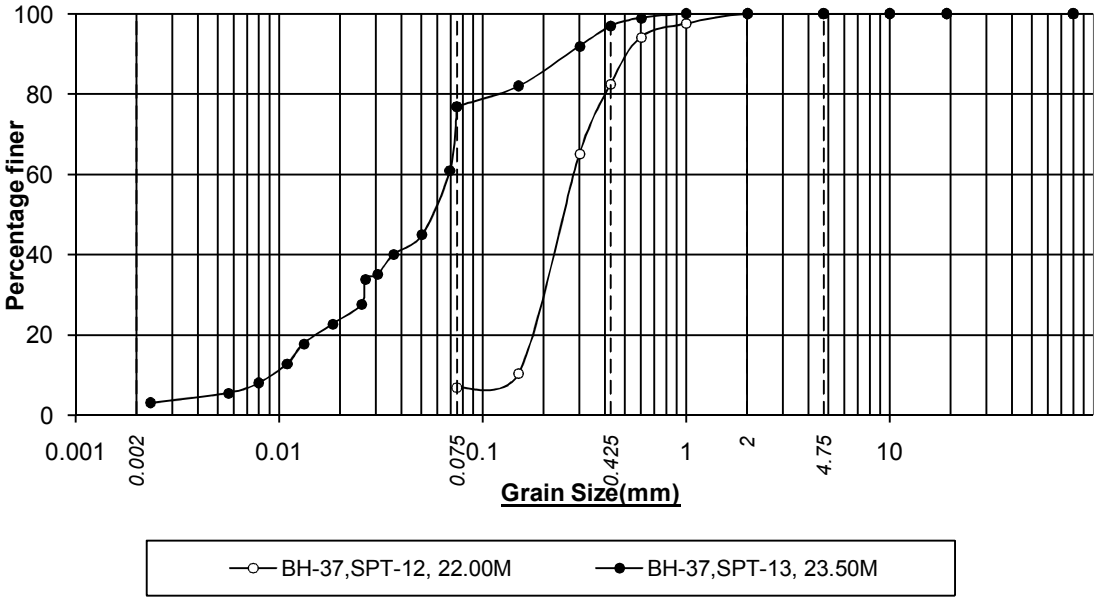
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-37,SPT-06, 12.75M	2.9	67.1	26.7	3.3	0.0	30.0		0.0
BH-37,SPT-10, 19.00M		9.5	75.2	15.3	0.0	90.5	2.046/1.011	0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-37,SPT-12, 22.00M		7.0	75.6	17.4	0.0	93.0	1.931/0.955	0.0
BH-37,SPT-13, 23.50M	2.7	74.3	20.0	3.0	0.0	23.0		0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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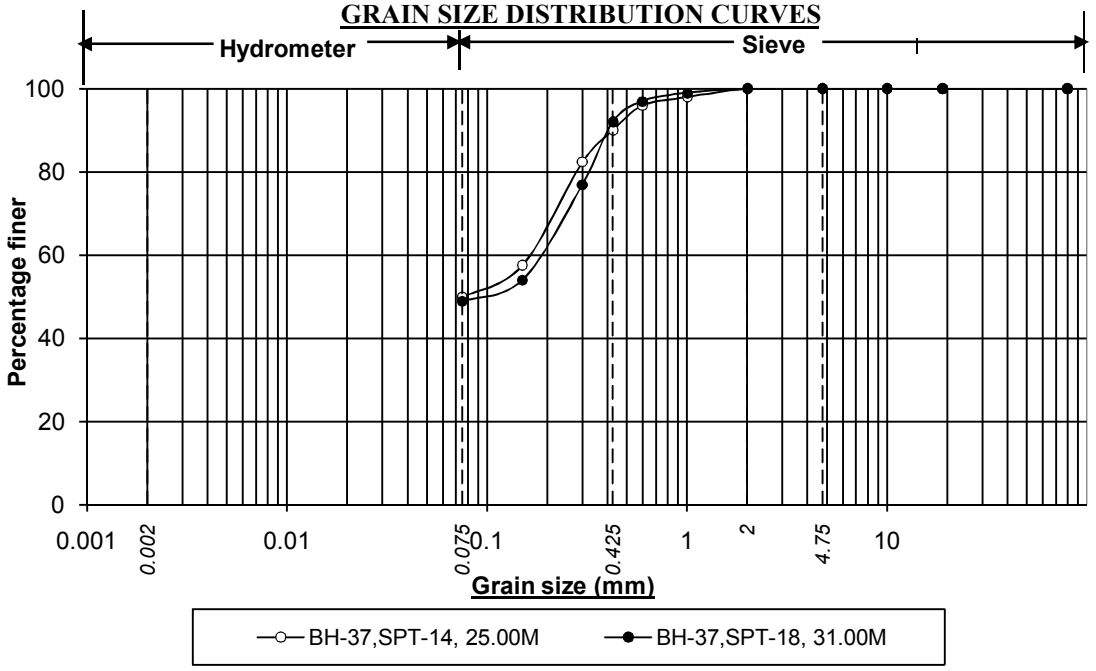
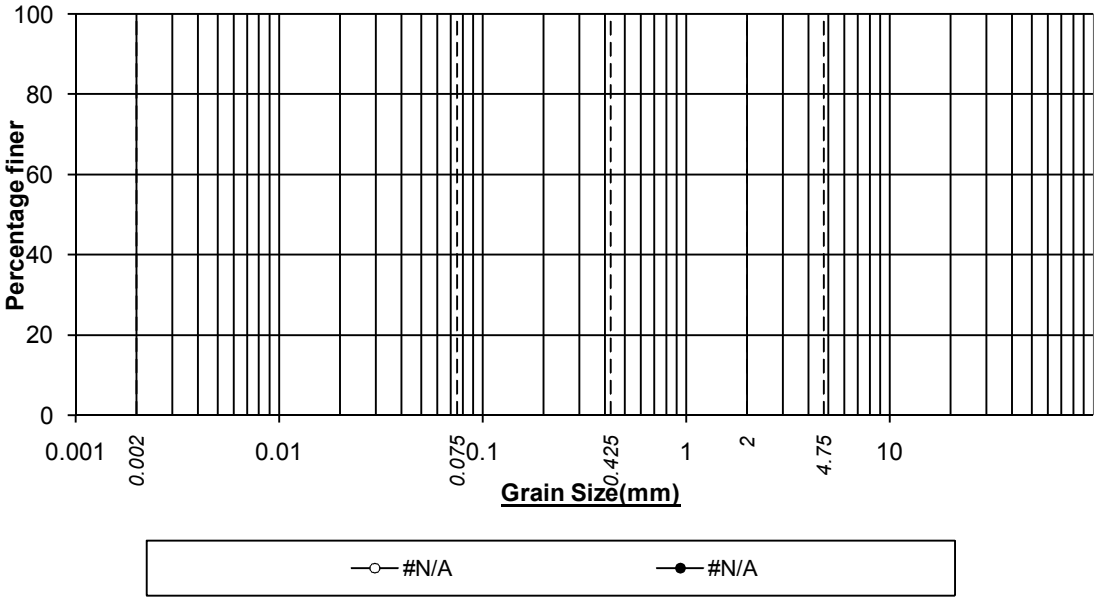
Sheet No.:

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-37,SPT-14, 25.00M		50.0	40.0	10.0	0.0	50.0		0.0
BH-37,SPT-18, 31.00M		49.0	43.0	8.0	0.0	51.0		0.0

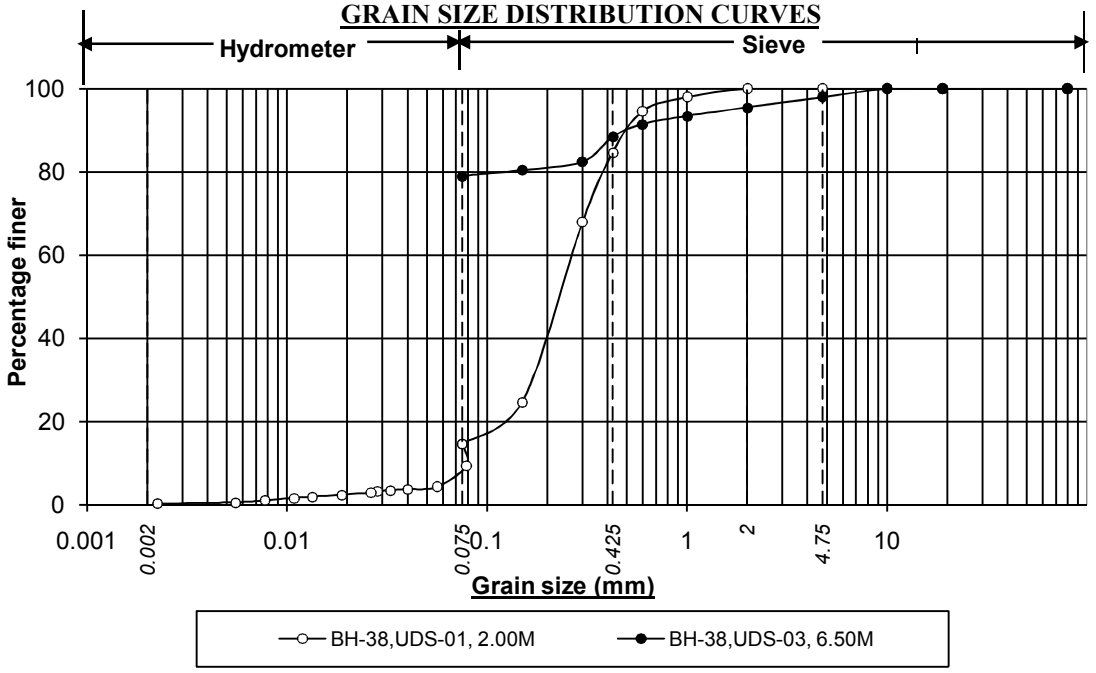


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

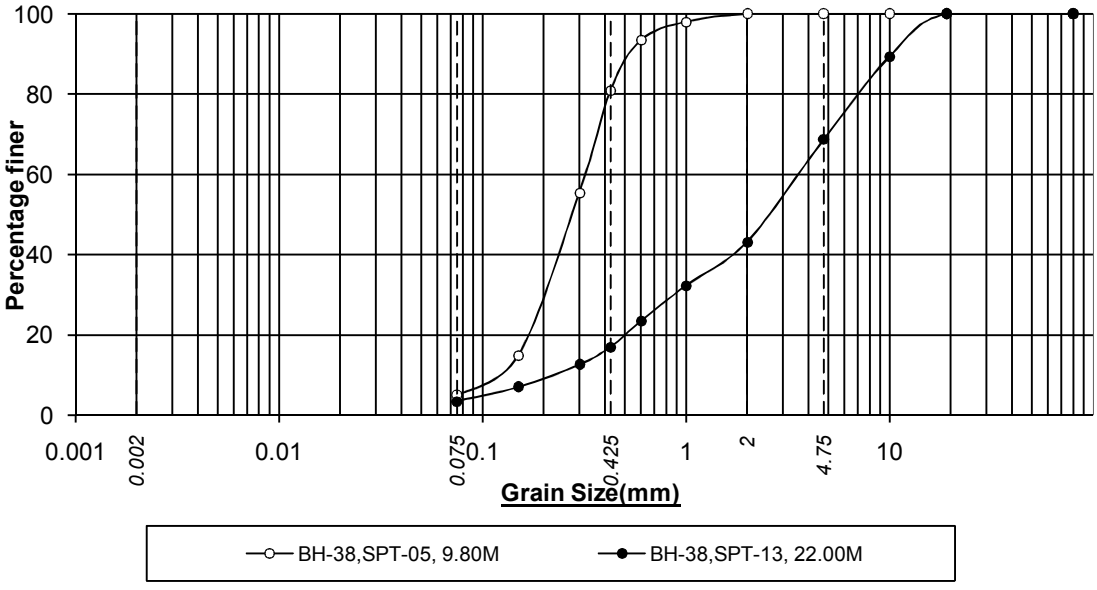
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-38,UDS-01, 2.00M	0.2	14.4	70.1	15.3	0.0	85.4		0.0
BH-38,UDS-03, 6.50M		79.0	9.5	7.0	2.5	19.0		2.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-38,SPT-05, 9.80M		5.0	76.0	19.0	0.0	95.0	2.606/1	0.0
BH-38,SPT-13, 22.00M		3.5	13.5	26.2	25.6	65.3	14.588/0.999	31.2

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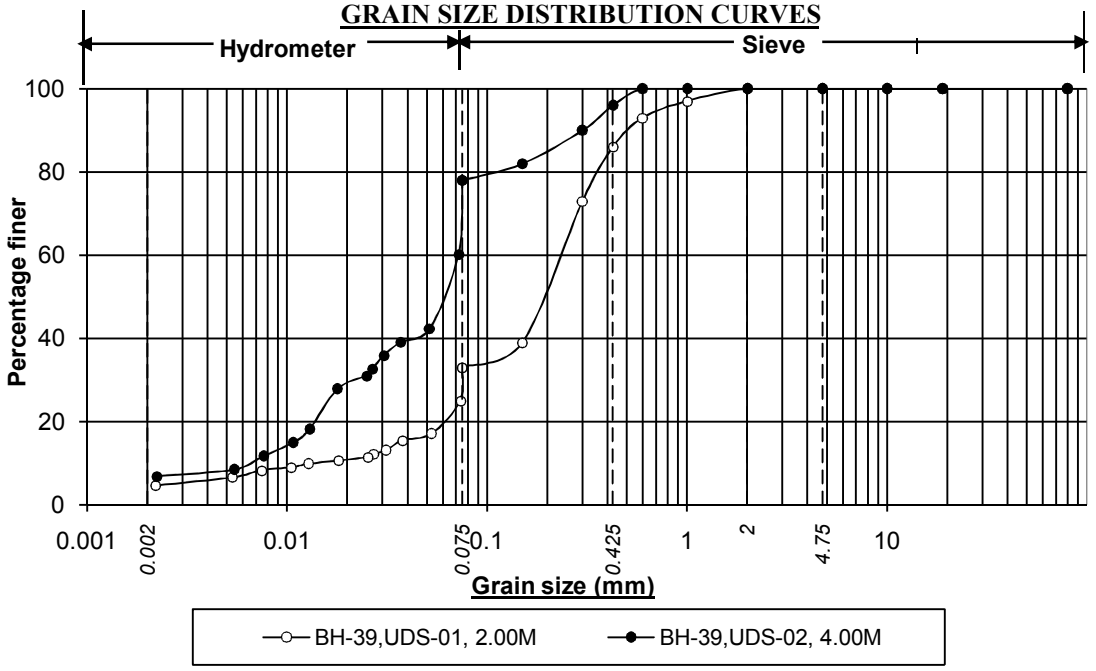
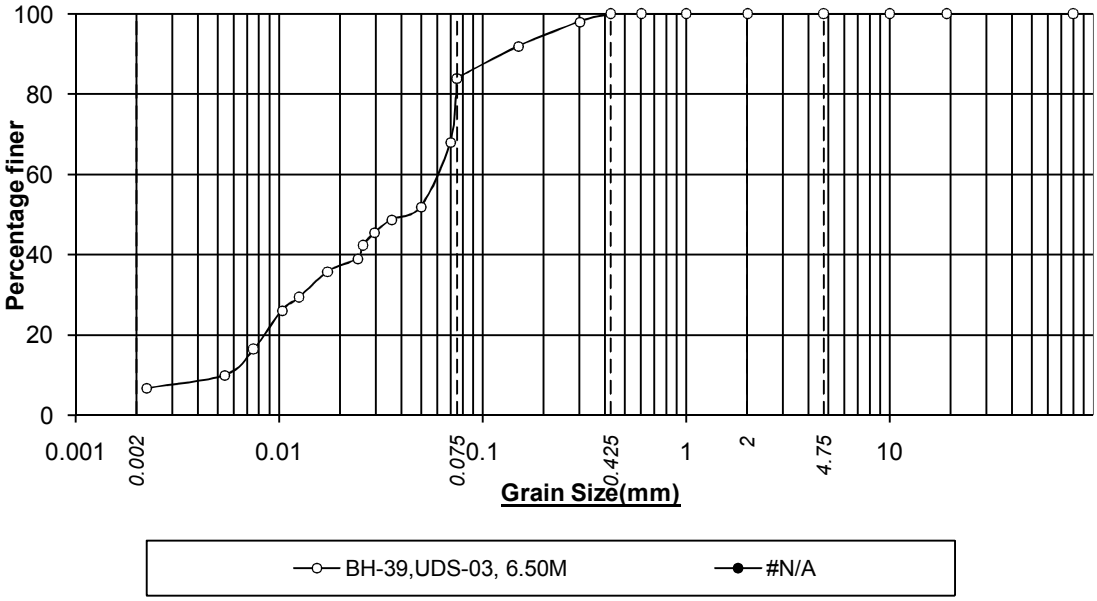
C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-39,UDS-01, 2.00M	4.4	28.6	53.0	14.0	0.0	67.0		0.0
BH-39,UDS-02, 4.00M	6.6	71.4	18.0	4.0	0.0	22.0		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-39,UDS-03, 6.50M	6.4	77.6	16.0	0.0	0.0	16.0		0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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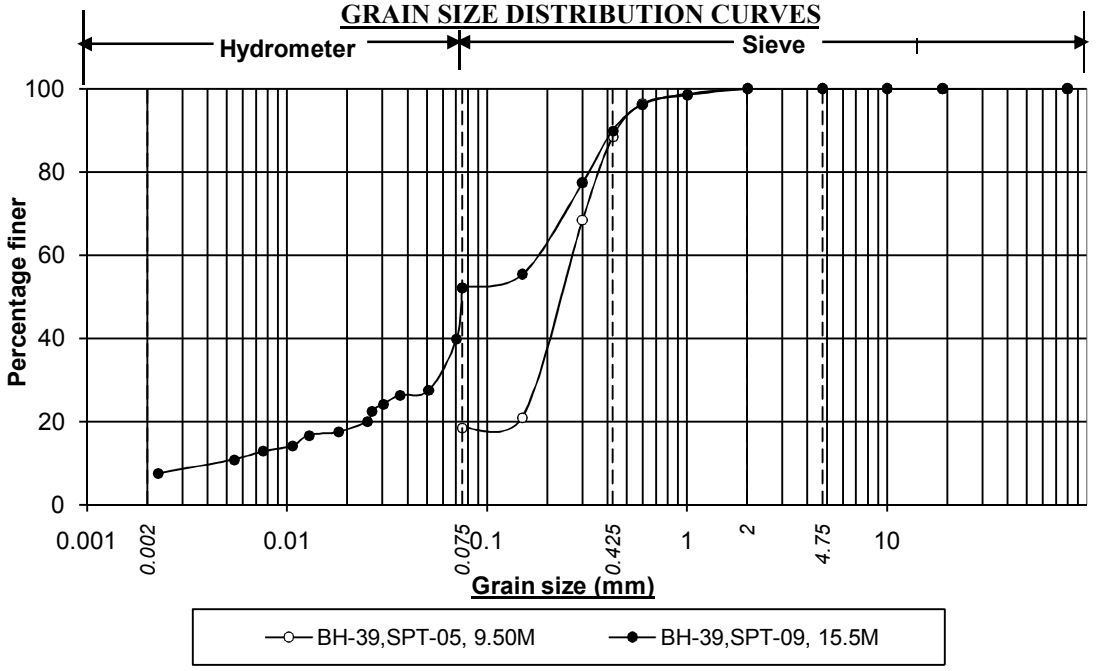
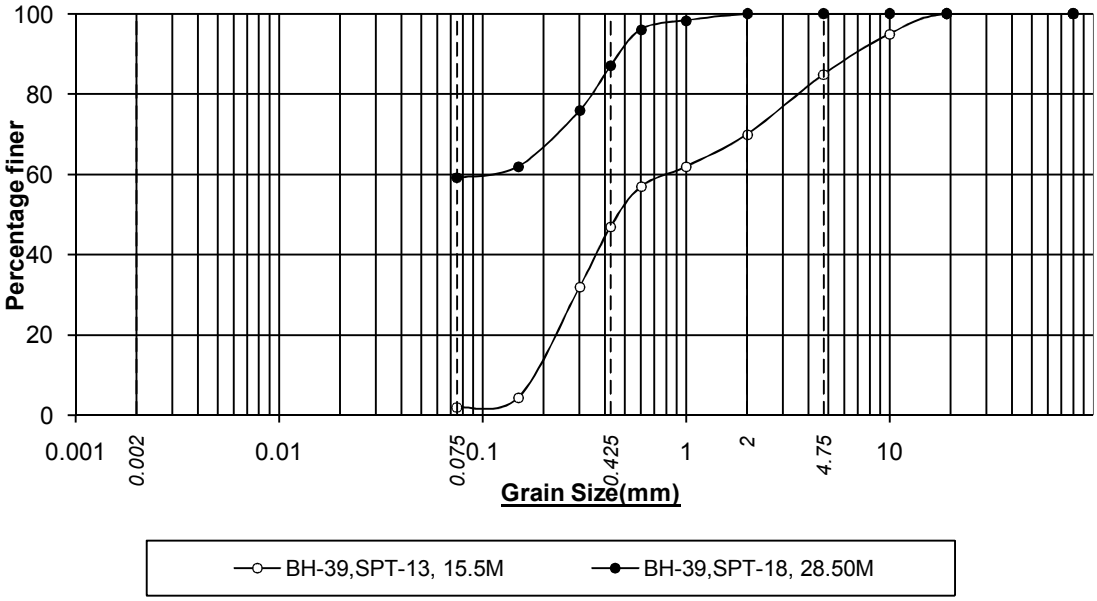
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-39,SPT-05, 9.50M		18.5	70.0	11.5	0.0	81.5		0.0
BH-39,SPT-09, 15.5M	7.1	45.1	37.7	10.1	0.0	47.8		0.0

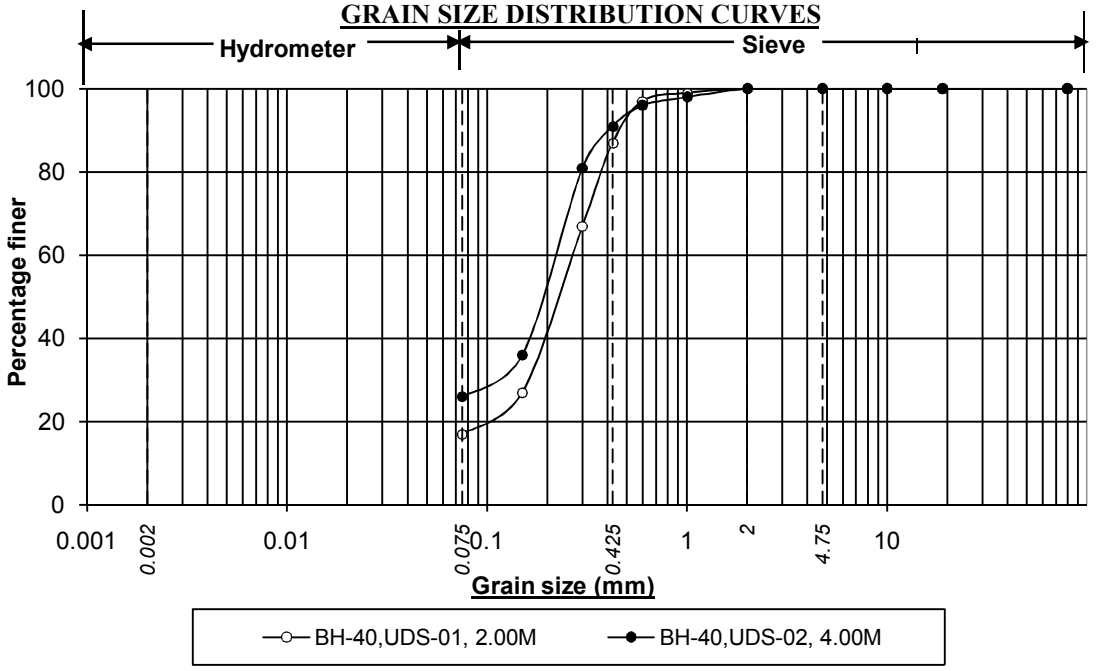


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-39,SPT-13, 15.5M		2.0	45.0	23.0	15.0	83.0	4.405/0.575	15.0
BH-39,SPT-18, 28.50M		59.2	28.0	12.8	0.0	40.8		0.0

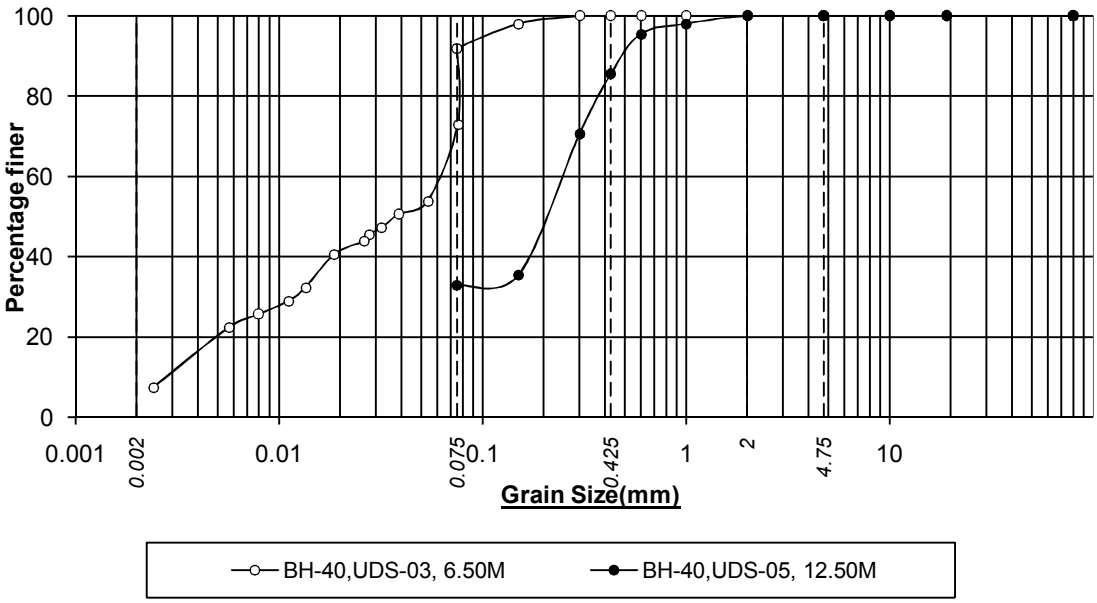
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-40,UDS-01, 2.00M		17.0	70.0	13.0	0.0	83.0		0.0
BH-40,UDS-02, 4.00M		26.0	65.0	9.0	0.0	74.0		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-40,UDS-03, 6.50M	4.2	87.8	8.0	0.0	0.0	8.0		0.0
BH-40,UDS-05, 12.50M		33.0	52.5	14.5	0.0	67.0		0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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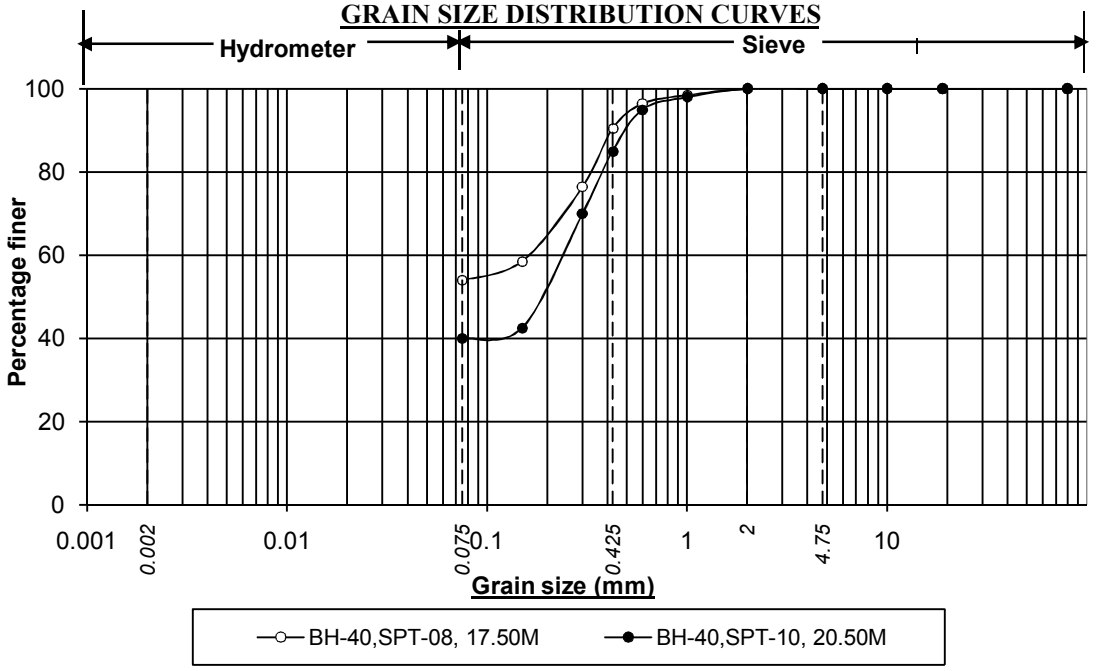
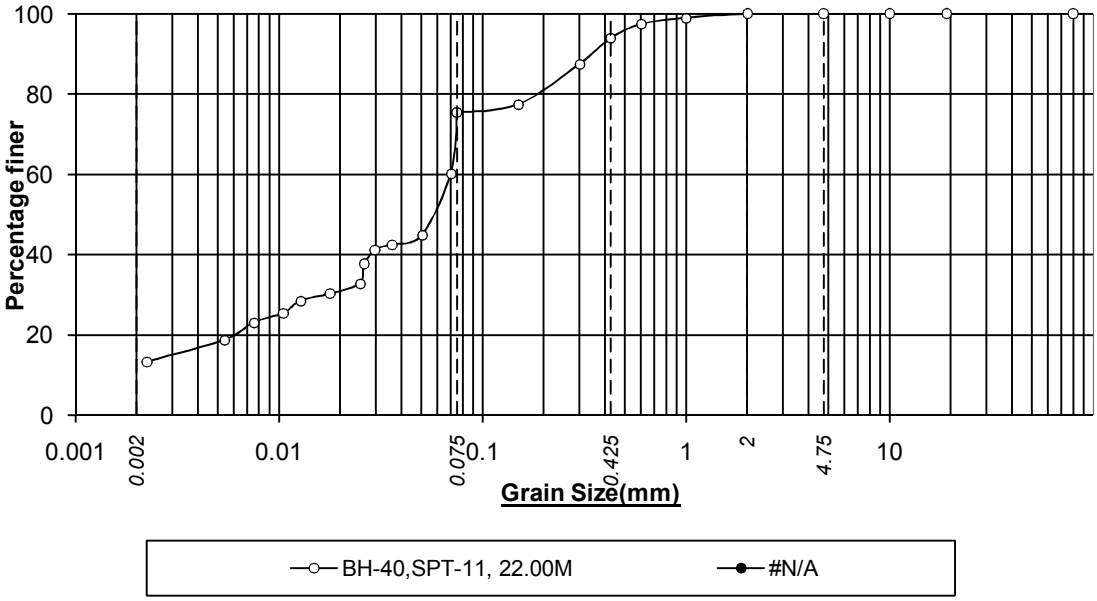
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-40,SPT-08, 17.50M		54.0	36.5	9.5	0.0	46.0		0.0
BH-40,SPT-10, 20.50M		40.0	45.0	15.0	0.0	60.0		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-40,SPT-11, 22.00M	12.6	62.9	18.5	6.0	0.0	24.5		0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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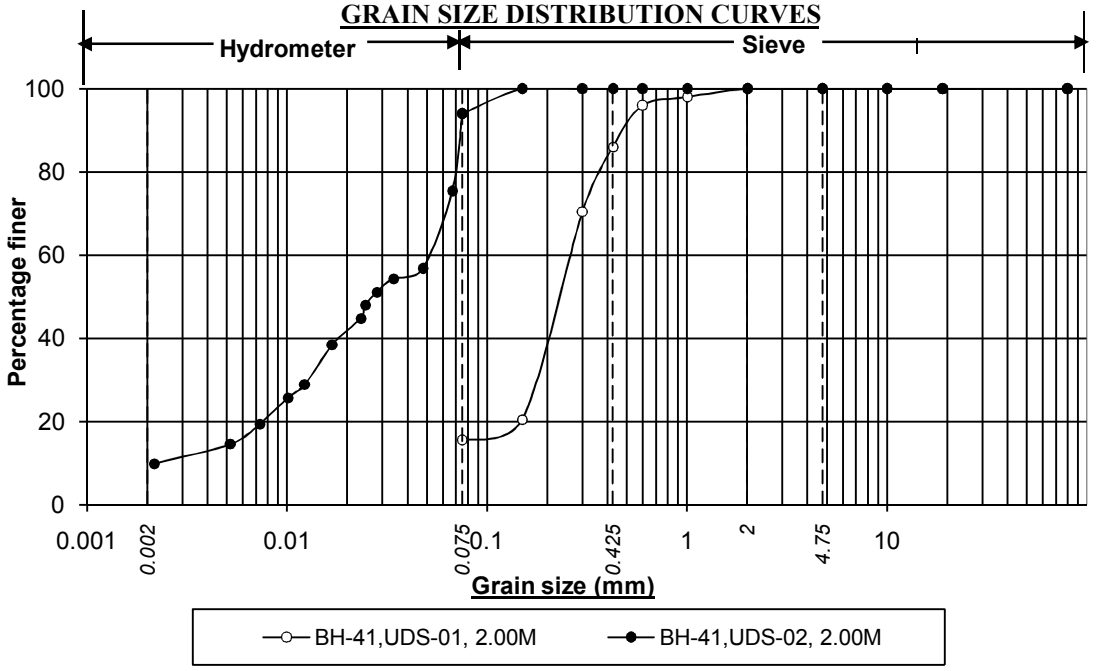
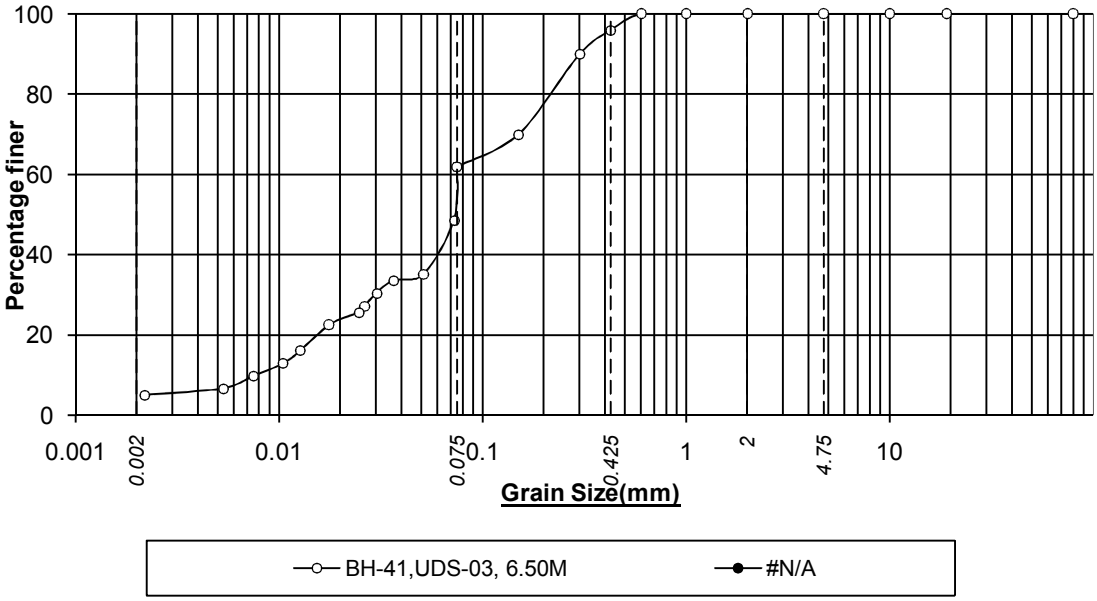
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-41,UDS-01, 2.00M		15.5	70.5	14.0	0.0	84.5		0.0
BH-41,UDS-02, 2.00M	9.4	84.6	6.0	0.0	0.0	6.0		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-41,UDS-03, 6.50M	4.9	57.1	34.0	4.0	0.0	38.0		0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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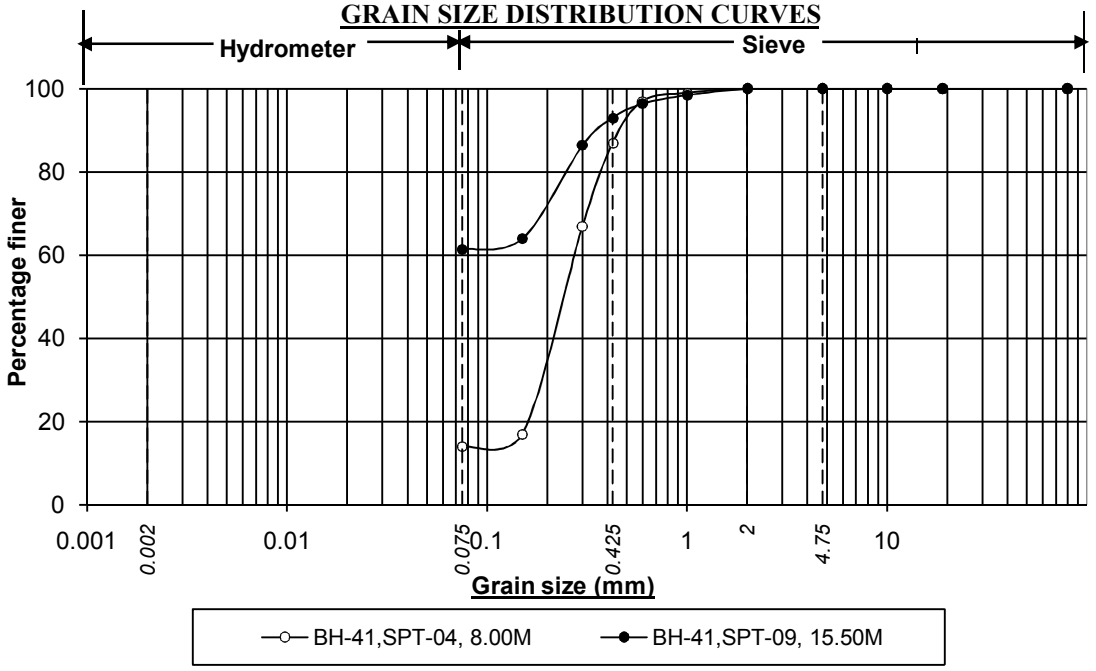
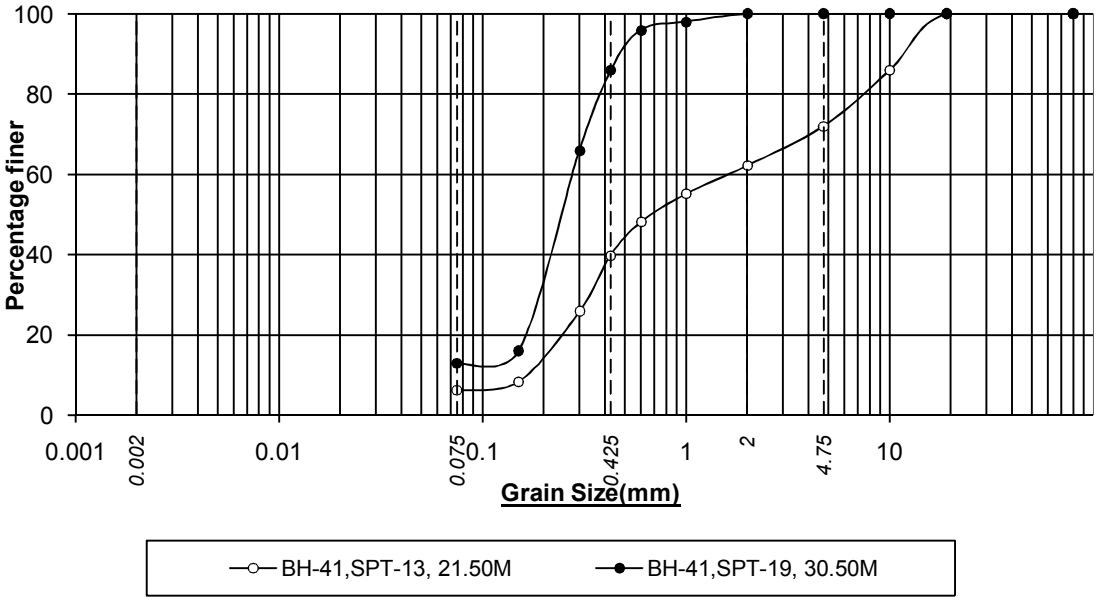
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-41,SPT-04, 8.00M		14.0	73.0	13.0	0.0	86.0		0.0
BH-41,SPT-09, 15.50M		61.5	31.5	7.0	0.0	38.5		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-41,SPT-13, 21.50M		6.3	33.5	22.4	9.8	65.7	9.594/0.452	28.0
BH-41,SPT-19, 30.50M		13.0	73.0	14.0	0.0	87.0		0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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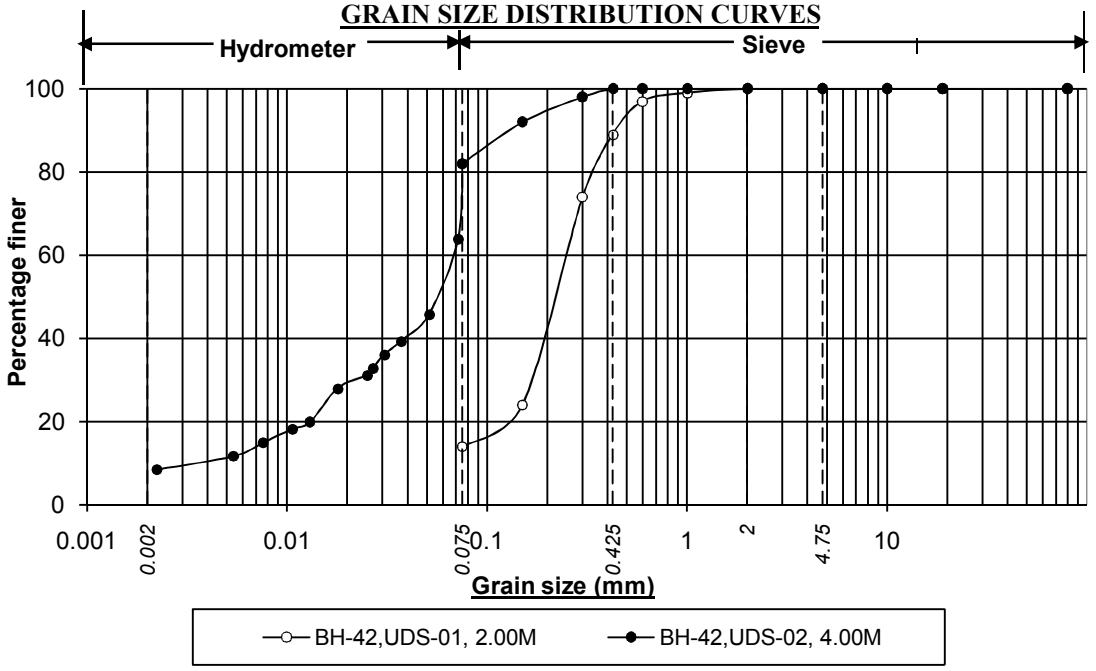
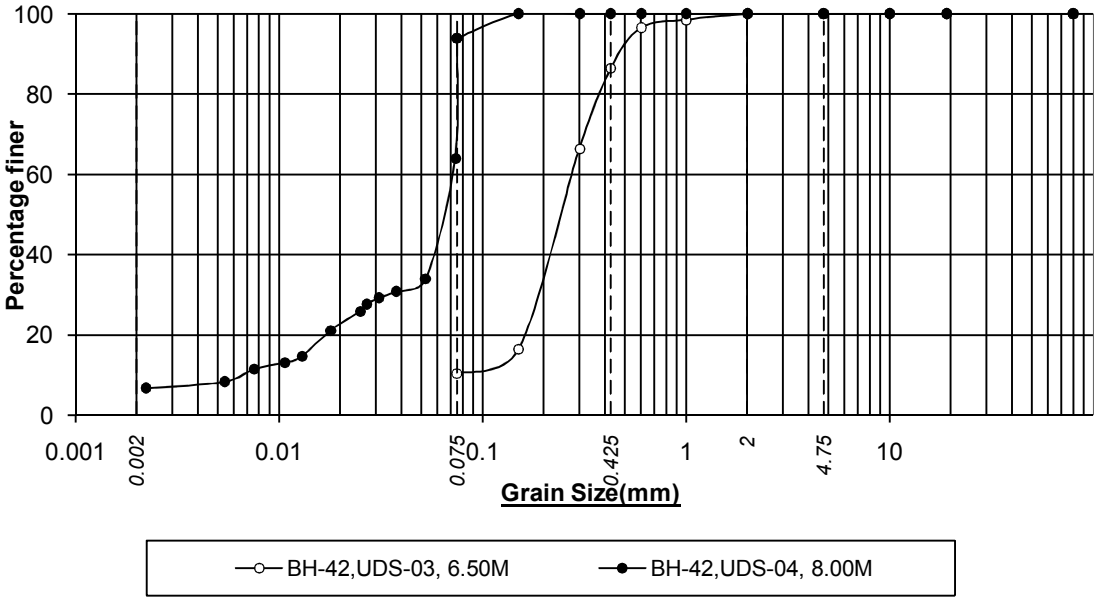
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-42,UDS-01, 2.00M		14.0	75.0	11.0	0.0	86.0		0.0
BH-42,UDS-02, 4.00M	8.0	74.0	18.0	0.0	0.0	18.0		0.0

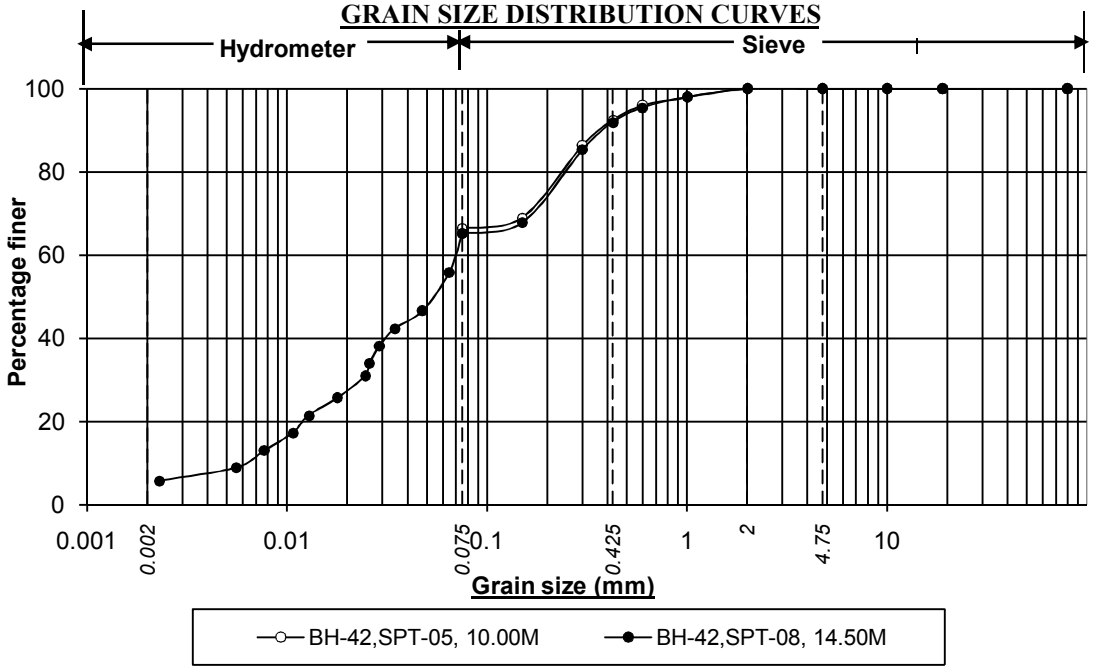


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-42,UDS-03, 6.50M		10.5	76.0	13.5	0.0	89.5		0.0
BH-42,UDS-04, 8.00M	6.6	87.4	6.0	0.0	0.0	6.0		0.0

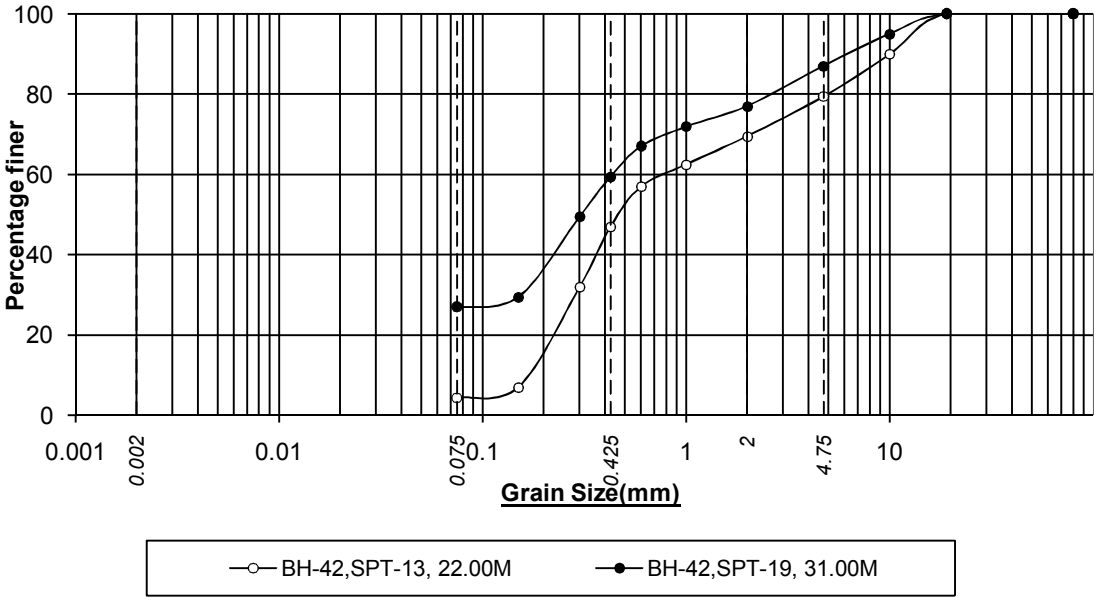
Project:-Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-42,SPT-05, 10.00M		66.5	26.0	7.5	0.0	33.5		0.0
BH-42,SPT-08, 14.50M	5.3	60.1	26.6	8.0	0.0	34.6		0.0



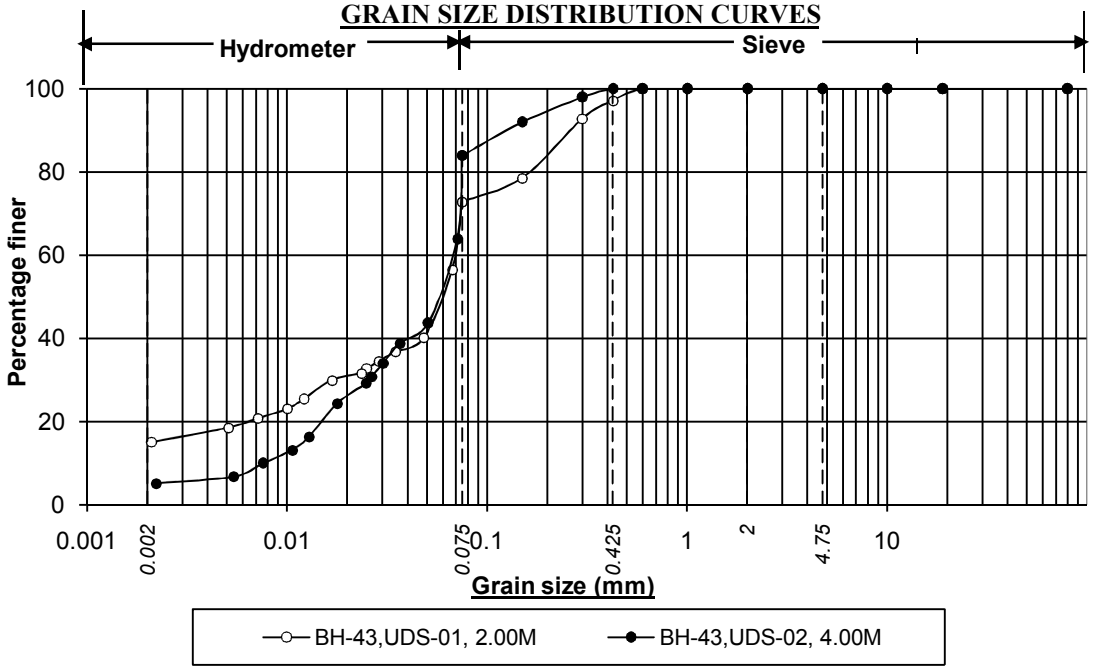
Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-42,SPT-13, 22.00M		4.5	42.5	22.5	10.0	75.0	4.623/0.598	20.5
BH-42,SPT-19, 31.00M		27.0	32.5	17.5	10.0	60.0		13.0

Project:-Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

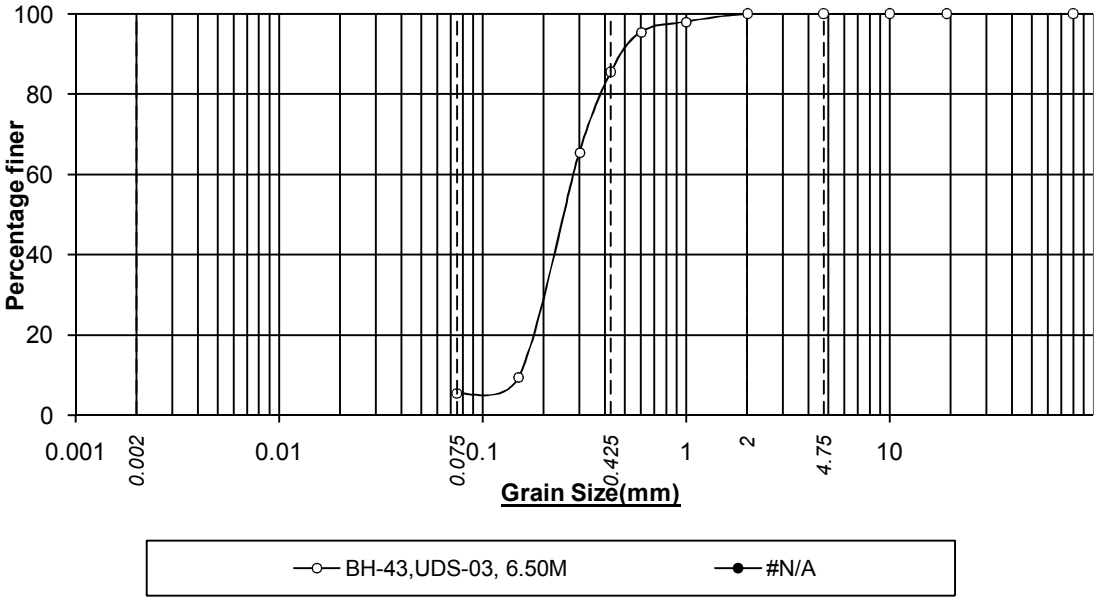
C. E. Testing Company Pvt. Ltd.

Sheet No.:

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-43,UDS-01, 2.00M	14.9	58.0	24.2	2.9	0.0	27.1		0.0
BH-43,UDS-02, 4.00M	5.0	79.0	16.0	0.0	0.0	16.0		0.0

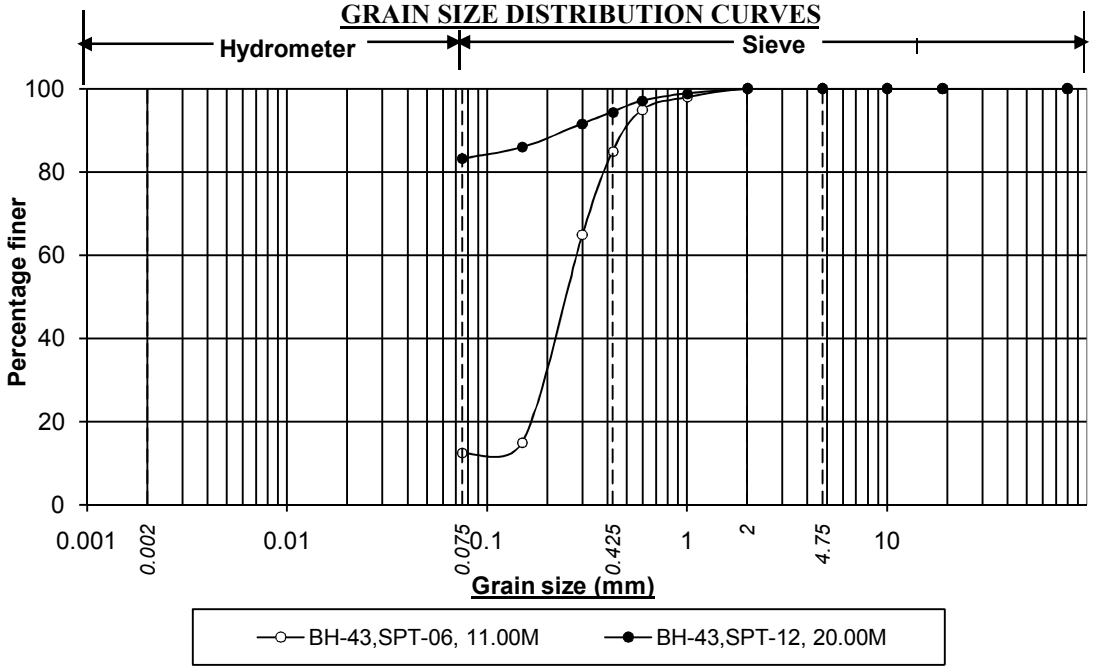


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-43,UDS-03, 6.50M		5.5	80.0	14.5	0.0	94.5	1.807/0.885	0.0

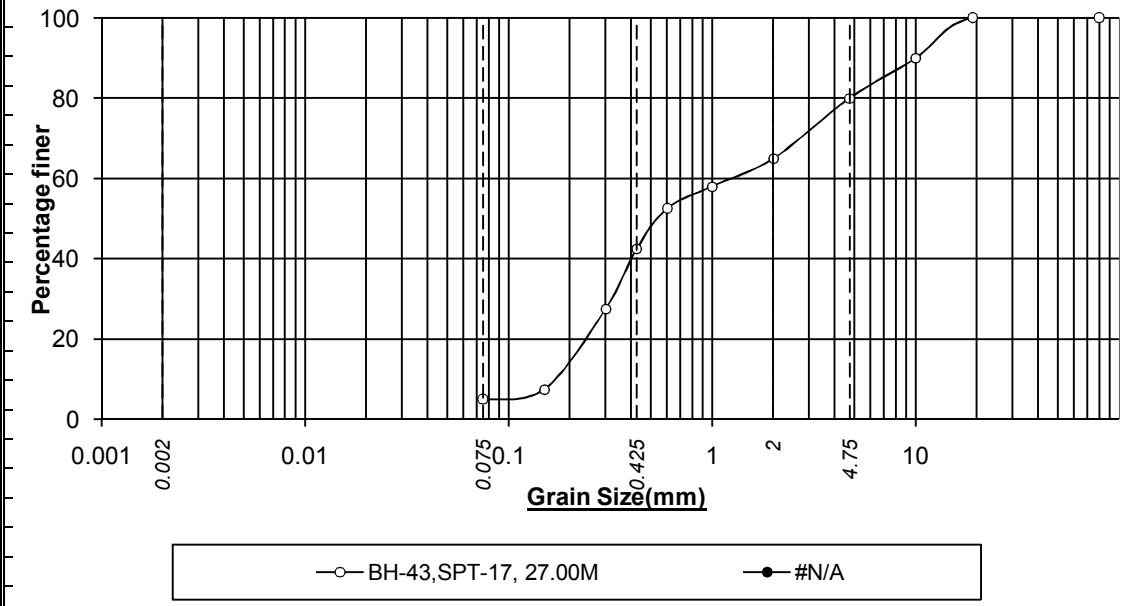
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-43,SPT-06, 11.00M		12.5	72.5	15.0	0.0	87.5		0.0
BH-43,SPT-12, 20.00M		83.2	11.2	5.6	0.0	16.8		0.0

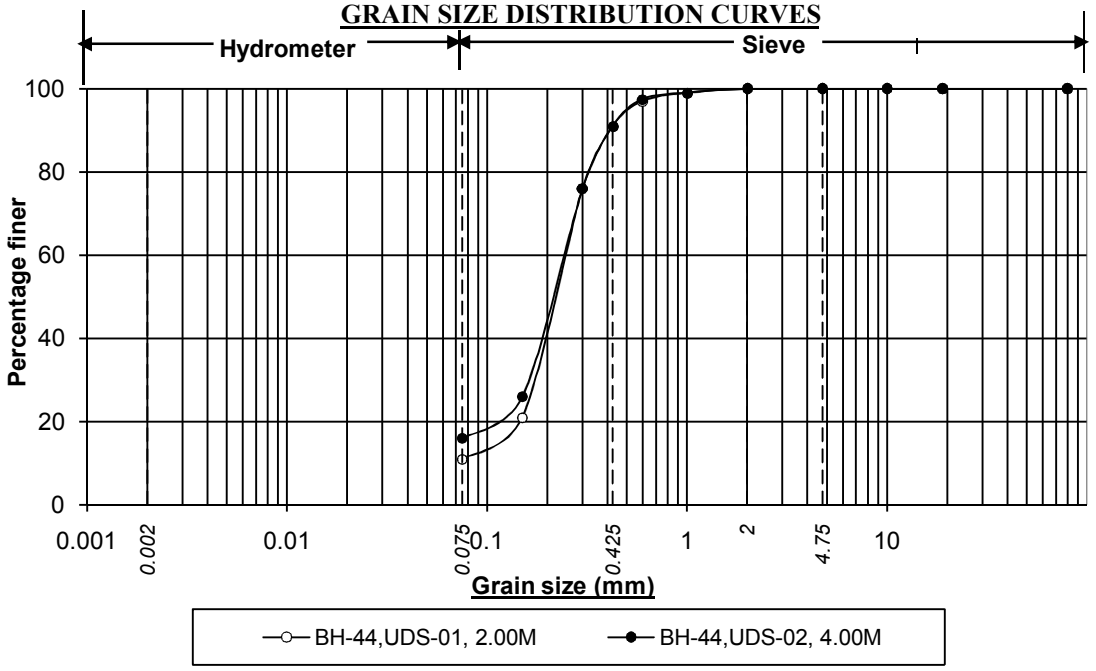


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-43,SPT-17, 27.00M		5.0	37.5	22.5	15.0	75.0	7.396/0.493	20.0

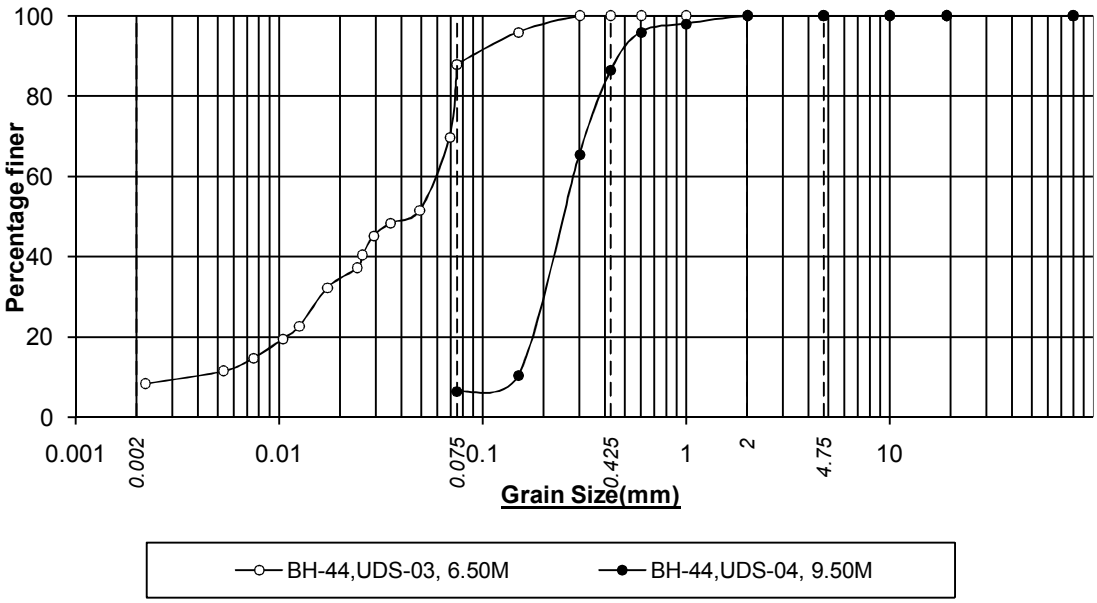
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	Total sand	Cu/Cc	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-44,UDS-01, 2.00M		11.0	80.0	9.0	0.0	89.0		0.0
BH-44,UDS-02, 4.00M		16.0	75.0	9.0	0.0	84.0		0.0

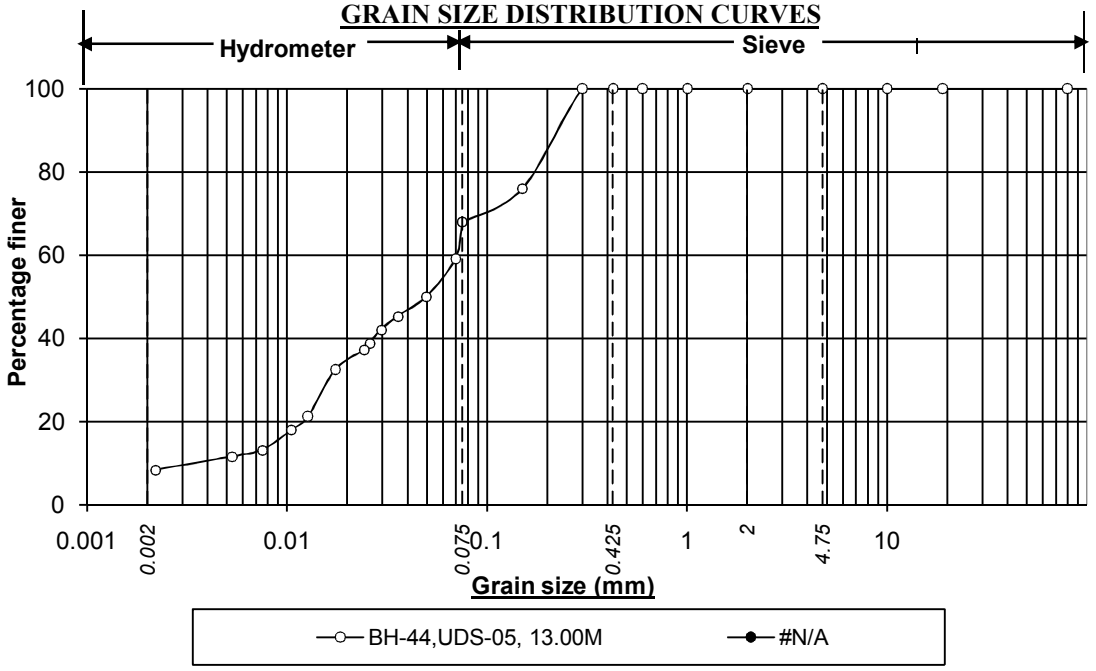


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	Total sand	Cu/Cc	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-44,UDS-03, 6.50M	8.0	80.0	12.0	0.0	0.0	12.0		0.0
BH-44,UDS-04, 9.50M		6.5	80.0	13.5	0.0	93.5	1.927/0.918	0.0

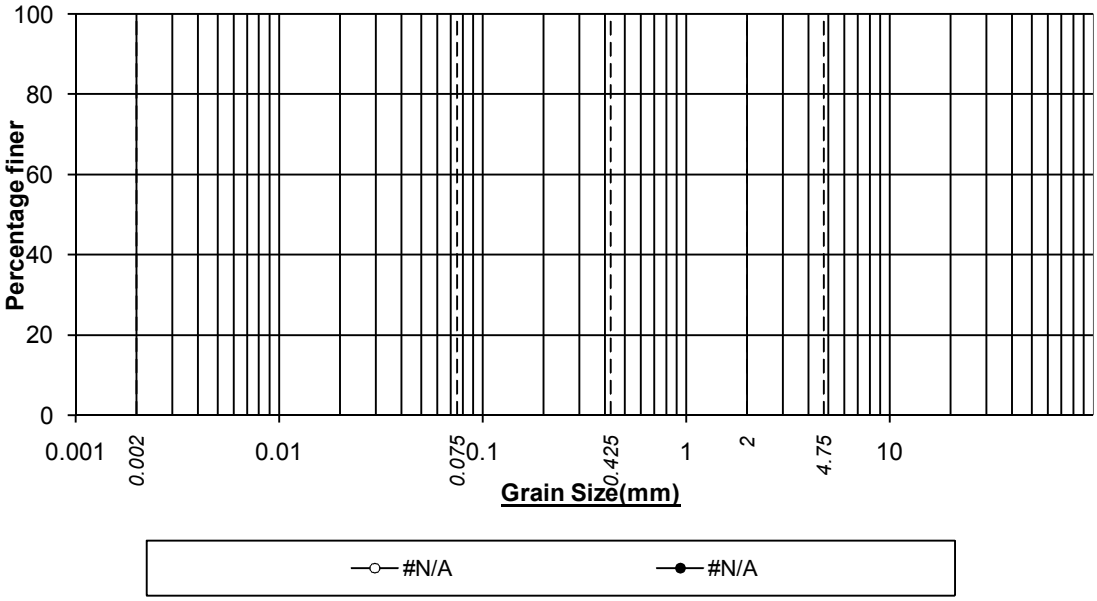
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-44,UDS-05, 13.00M	8.0	60.0	32.0	0.0	0.0	32.0		0.0

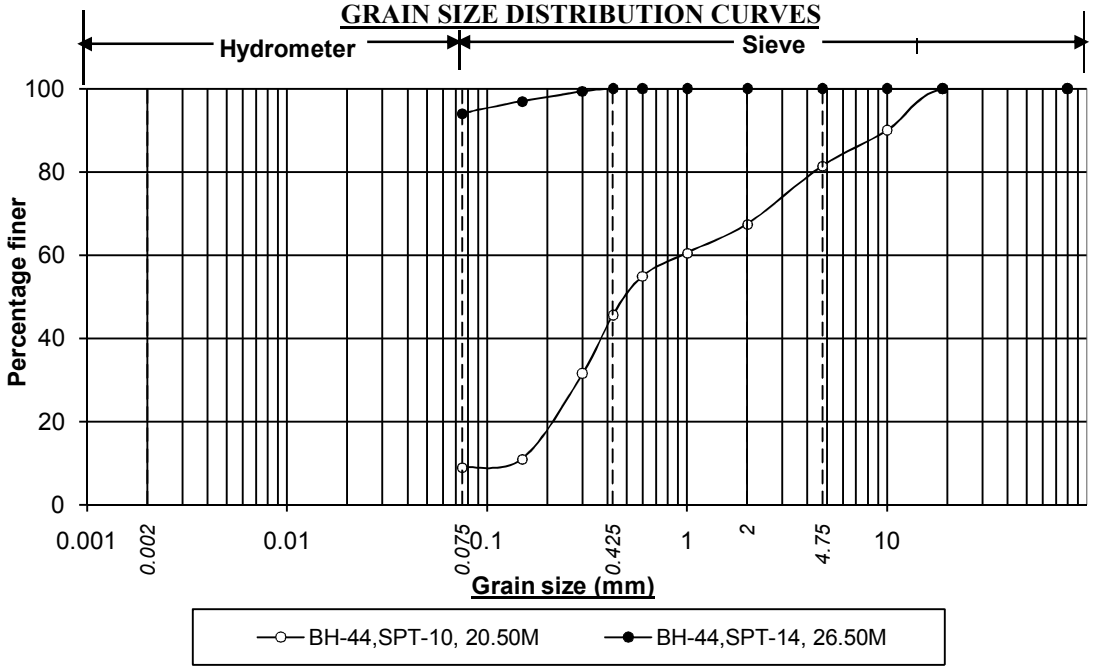


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

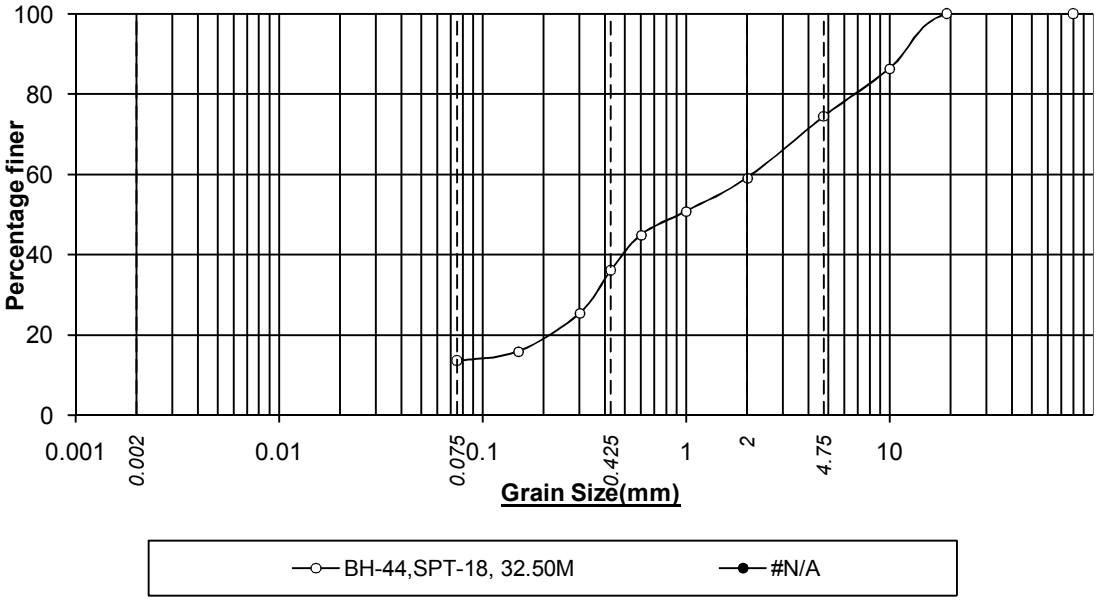
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-44,SPT-10, 20.50M		9.0	36.5	22.0	14.0	72.5	7.144/0.639	18.5
BH-44,SPT-14, 26.50M		94.1	5.9	0.0	0.0	5.9		0.0

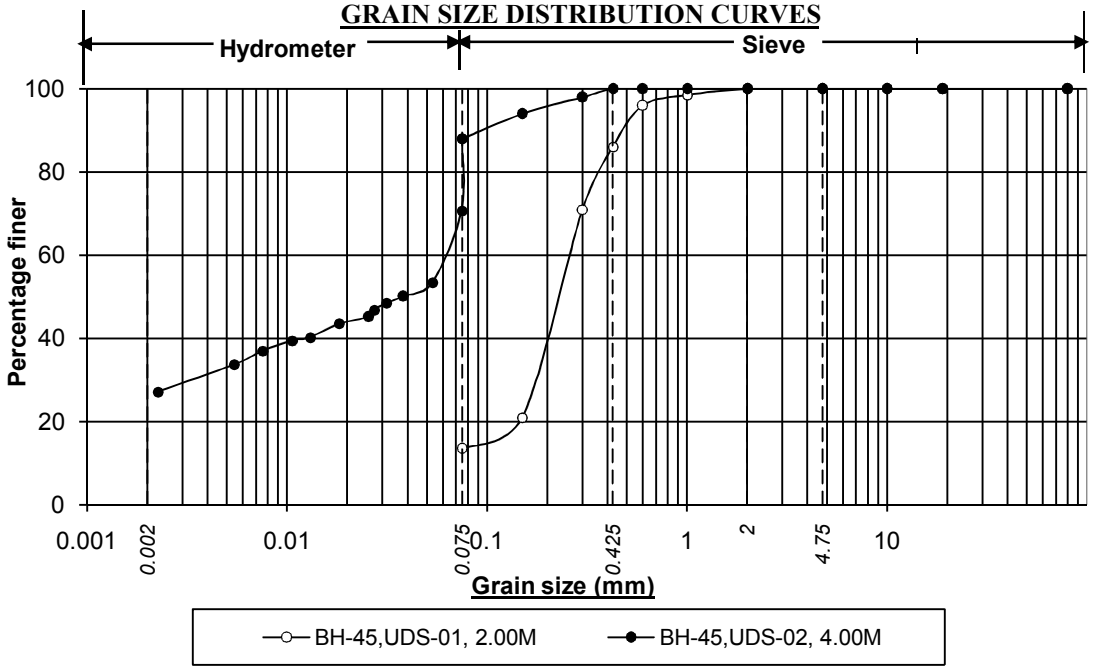


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-44,SPT-18, 32.50M		13.6	22.5	23.1	15.4	61.0		25.4

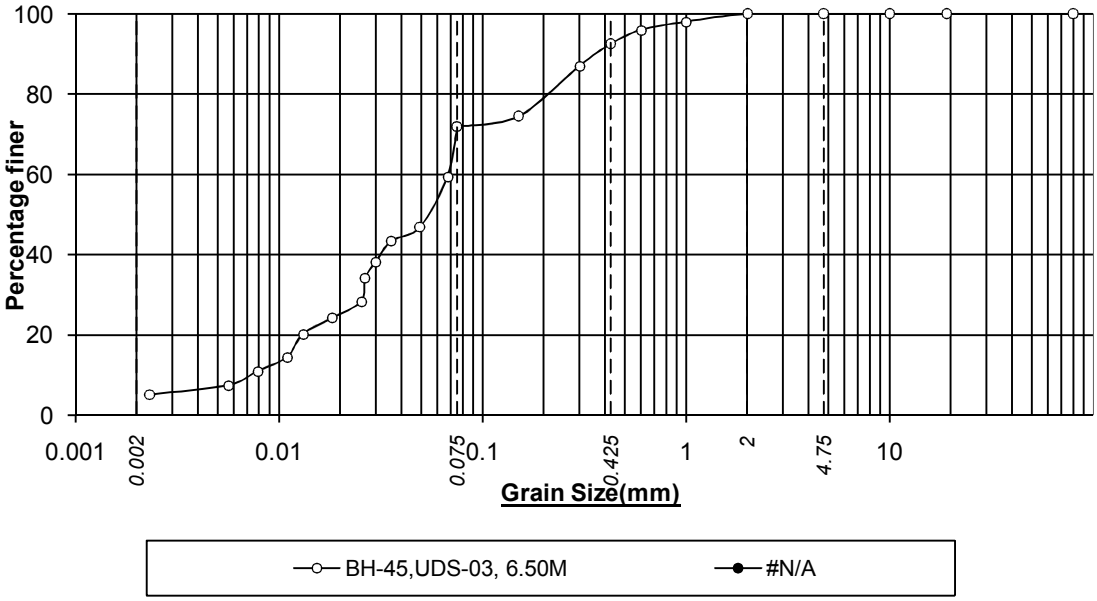
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-45,UDS-01, 2.00M		13.5	72.5	14.0	0.0	86.5		0.0
BH-45,UDS-02, 4.00M	26.2	61.8	12.0	0.0	0.0	12.0		0.0

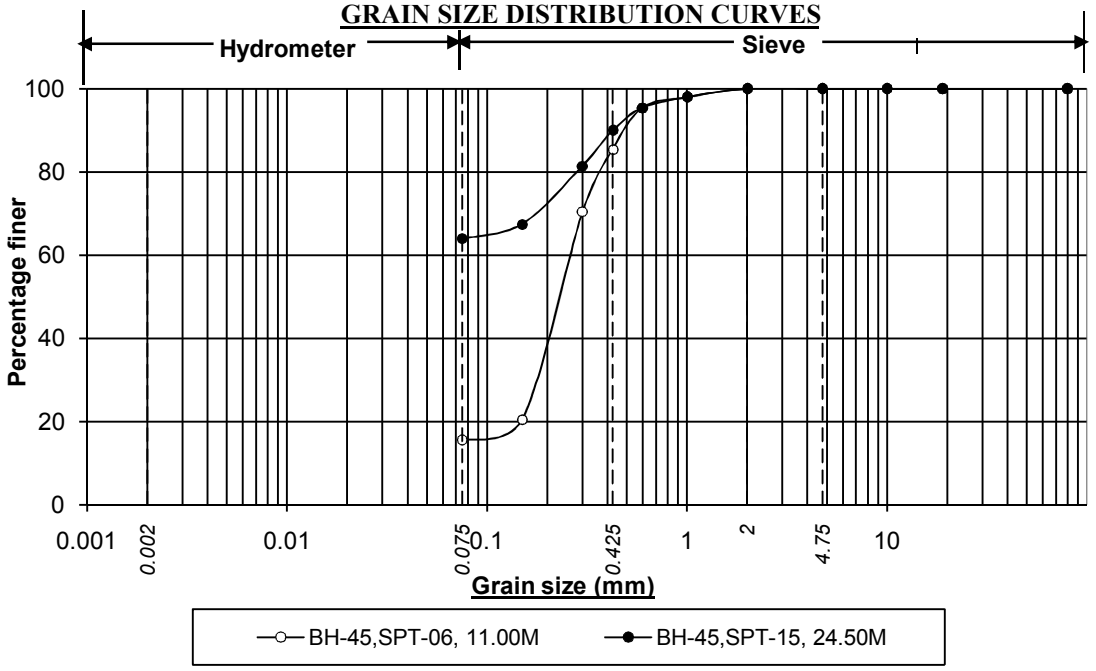


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-45,UDS-03, 6.50M	4.8	67.2	20.5	7.5	0.0	28.0		0.0

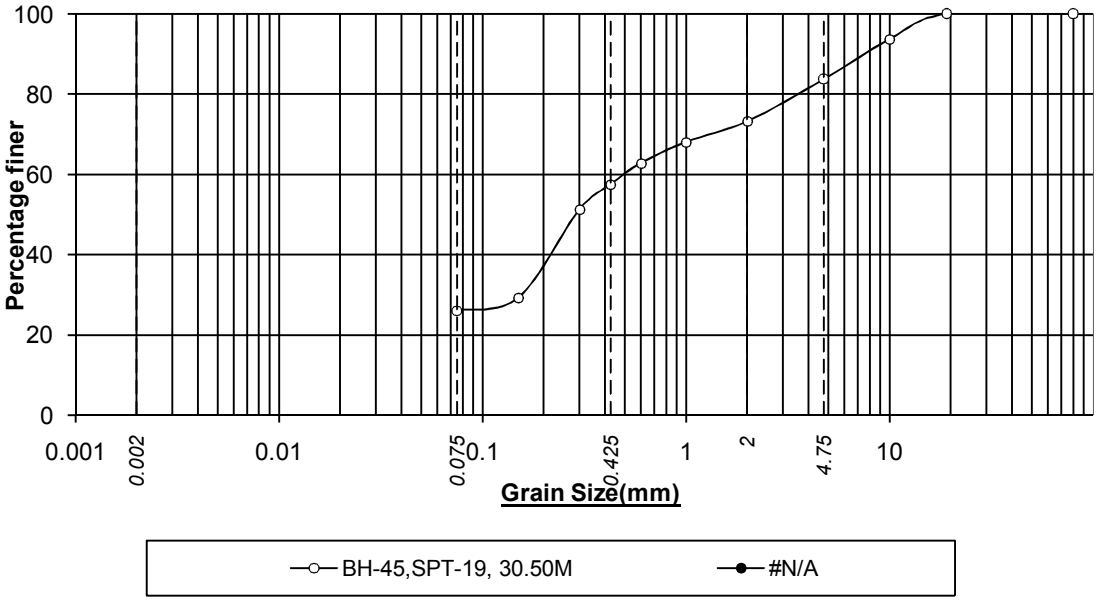
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-45,SPT-06, 11.00M		15.5	70.0	14.5	0.0	84.5		0.0
BH-45,SPT-15, 24.50M		64.0	26.0	10.0	0.0	36.0		0.0

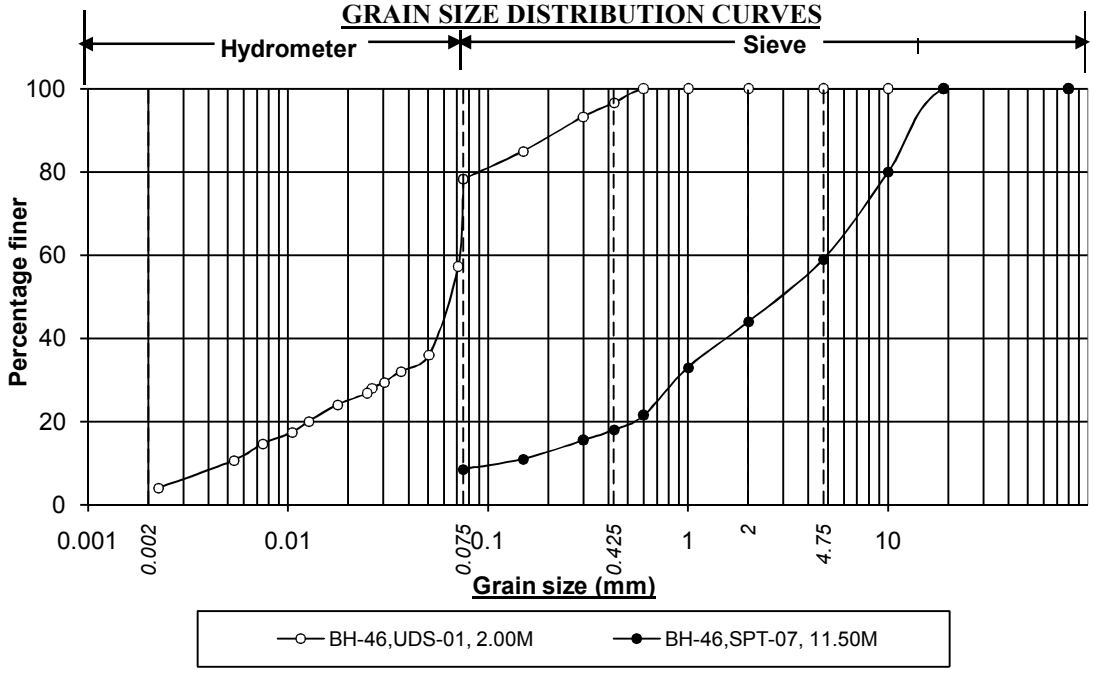


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-45,SPT-19, 30.50M		26.2	31.3	15.7	10.5	57.5		16.3

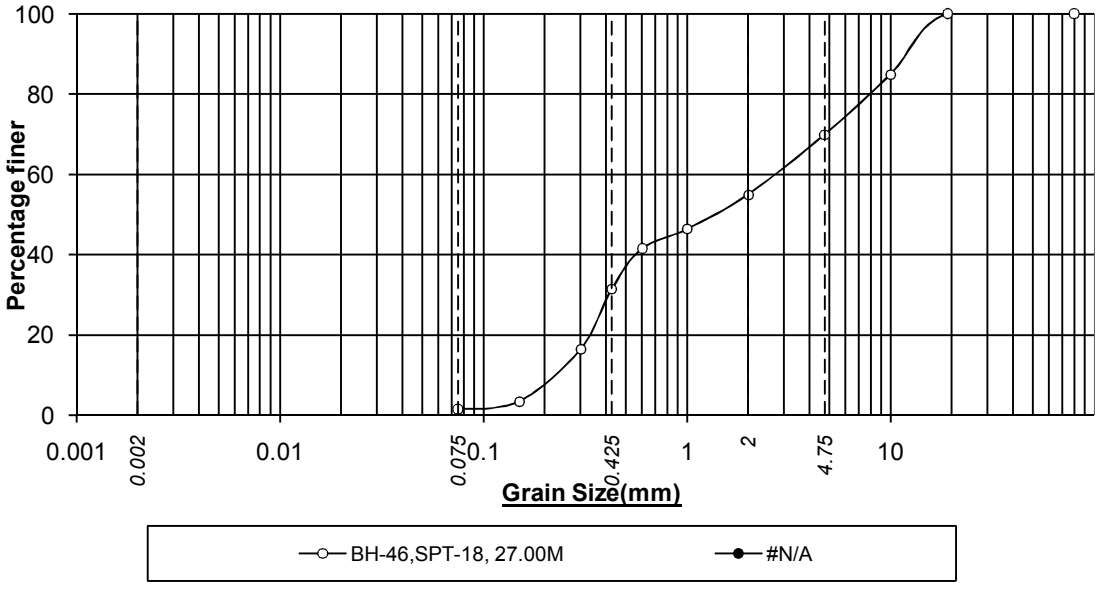
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-46,UDS-01, 2.00M	3.1	75.2	18.4	3.3	0.0	21.7		0.0
BH-46,SPT-07, 11.50M		8.5	9.5	26.0	15.0	50.5	33.884/1.009	41.0

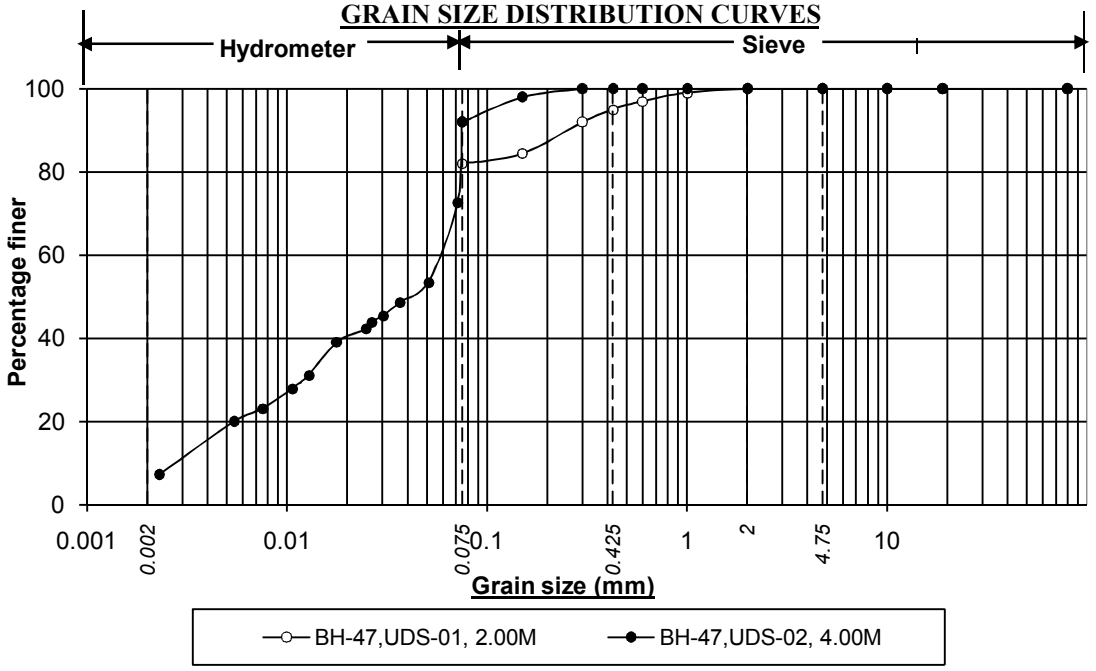


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-46,SPT-18, 27.00M		1.5	30.0	23.5	15.0	68.5	12.022/0.267	30.0

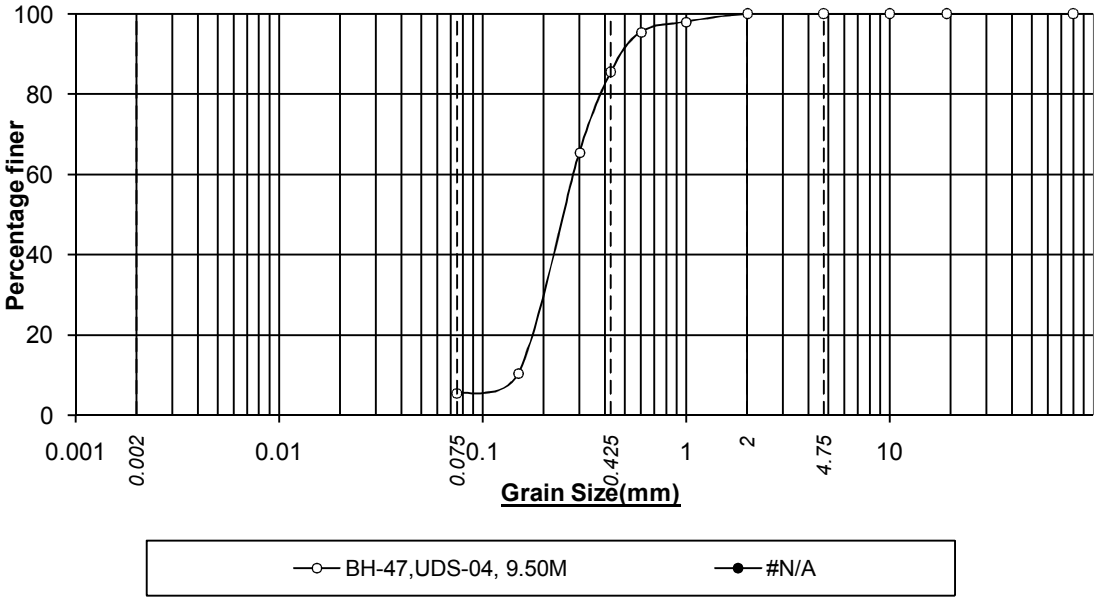
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-47,UDS-01, 2.00M		82.0	13.0	5.0	0.0	18.0		0.0
BH-47,UDS-02, 4.00M	5.2	86.8	8.0	0.0	0.0	8.0		0.0

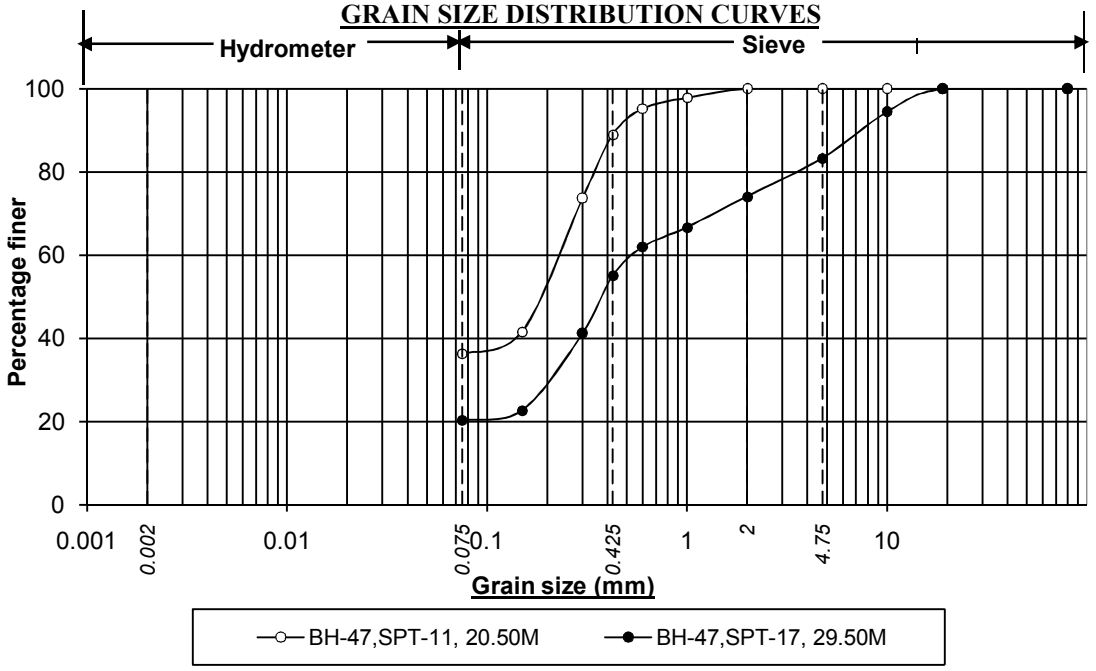


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-47,UDS-04, 9.50M		5.5	80.0	14.5	0.0	94.5	1.923/0.924	0.0

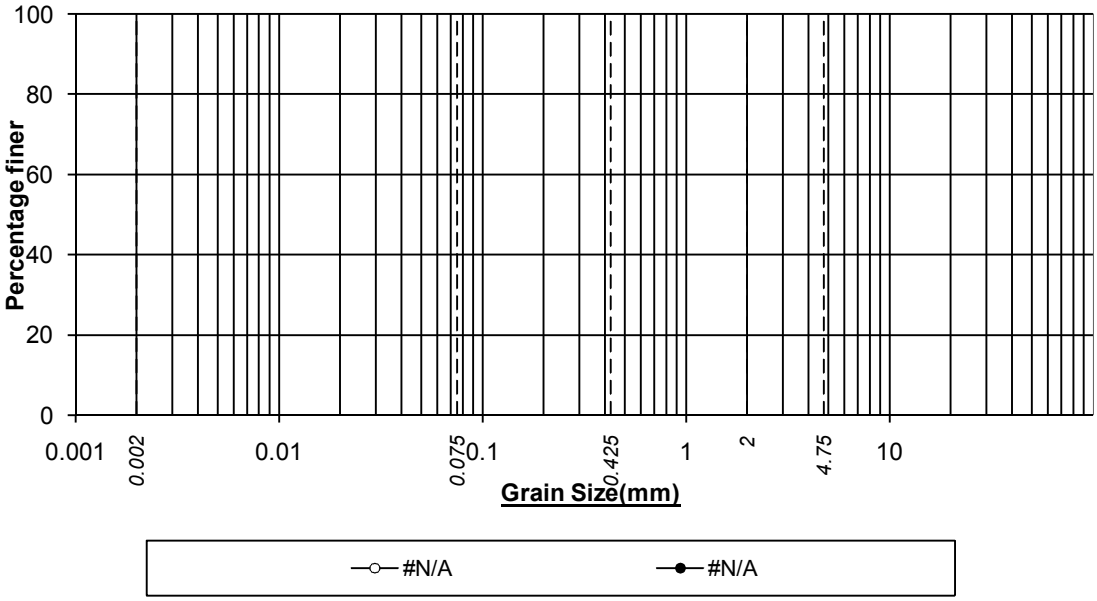
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-47,SPT-11, 20.50M		36.3	52.6	11.1	0.0	63.7		0.0
BH-47,SPT-17, 29.50M		20.4	34.6	19.0	9.3	62.9		16.7



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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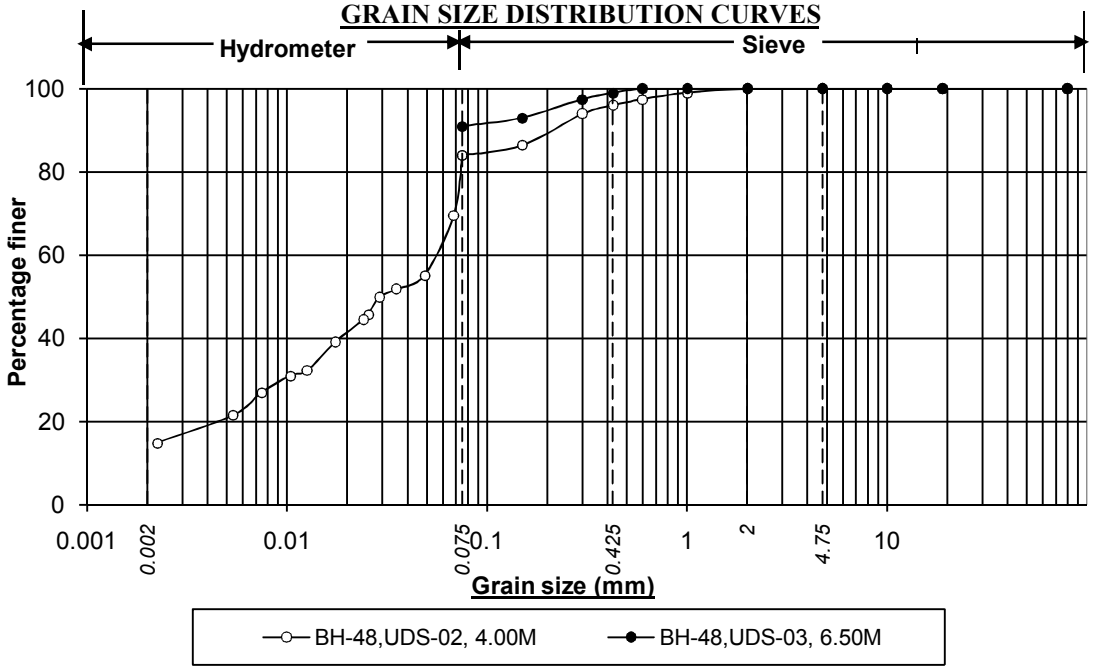
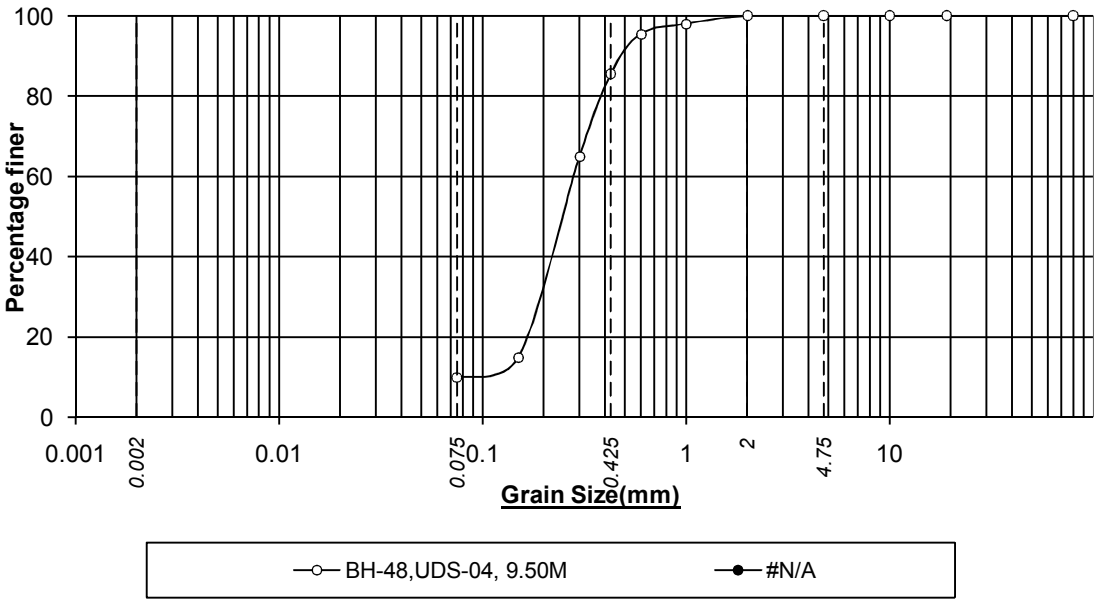
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-48,UDS-02, 4.00M	13.9	70.1	12.0	4.0	0.0	16.0		0.0
BH-48,UDS-03, 6.50M		91.0	8.0	1.0	0.0	9.0		0.0

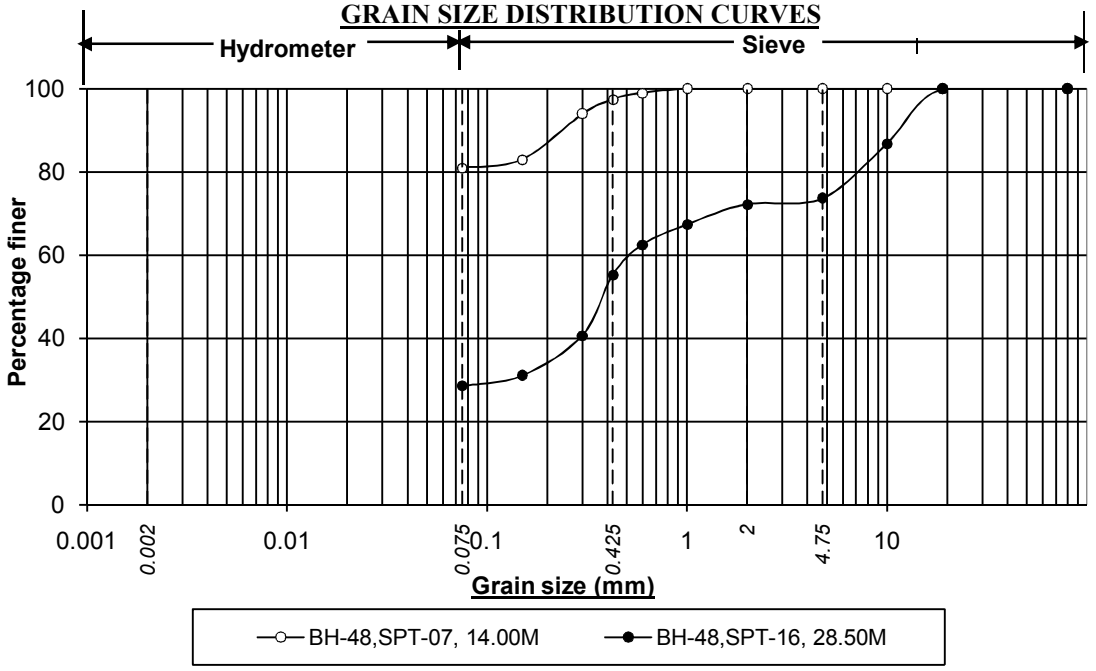


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-48,UDS-04, 9.50M		10.0	75.5	14.5	0.0	90.0		0.0

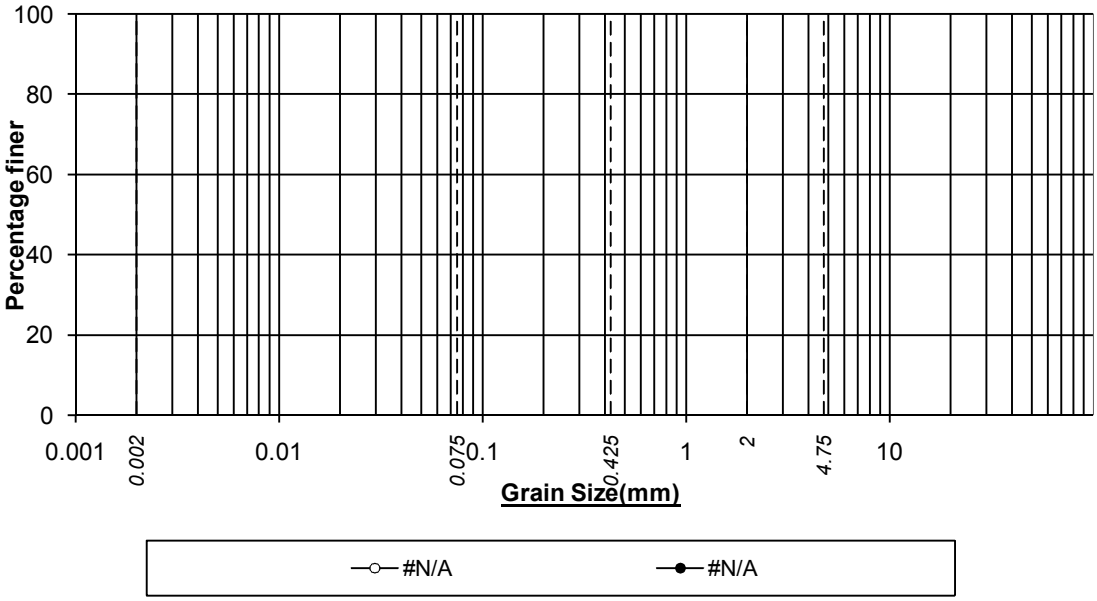
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-48,SPT-07, 14.00M		81.0	16.5	2.5	0.0	19.0		0.0
BH-48,SPT-16, 28.50M		28.6	26.6	17.0	1.5	45.1		26.3

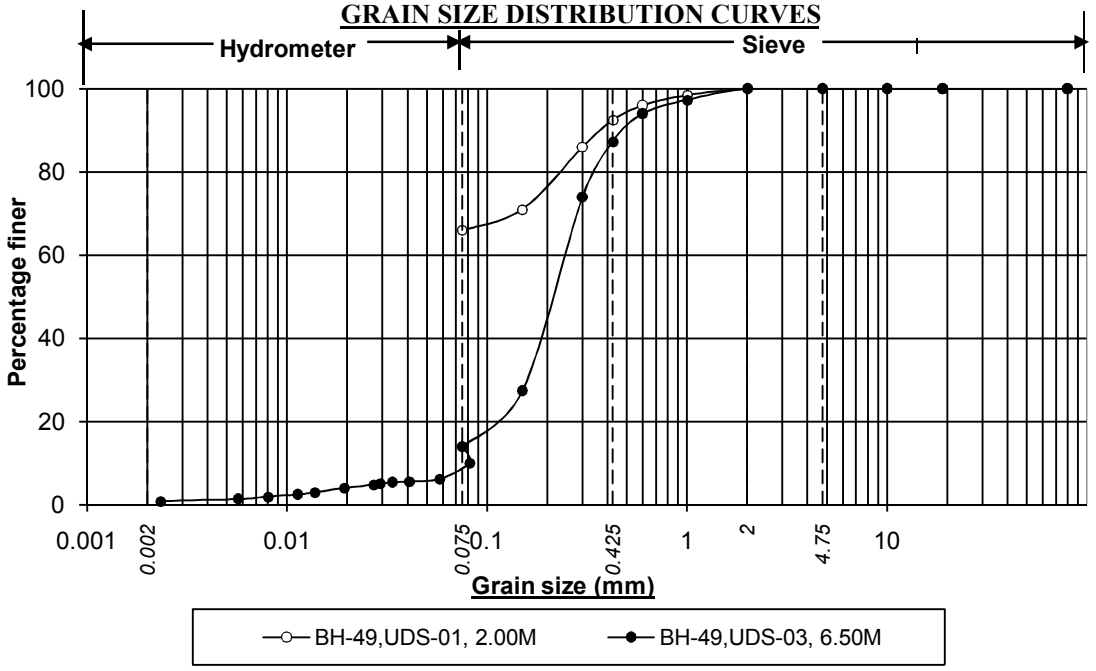


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

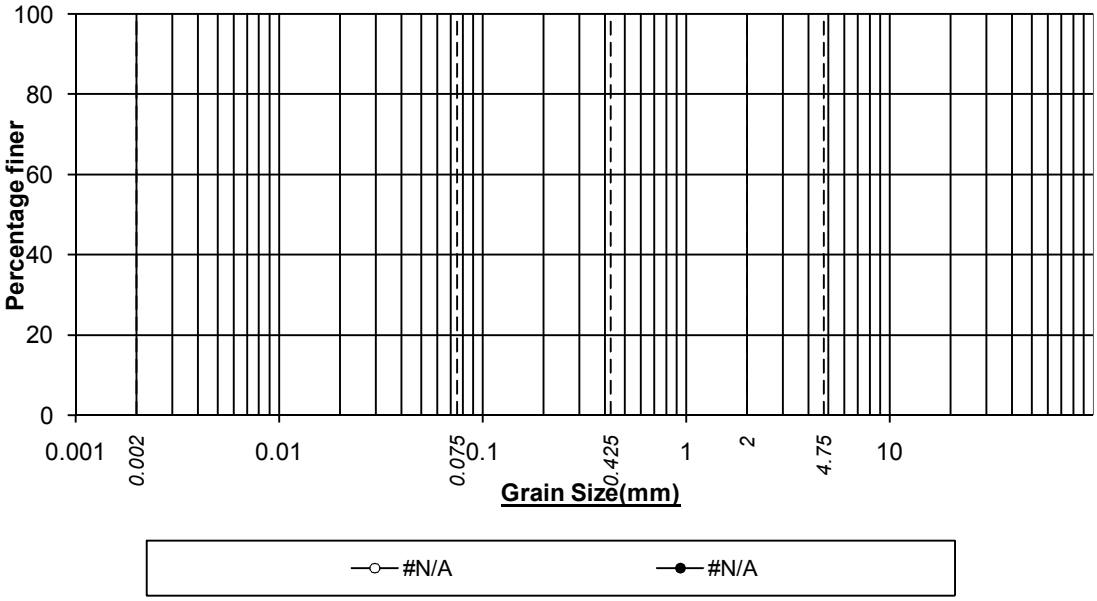
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-49,UDS-01, 2.00M		66.0	26.5	7.5	0.0	34.0		0.0
BH-49,UDS-03, 6.50M	0.7	13.3	73.3	12.7	0.0	86.0		0.0

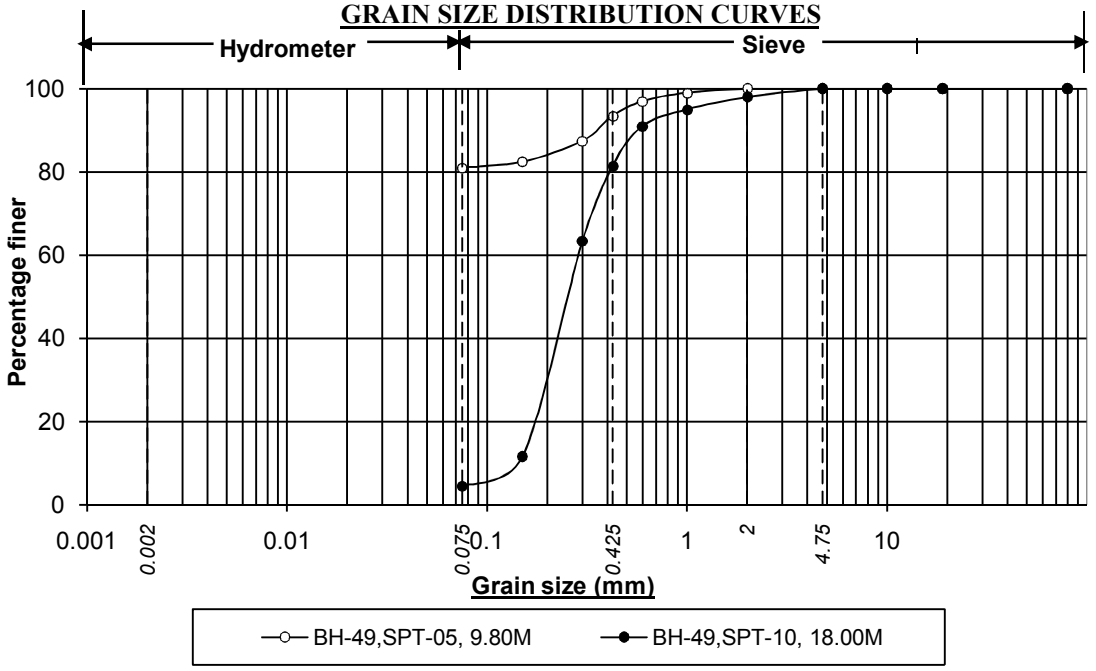


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

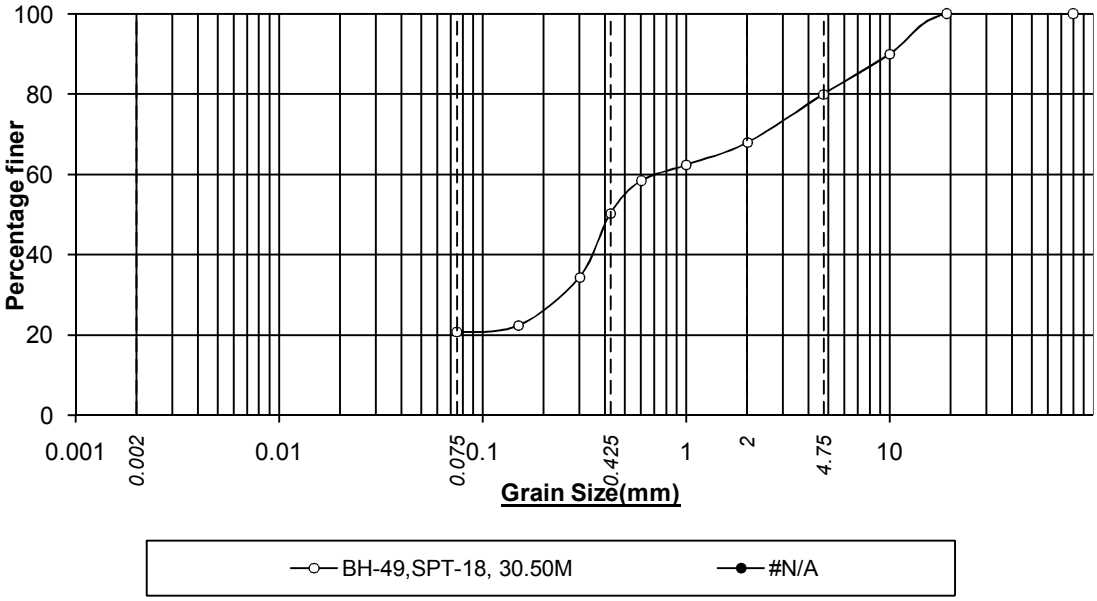
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-49,SPT-05, 9.80M		81.0	12.5	6.5	0.0	19.0		0.0
BH-49,SPT-10, 18.00M		4.5	77.0	16.5	2.0	95.5	2.004/0.95	0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-49,SPT-18, 30.50M		20.8	29.6	17.6	12.0	59.2		20.0

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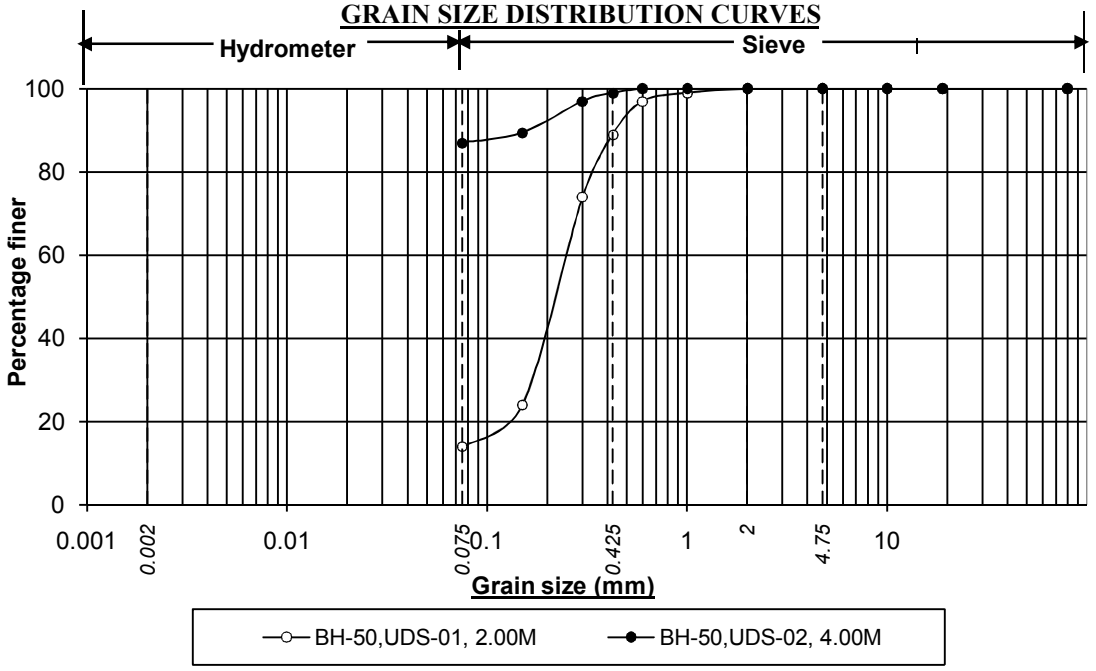
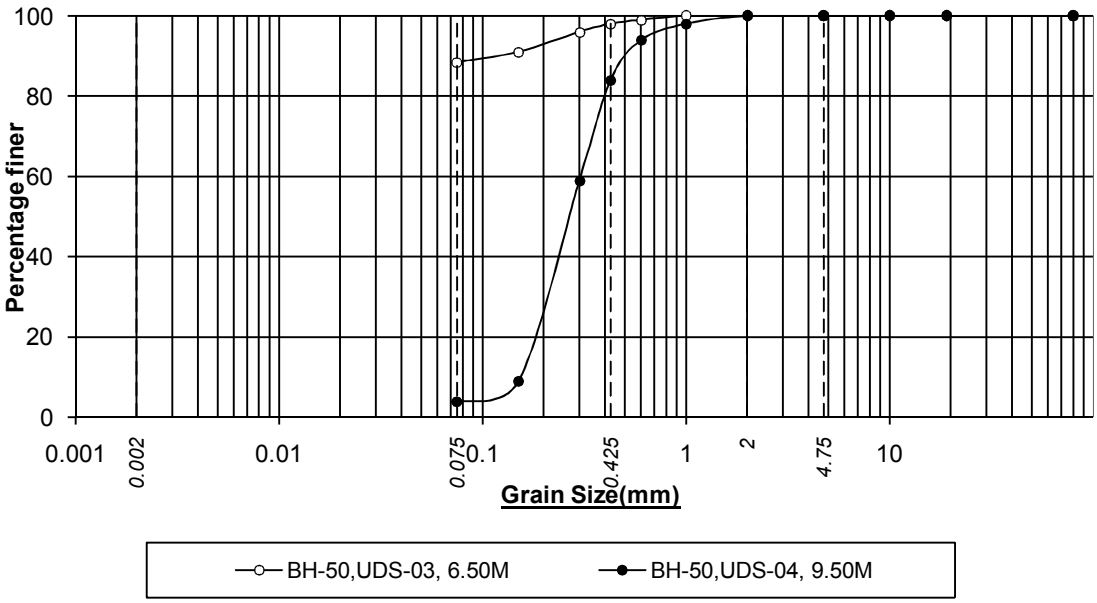
C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-50,UDS-01, 2.00M		14.0	75.0	11.0	0.0	86.0		0.0
BH-50,UDS-02, 4.00M		87.0	12.0	1.0	0.0	13.0		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-50,UDS-03, 6.50M		88.5	9.5	2.0	0.0	11.5		0.0
BH-50,UDS-04, 9.50M		4.0	80.0	16.0	0.0	96.0	2.065/0.935	0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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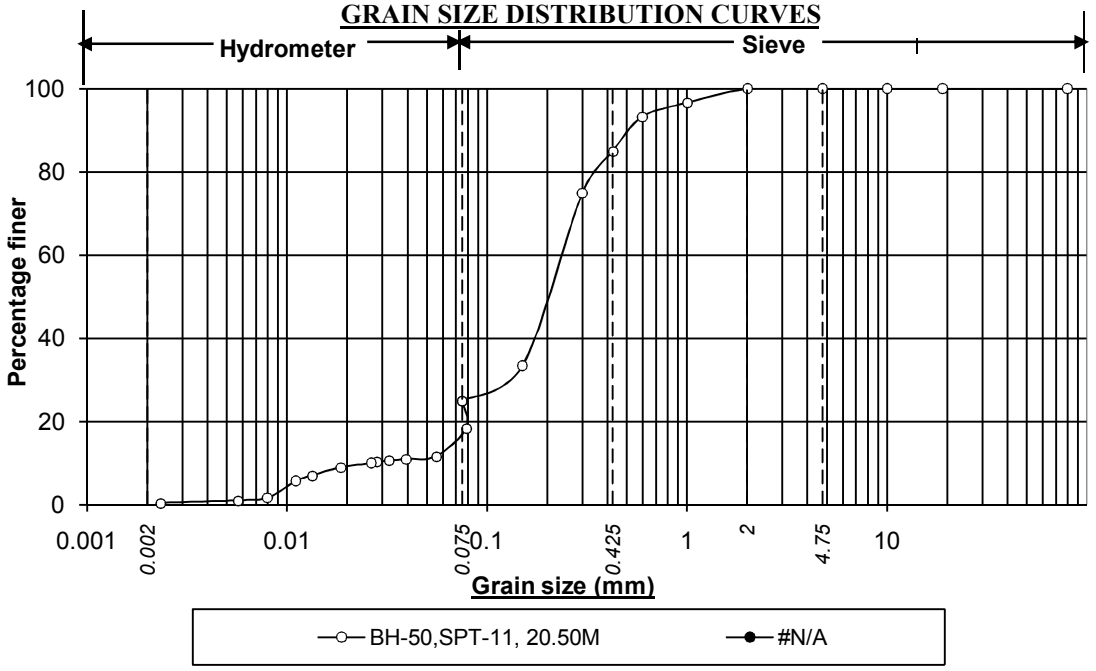
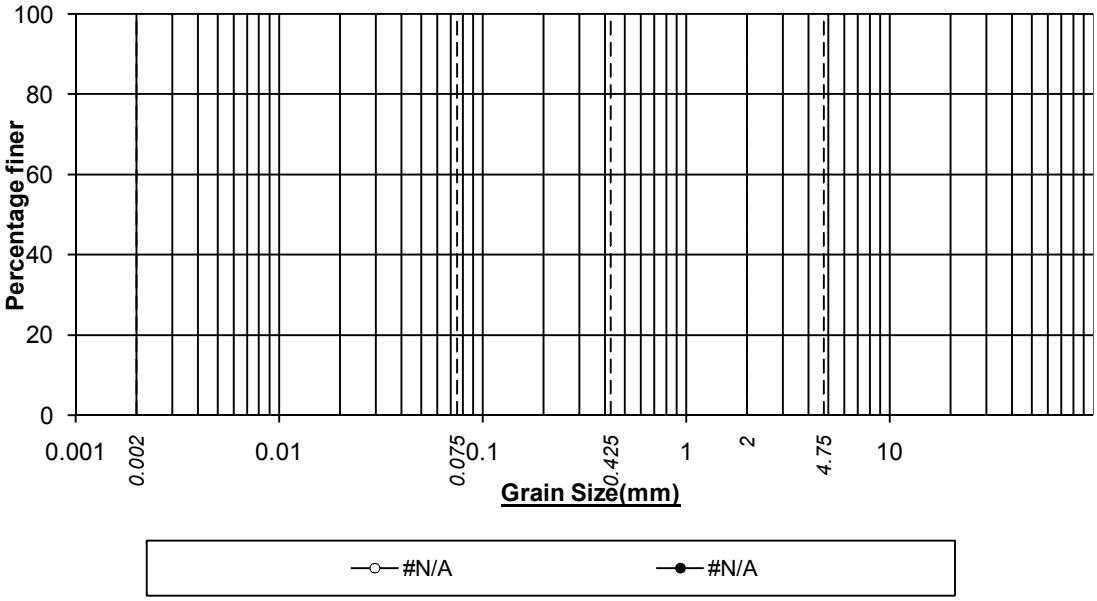
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-50,SPT-11, 20.50M	0.2	24.8	60.0	15.0	0.0	75.0		0.0

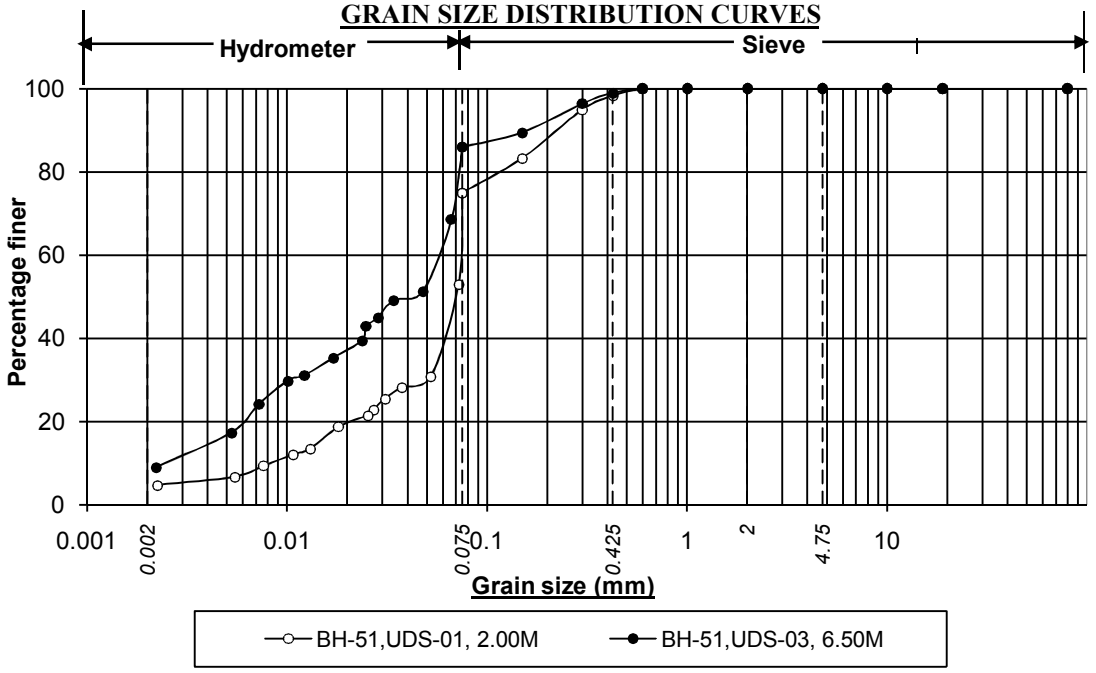


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

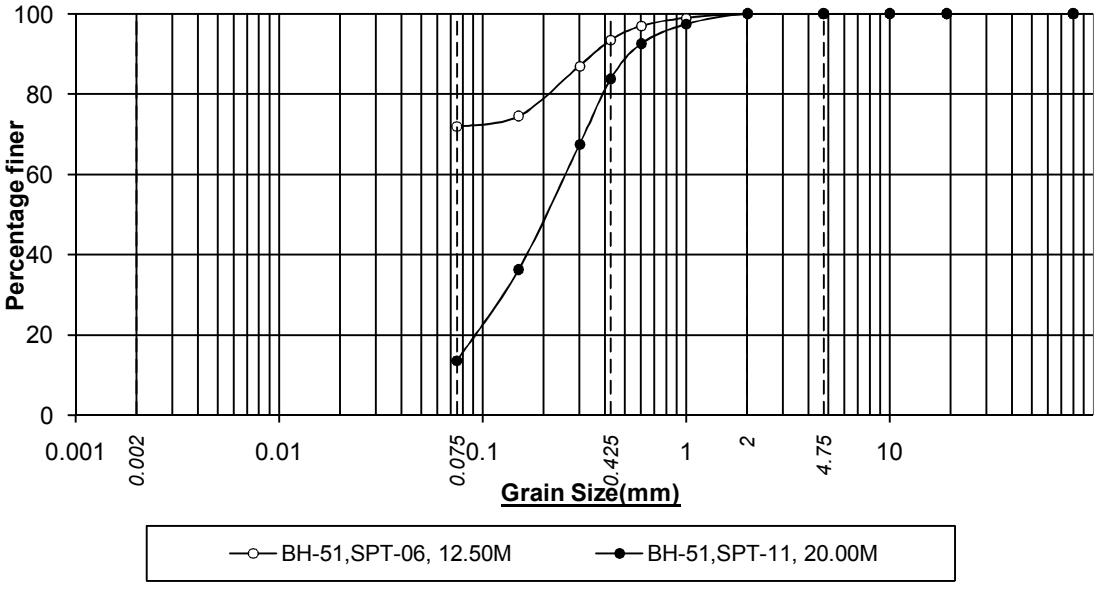
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat.	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-51,UDS-01, 2.00M	4.4	70.6	23.3	1.7	0.0	25.0		0.0
BH-51,UDS-03, 6.50M	8.0	78.0	13.0	1.0	0.0	14.0		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-51,SPT-06, 12.50M		72.0	21.5	6.5	0.0	28.0		0.0
BH-51,SPT-11, 20.00M		13.8	69.9	16.3	0.0	86.2		0.0

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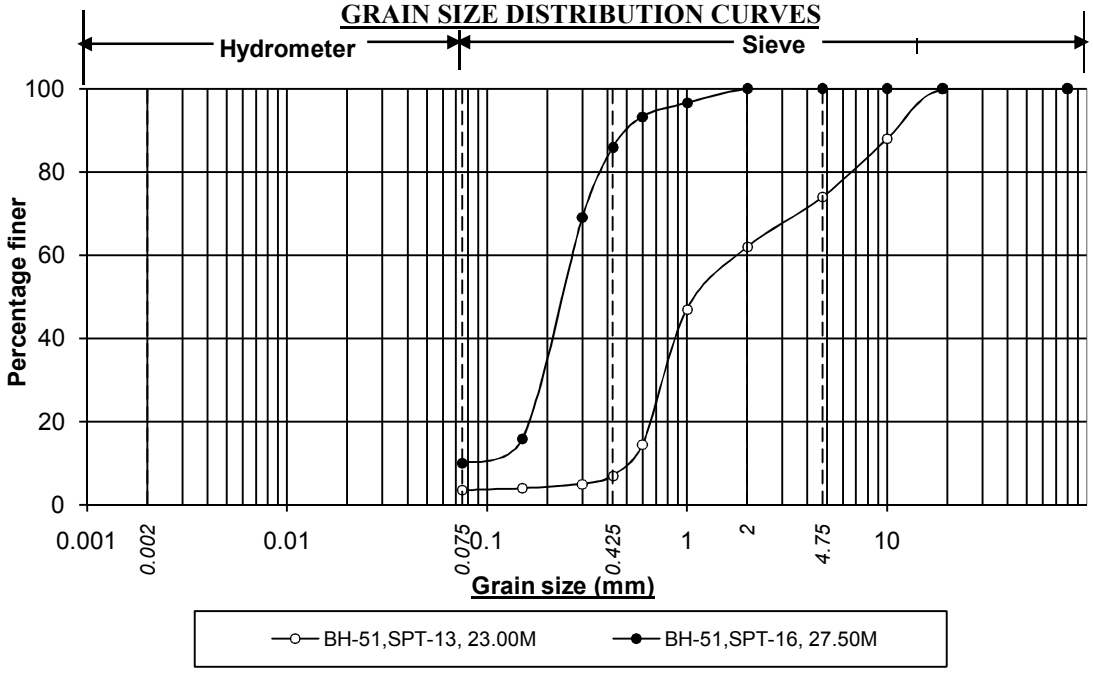
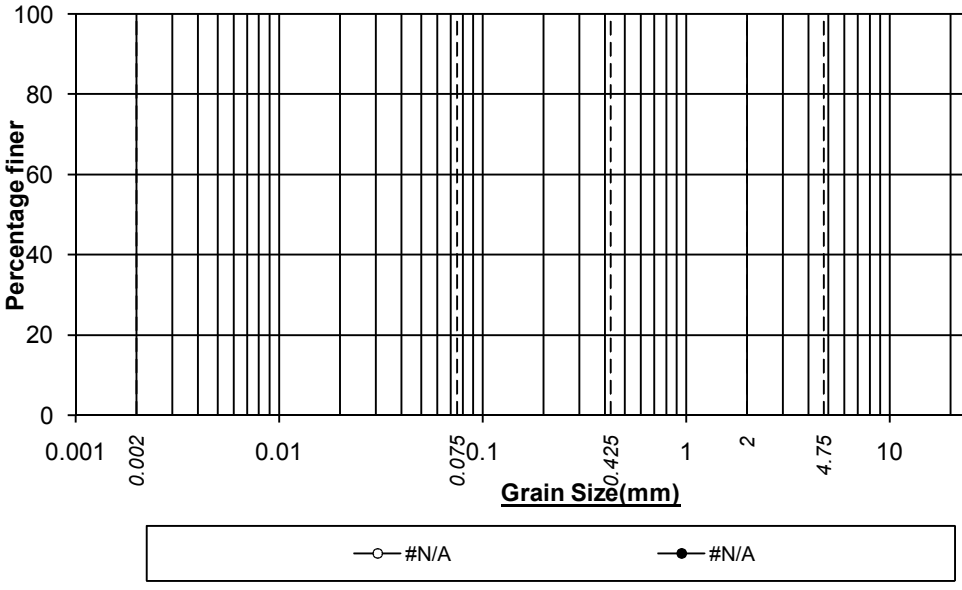
C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-51,SPT-13, 23.00M		3.5	3.5	55.0	12.0	70.5	3.372/0.619	26.0
BH-51,SPT-16, 27.50M		10.0	75.8	14.2	0.0	90.0	3.507/1.832	0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

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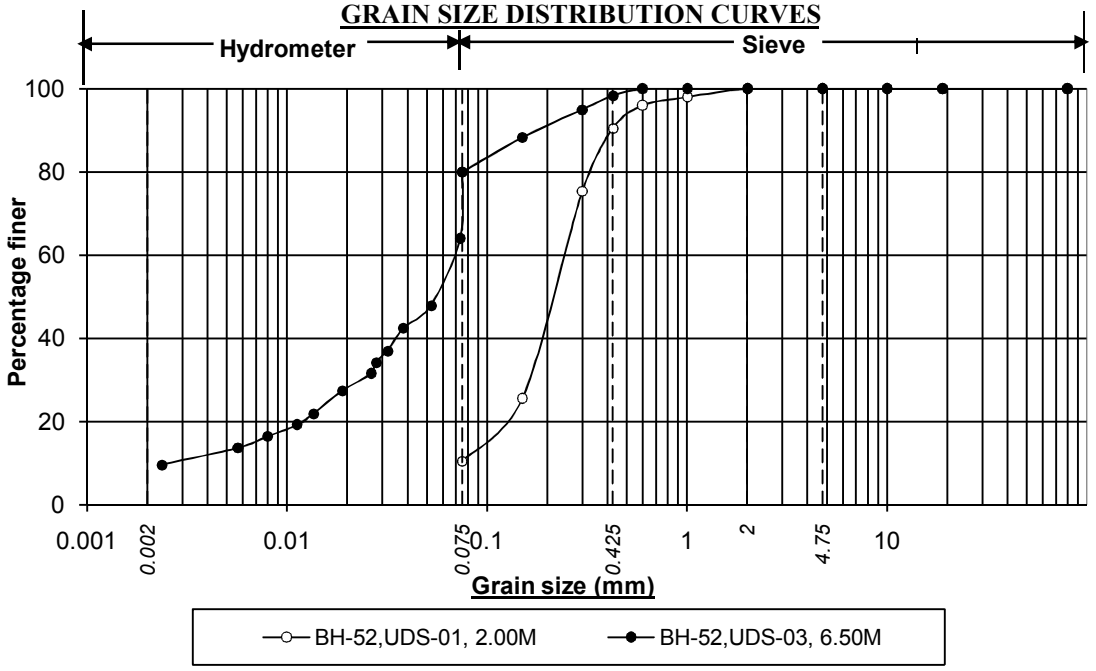
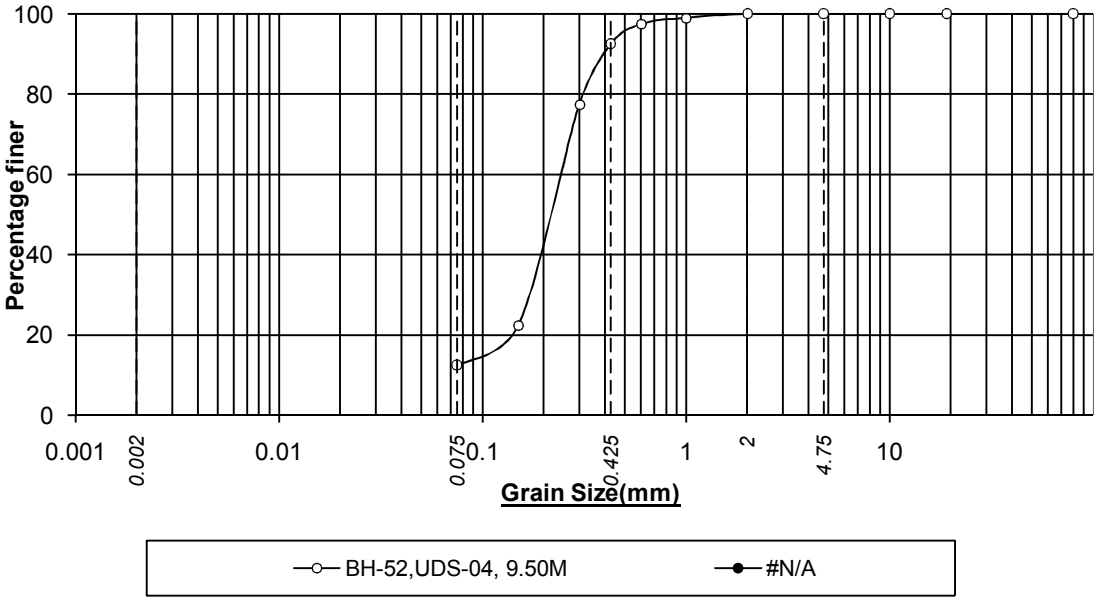
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-52,UDS-01, 2.00M		10.5	80.0	9.5	0.0	89.5		0.0
BH-52,UDS-03, 6.50M	8.8	71.2	18.3	1.7	0.0	20.0		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-52,UDS-04, 9.50M		12.5	80.0	7.5	0.0	87.5		0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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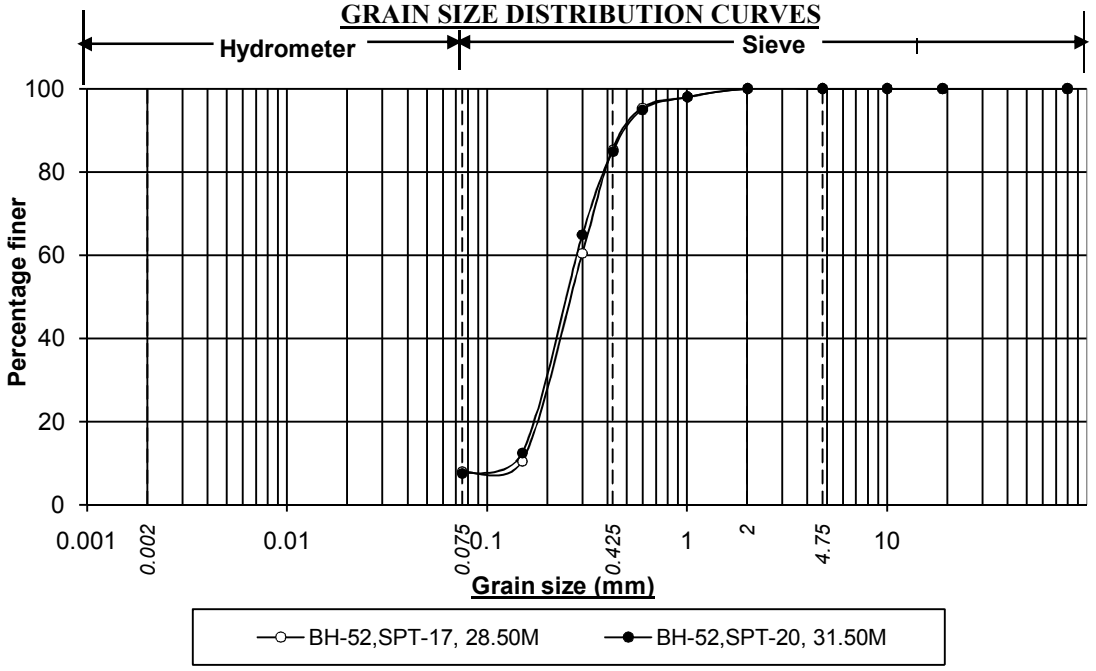
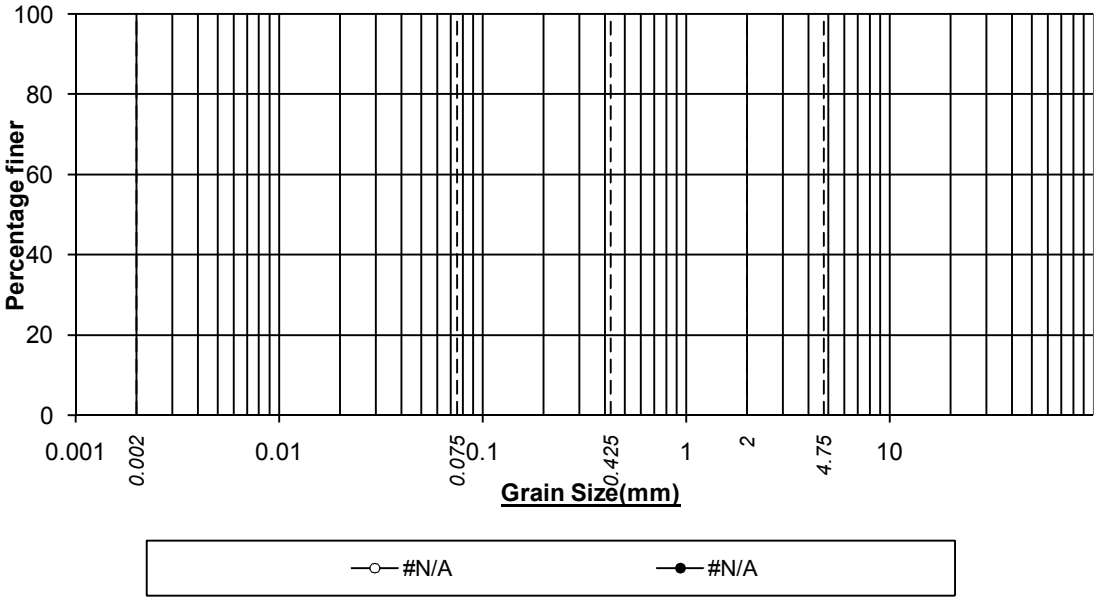
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-52,SPT-17, 28.50M		8.0	77.5	14.5	0.0	92.0	1.931/0.946	0.0
BH-52,SPT-20, 31.50M		7.5	77.5	15.0	0.0	92.5	2.037/1.078	0.0

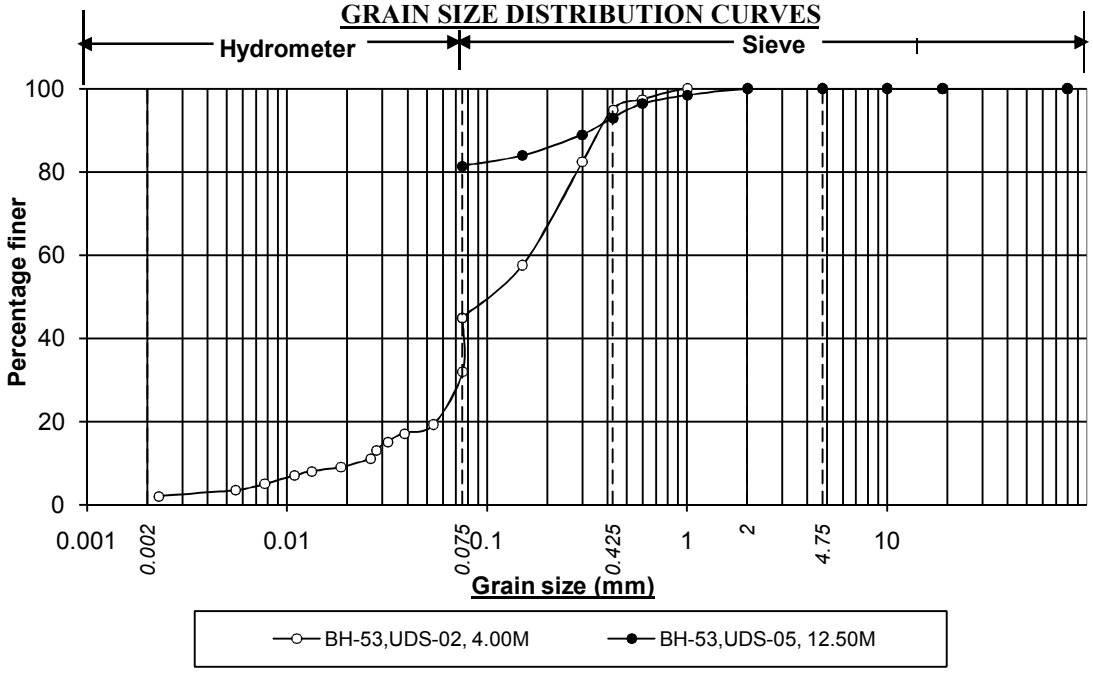


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)

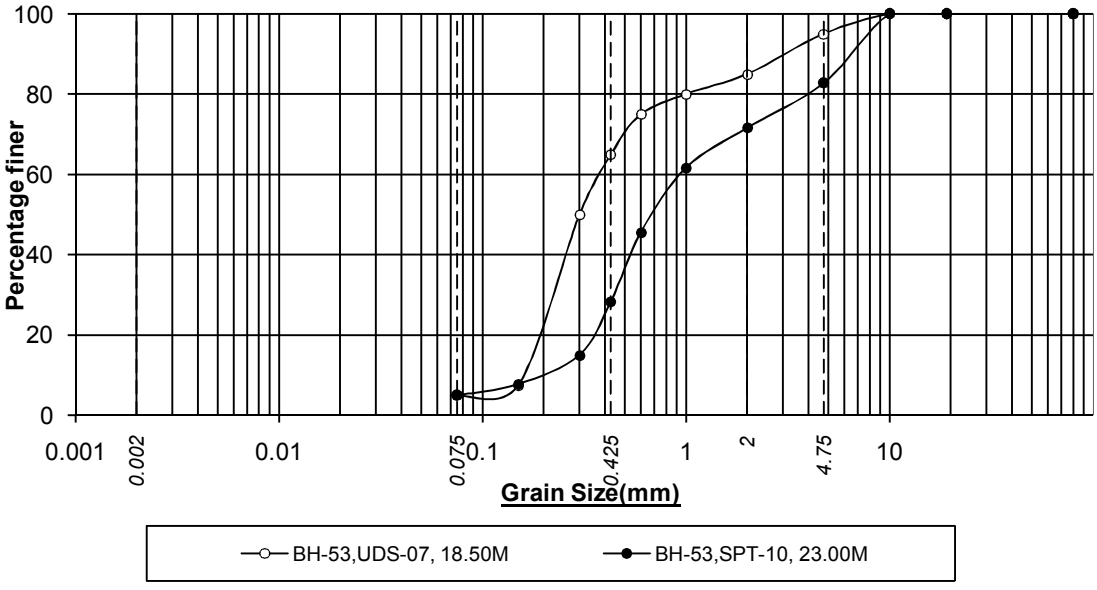
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-53,UDS-02, 4.00M	1.8	43.2	50.0	5.0	0.0	55.0		0.0
BH-53,UDS-05, 12.50M		81.5	11.5	7.0	0.0	18.5		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-53,UDS-07, 18.50M		5.0	60.0	20.0	10.0	90.0	2.301/0.859	5.0
BH-53,SPT-10, 23.00M		5.0	23.4	43.3	11.1	77.8	4.731/1.059	17.2

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

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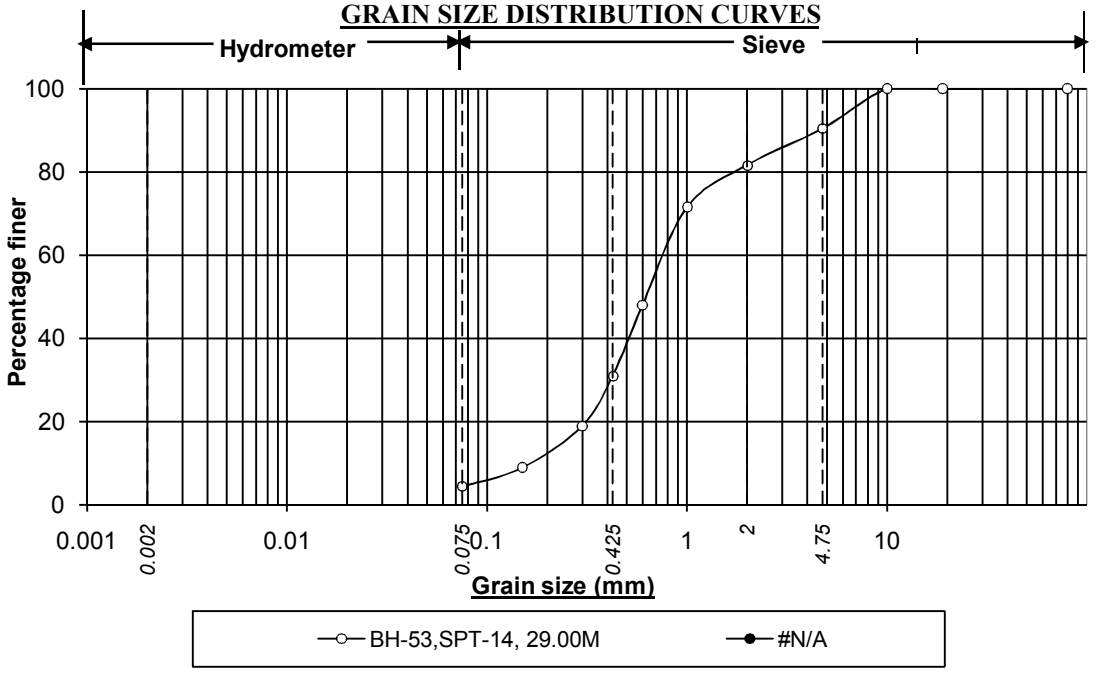
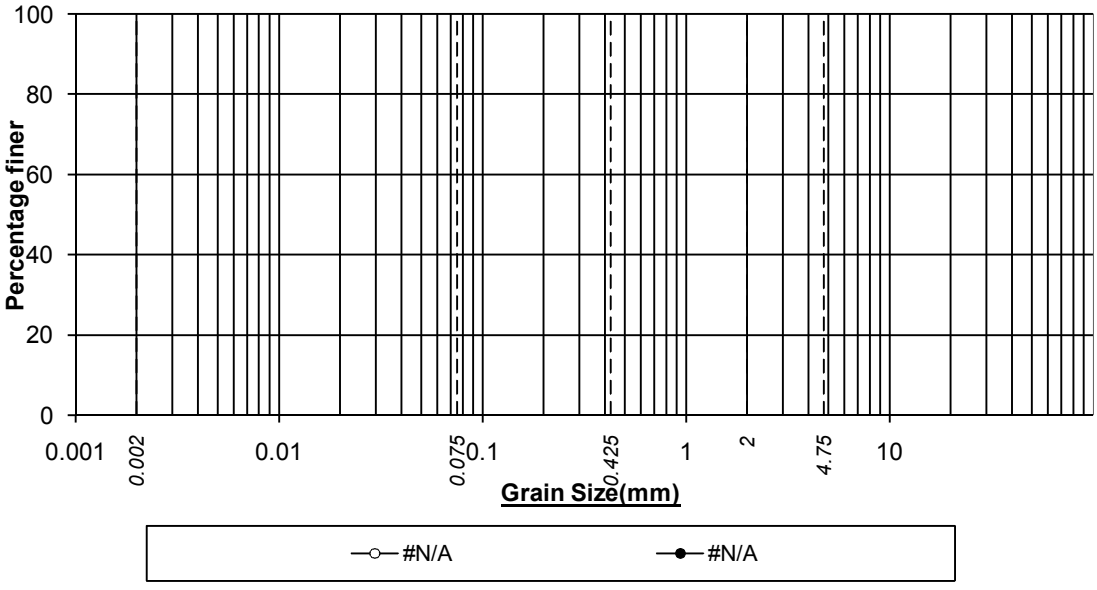
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-53,SPT-14, 29.00M		4.4	26.6	50.6	8.9	86.1	4.698/1.452	9.5



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat	Job No. 3369	

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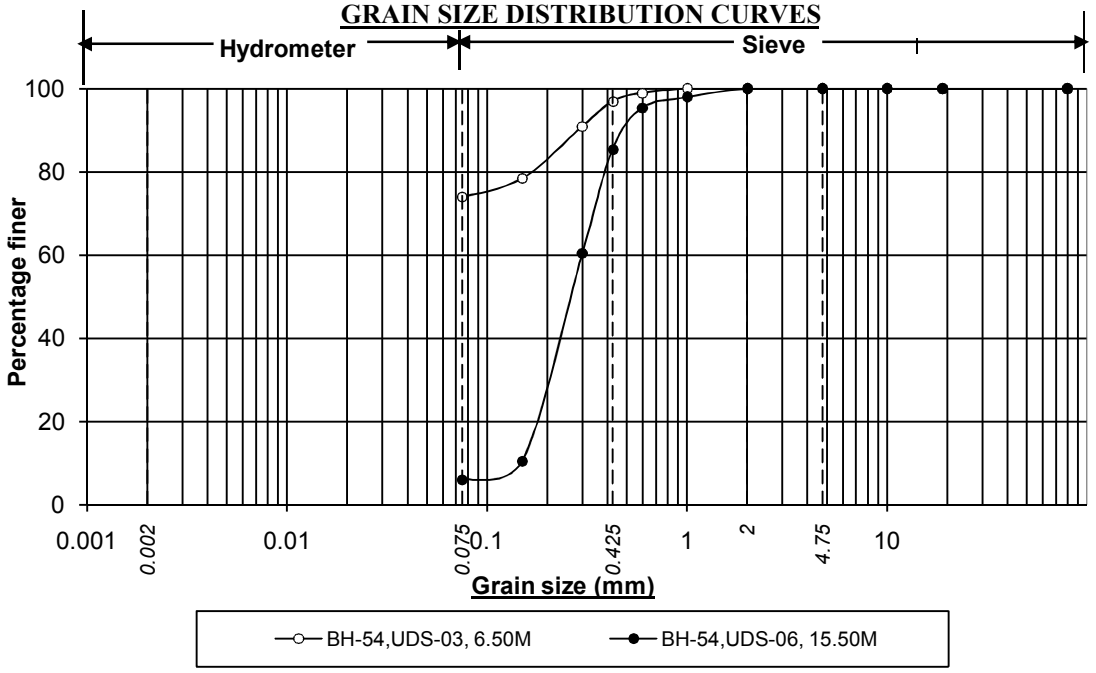
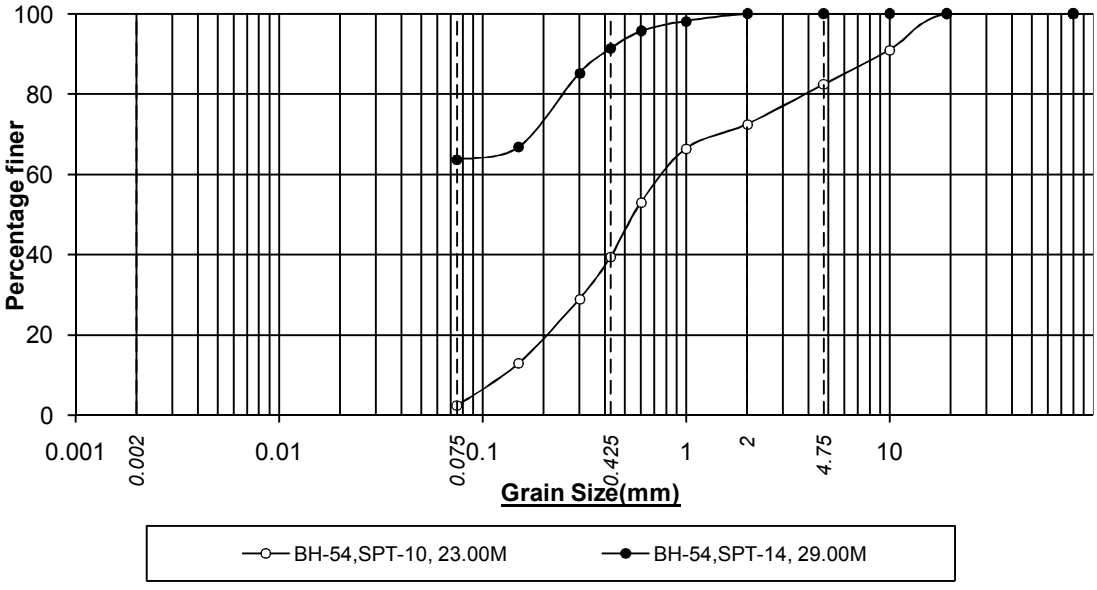
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-54,UDS-03, 6.50M		74.0	23.0	3.0	0.0	26.0		0.0
BH-54,UDS-06, 15.50M		6.0	79.5	14.5	0.0	94.0	2.013/0.92	0.0

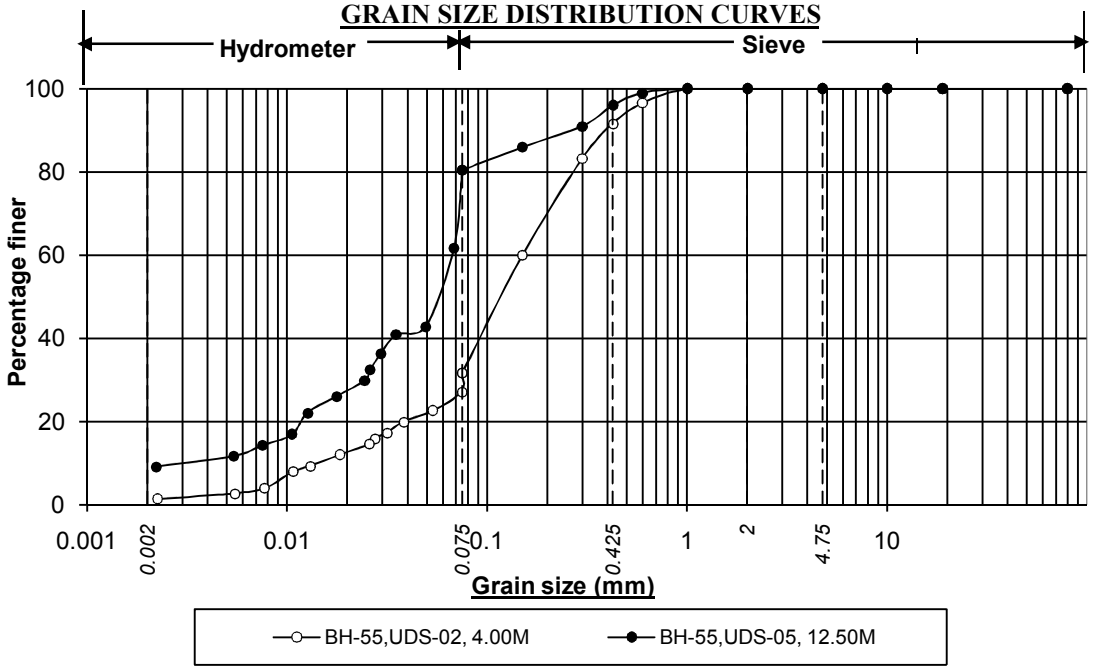


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-54,SPT-10, 23.00M		2.5	37.0	33.0	10.0	80.0	5.929/0.979	17.5
BH-54,SPT-14, 29.00M		63.8	27.6	8.6	0.0	36.2		0.0

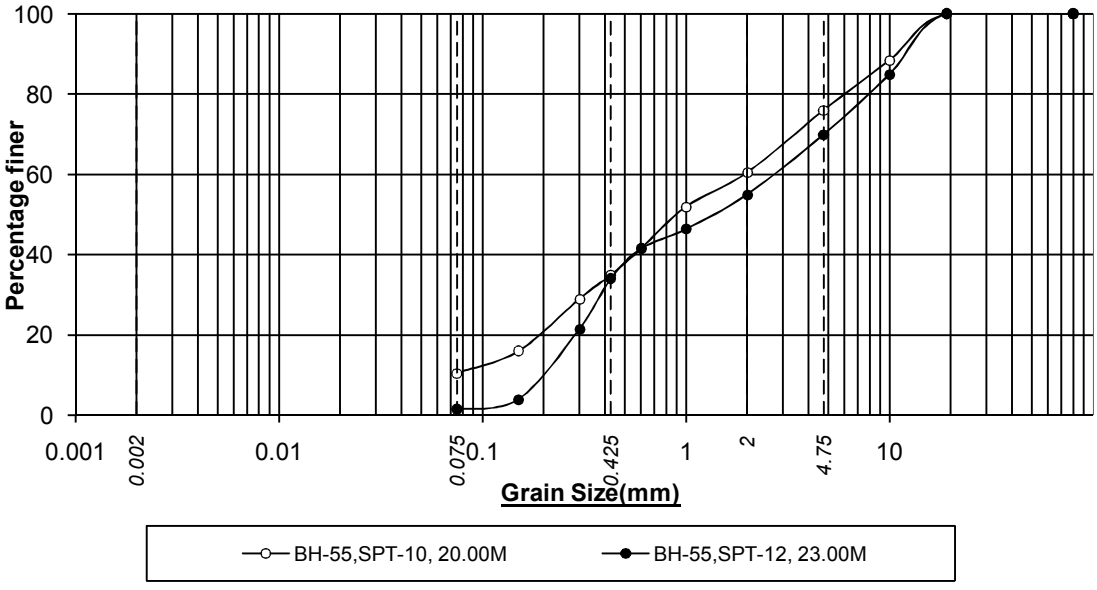
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No.**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-55,UDS-02, 4.00M	1.2	30.5	60.0	8.3	0.0	68.3		0.0
BH-55,UDS-05, 12.50M	8.8	71.7	15.5	4.0	0.0	19.5		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-55,SPT-10, 20.00M		10.5	24.5	25.5	15.5	65.5		24.0
BH-55,SPT-12, 23.00M		1.5	32.5	21.0	15.0	68.5	13.708/0.261	30.0

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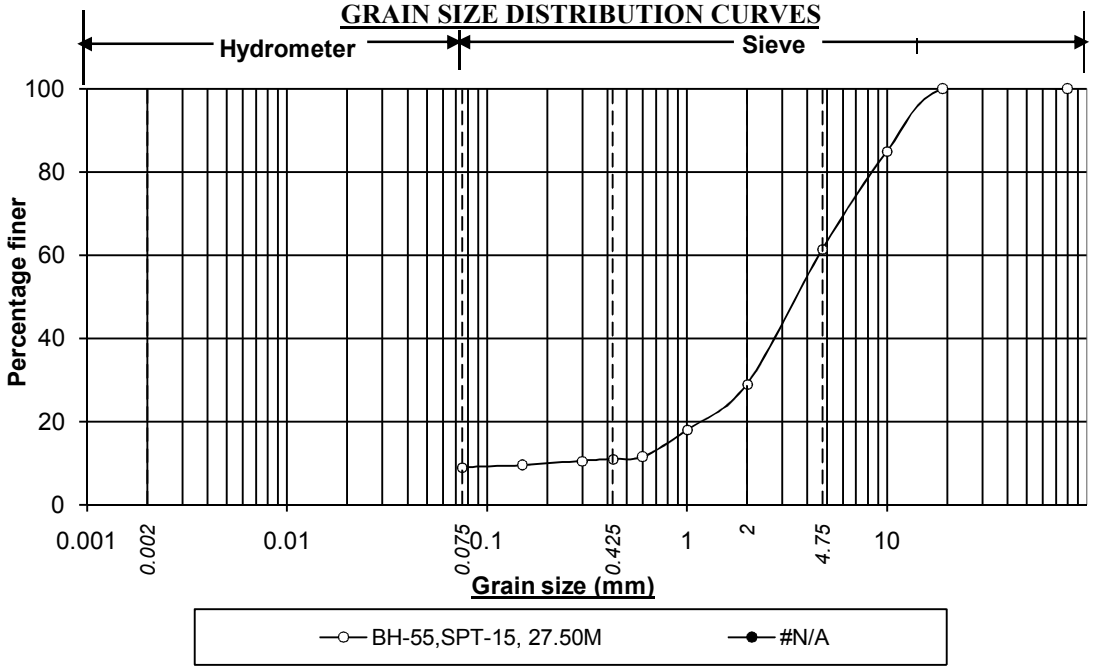
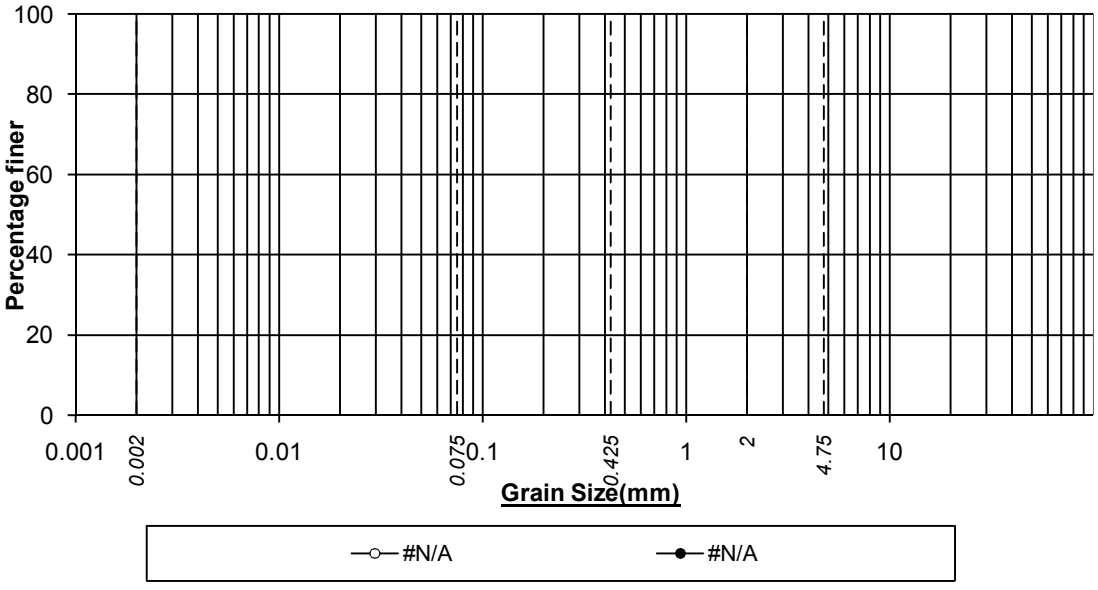
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	Total sand	Cu/Cc	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-55,SPT-15, 27.50M		9.0	2.0	18.0	32.5	52.5	27.989/6.441	38.5



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	Total sand	Cu/Cc	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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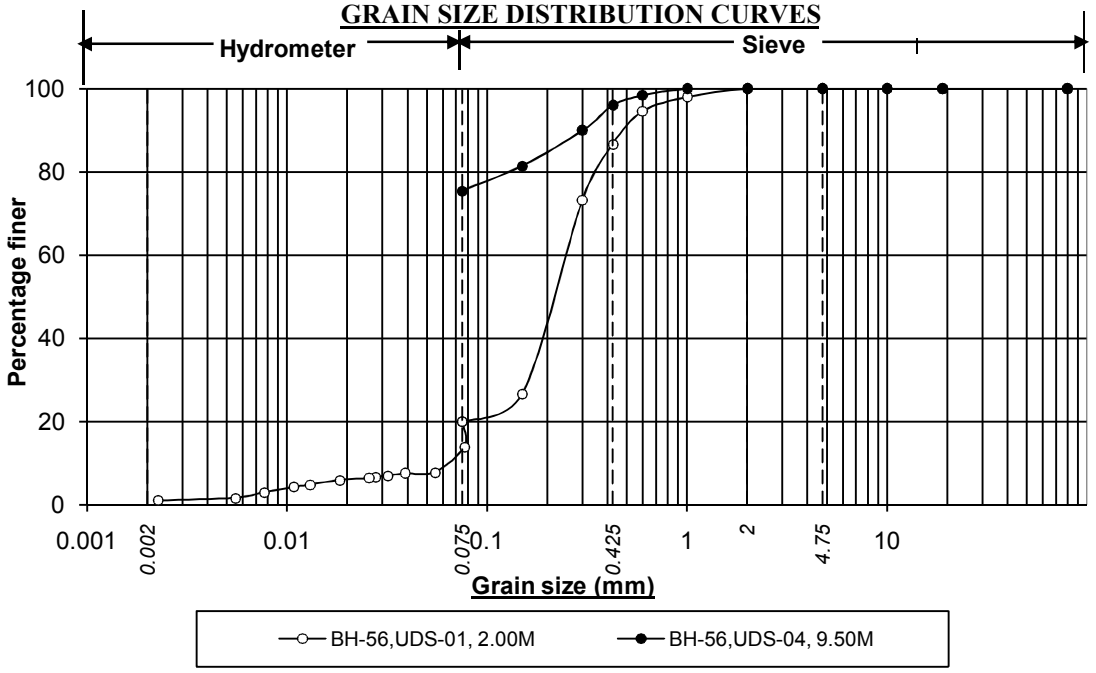
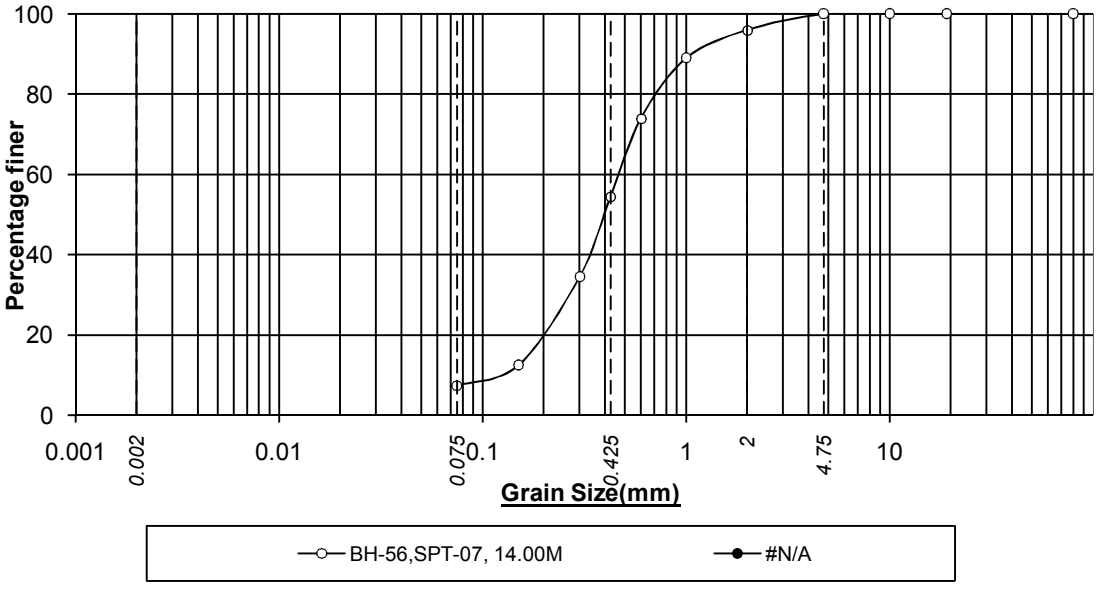
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-56,UDS-01, 2.00M	1.0	19.0	66.7	13.3	0.0	80.0		0.0
BH-56,UDS-04, 9.50M		75.5	20.5	4.0	0.0	24.5		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-56,SPT-07, 14.00M		7.5	47.0	41.5	4.0	92.5	3.767/1.153	0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat — **Job No. 3369**

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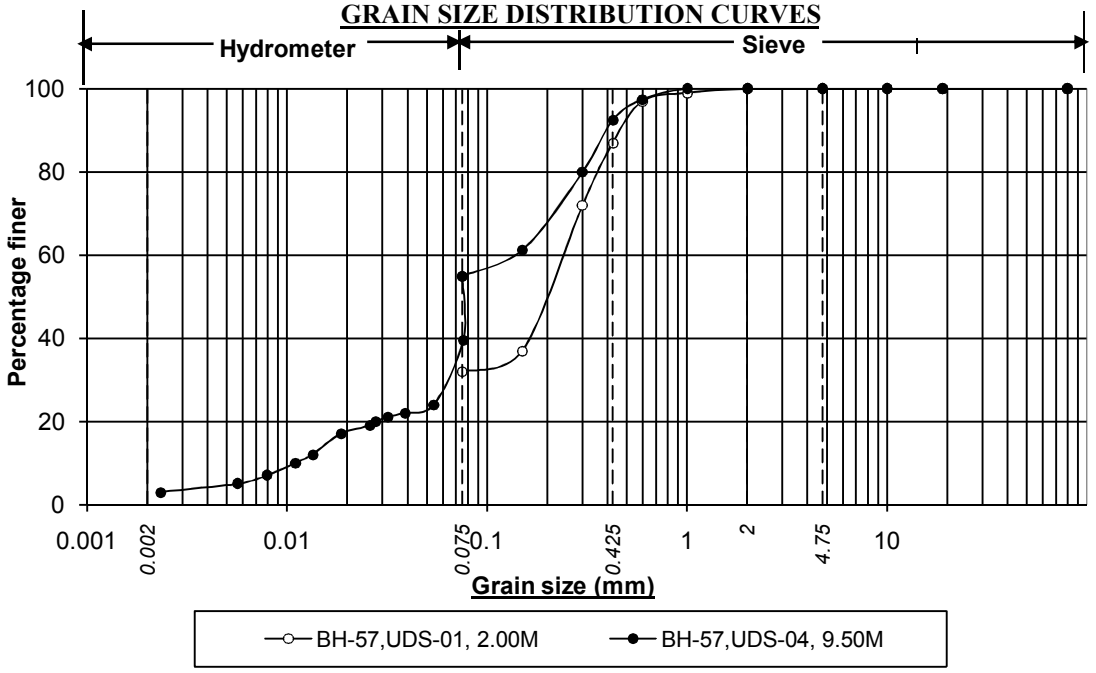
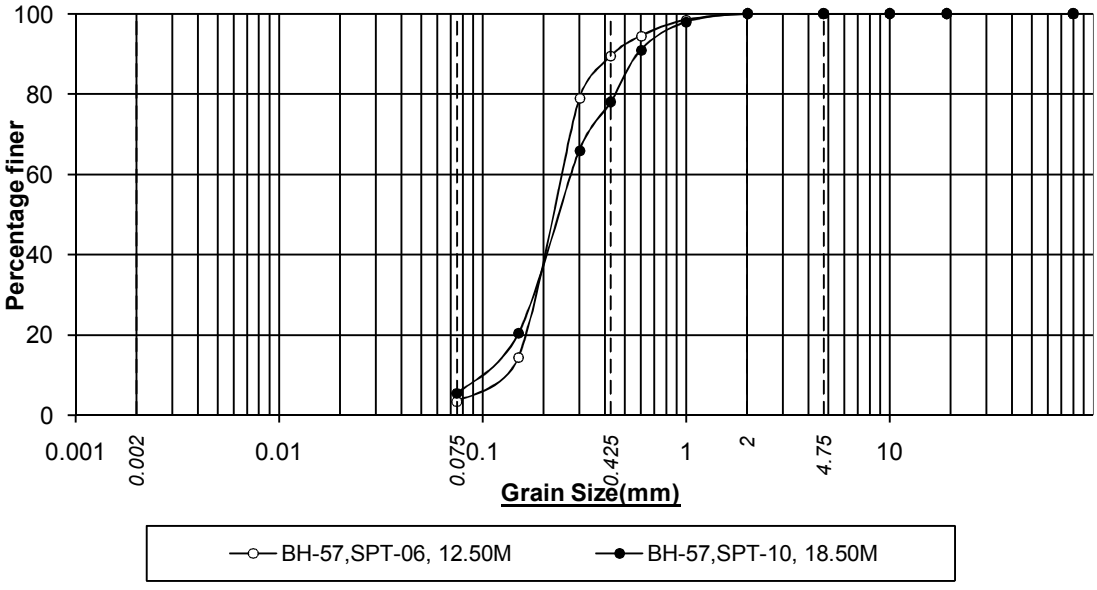
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-57,UDS-01, 2.00M		32.0	55.0	13.0	0.0	68.0		0.0
BH-57,UDS-04, 9.50M	2.7	52.3	37.5	7.5	0.0	45.0		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-57,SPT-06, 12.50M		3.5	86.0	10.5	0.0	96.5	1.823/1.03	0.0
BH-57,SPT-10, 18.50M		5.5	72.5	22.0	0.0	94.5	2.76/1.244	0.0

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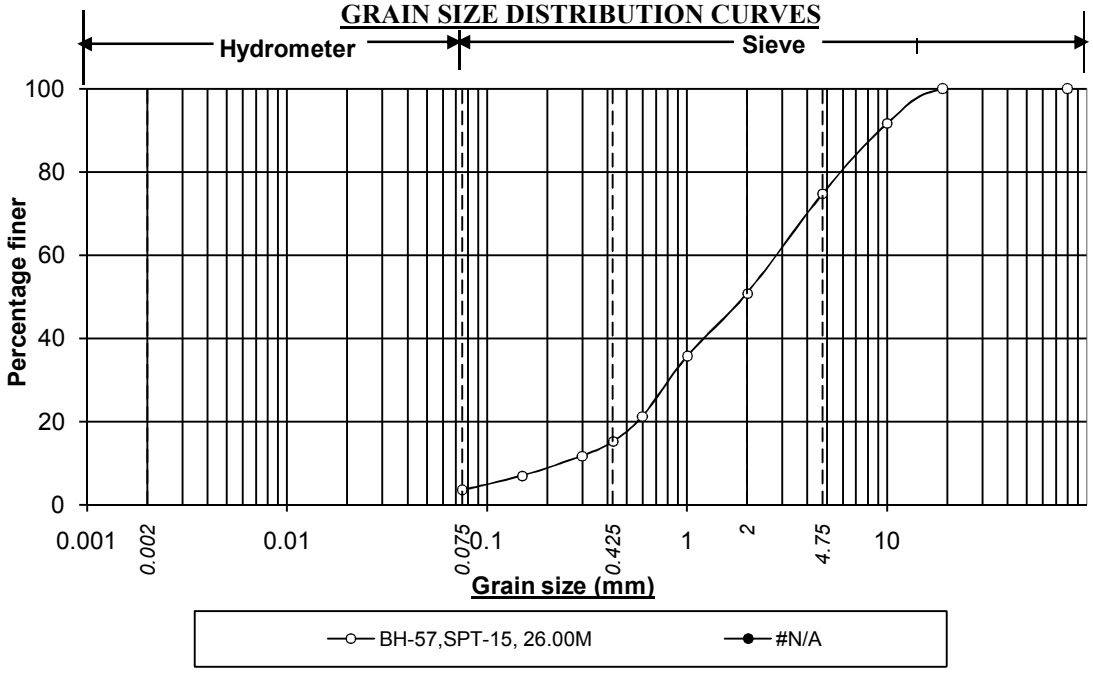
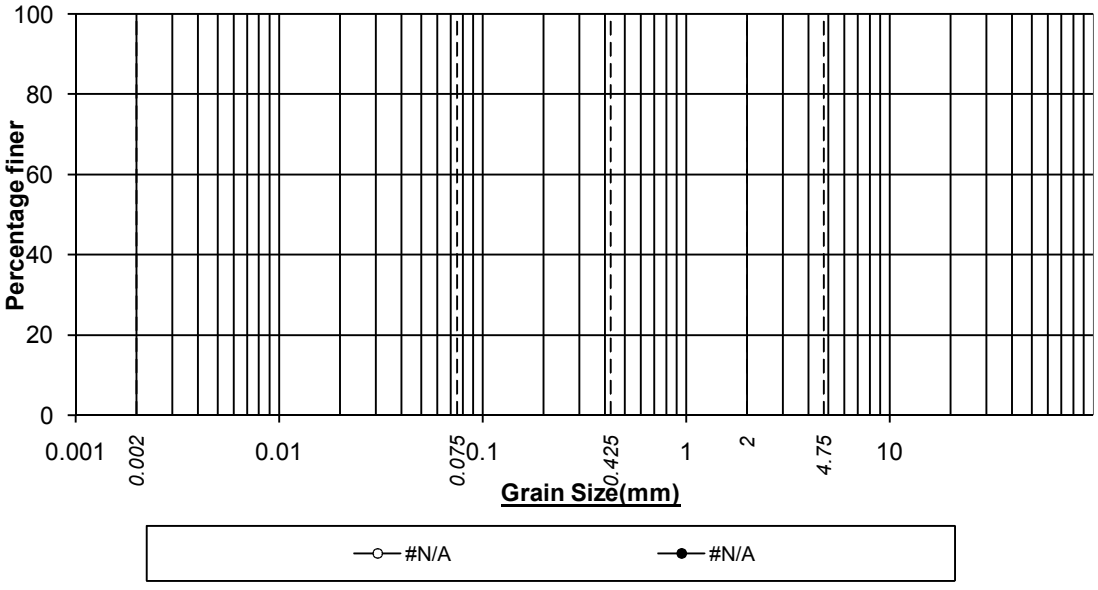
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-57,SPT-15, 26.00M		3.5	11.7	35.7	23.9	71.3	11.994/1.002	25.2

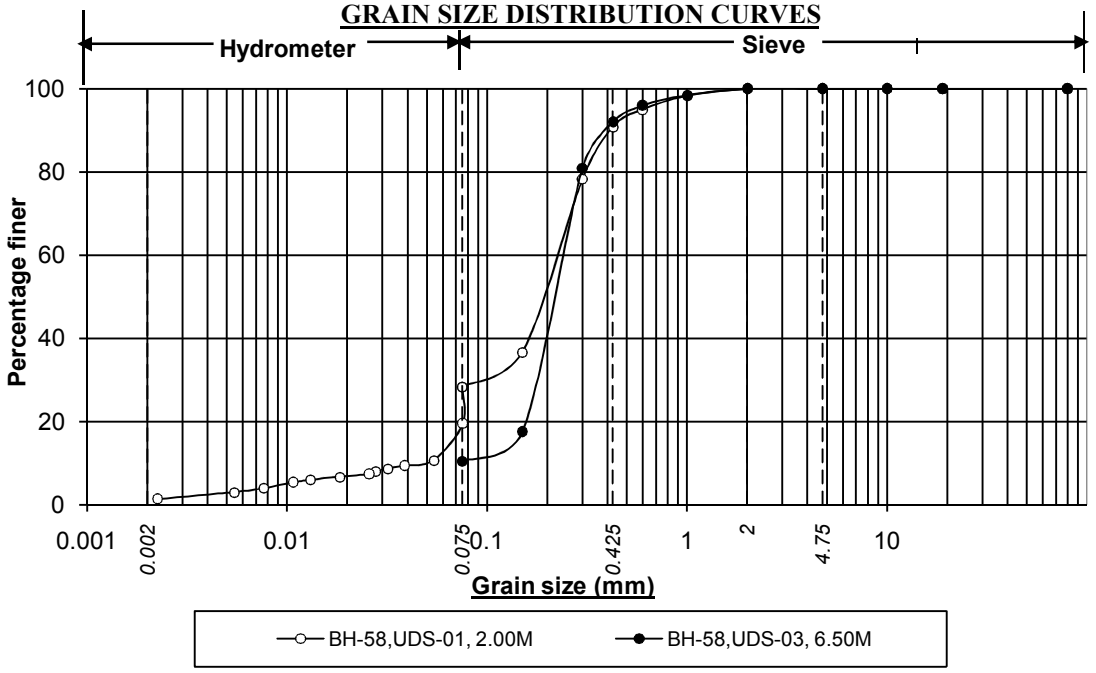


Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**

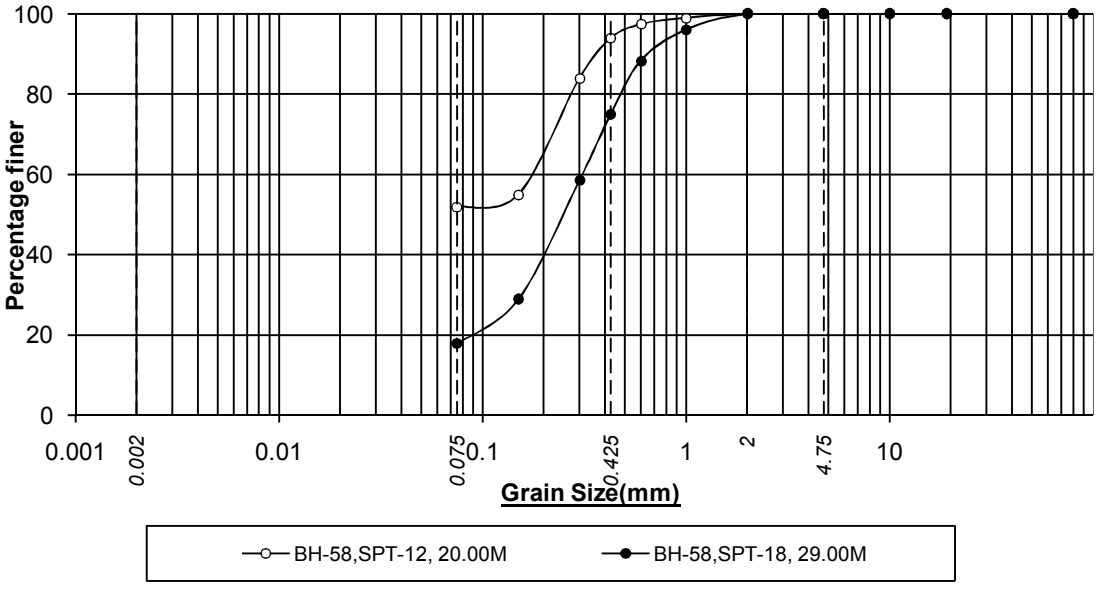
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat	**Job No. 3369**	

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-58,UDS-01, 2.00M	1.1	27.2	62.5	9.2	0.0	71.7		0.0
BH-58,UDS-03, 6.50M		10.5	81.5	8.0	0.0	89.5		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-58,SPT-12, 20.00M		52.0	42.0	6.0	0.0	48.0		0.0
BH-58,SPT-18, 29.00M		18.0	57.0	25.0	0.0	82.0		0.0

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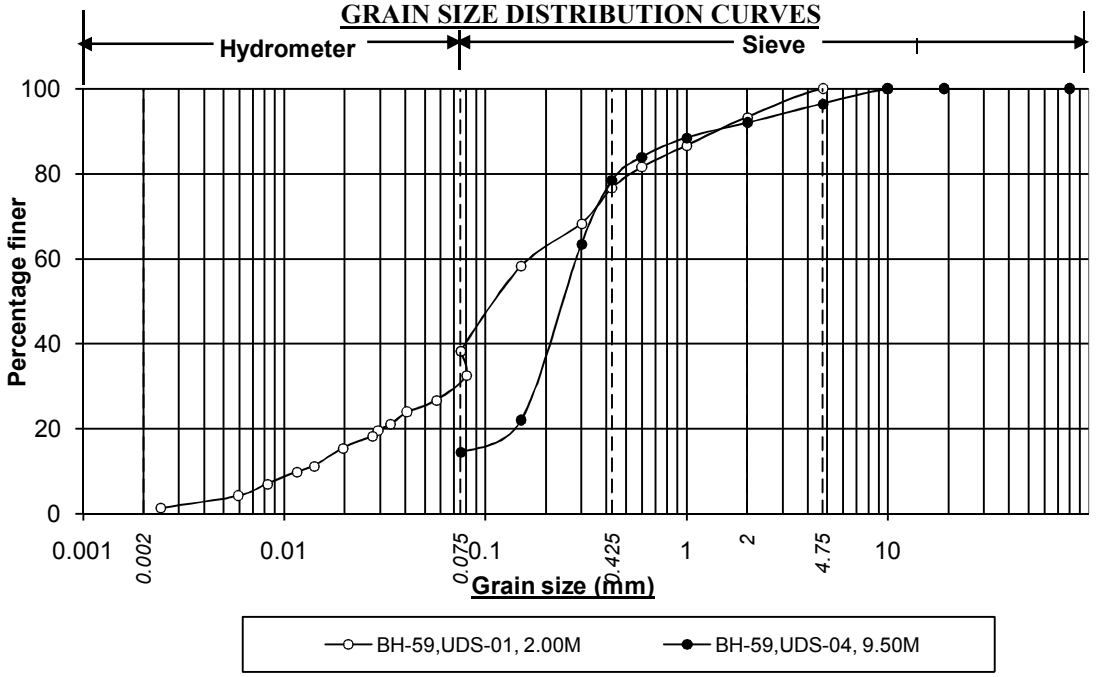
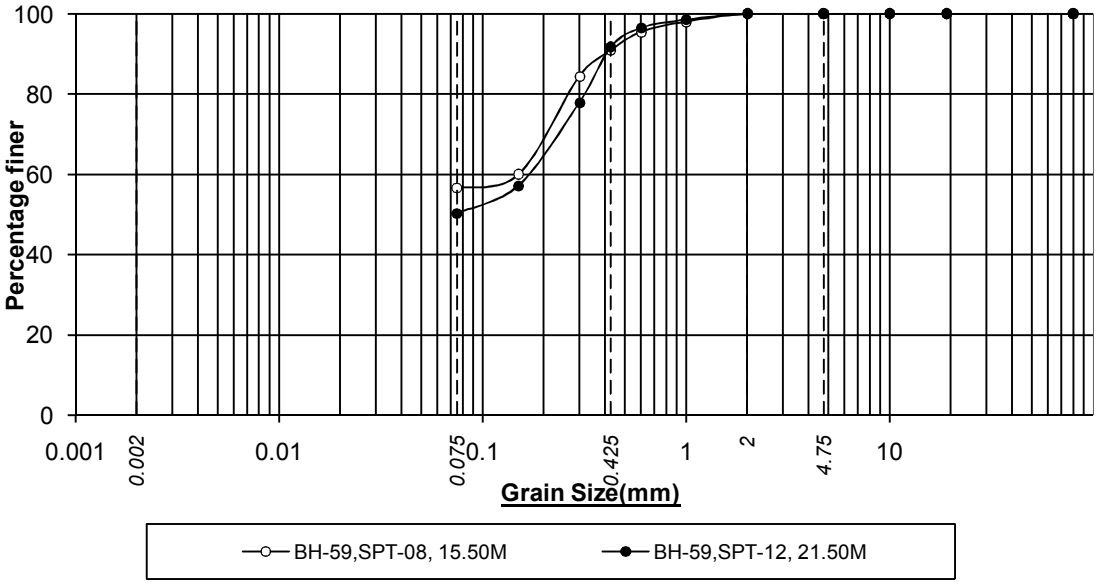
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-59,UDS-01, 2.00M	0.8	37.5	38.3	16.7	6.7	61.7		0.0
BH-59,UDS-04, 9.50M		14.5	64.0	13.5	4.5	82.0		3.5



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-59,SPT-08, 15.50M		56.8	34.2	9.0	0.0	43.2		0.0
BH-59,SPT-12, 21.50M		50.3	41.4	8.3	0.0	49.7		0.0

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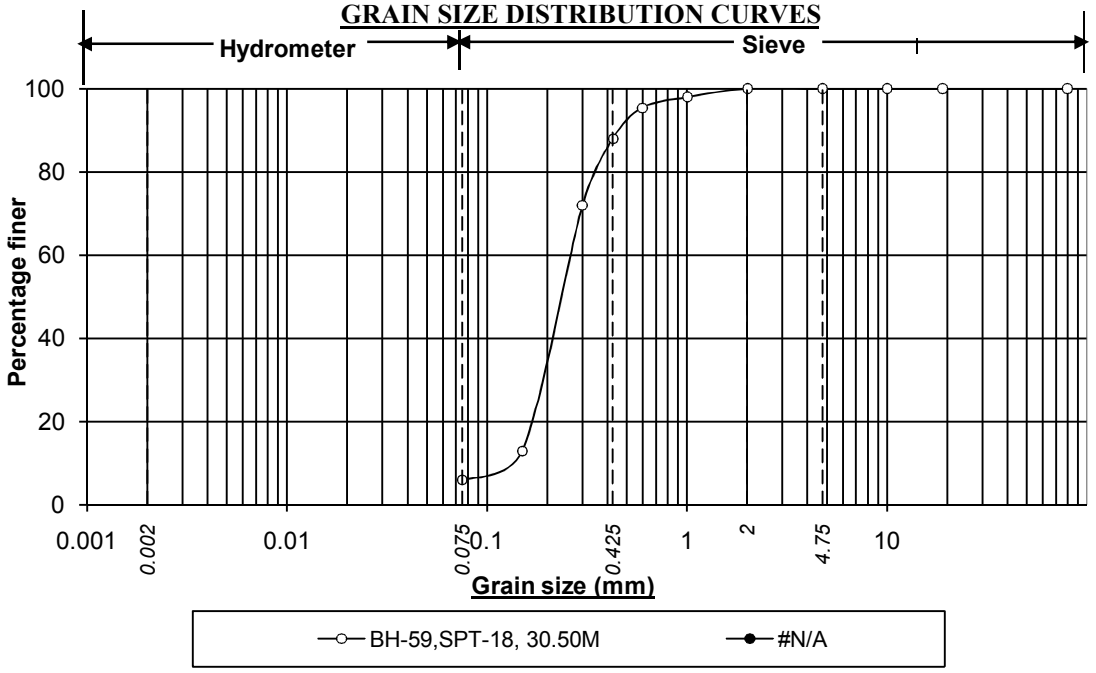
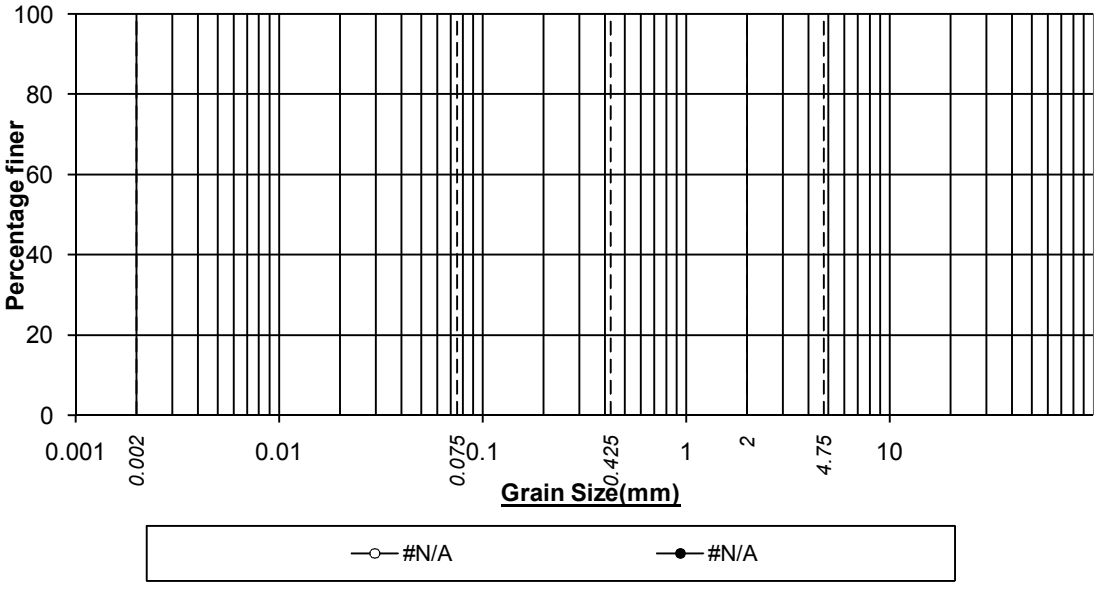
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-59,SPT-18, 30.50M		6.0	82.0	12.0	0.0	94.0	1.823/1.025	0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat. | **Job No. 3369**

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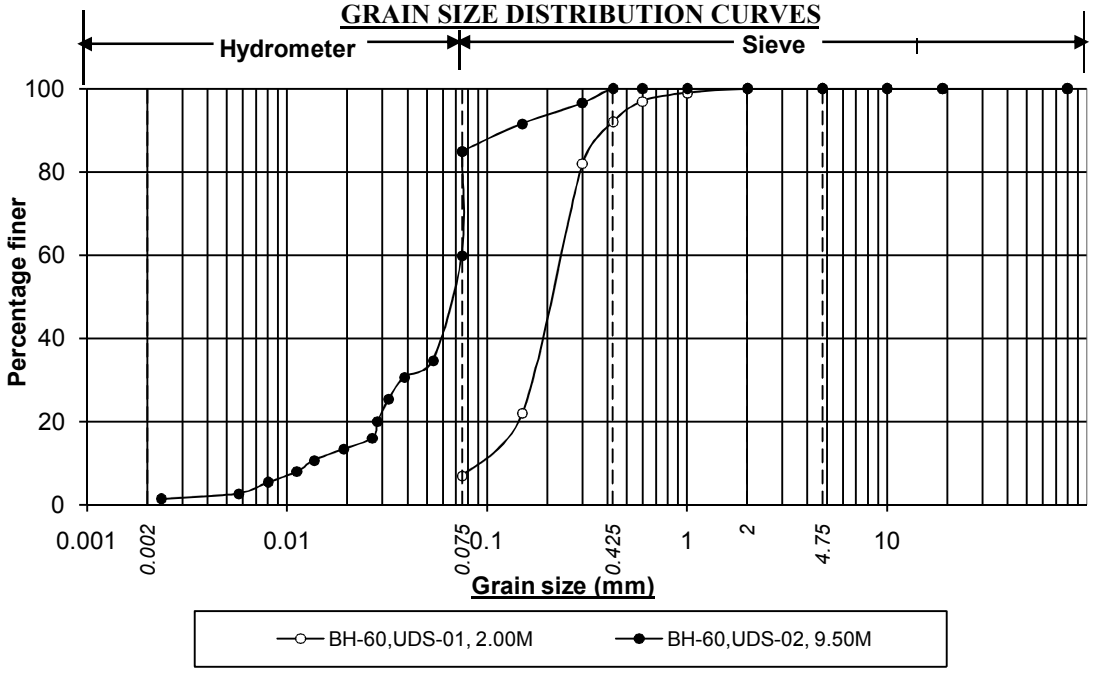
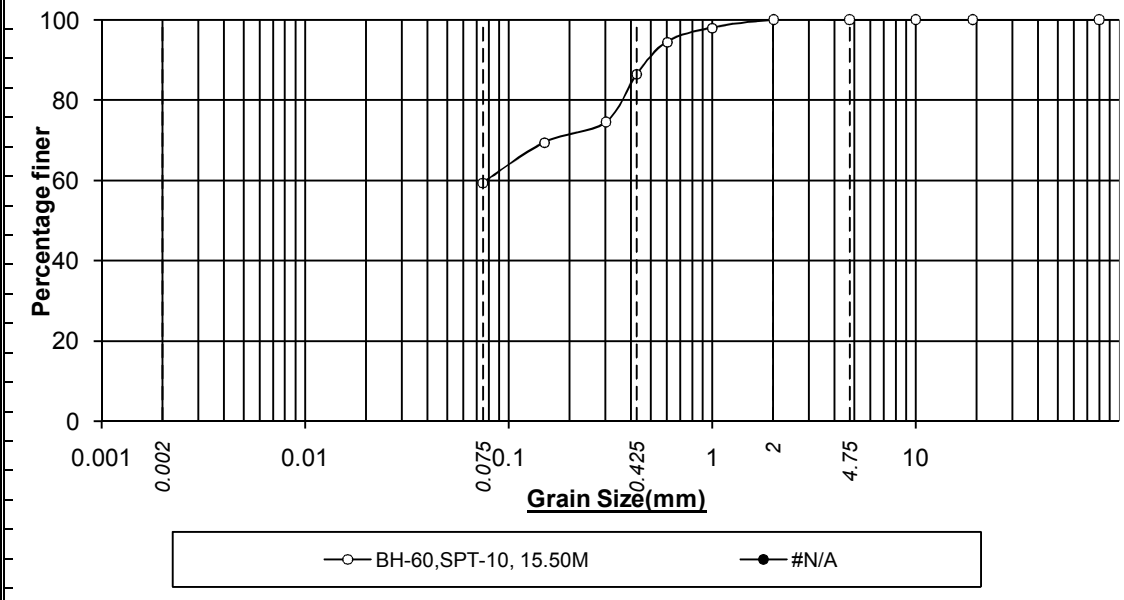
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-60,UDS-01, 2.00M		7.0	85.0	8.0	0.0	93.0	2.529/1.315	0.0
BH-60,UDS-02, 9.50M	1.1	83.9	15.0	0.0	0.0	15.0		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-60,SPT-10, 15.50M		59.5	27.0	13.5	0.0	40.5		0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

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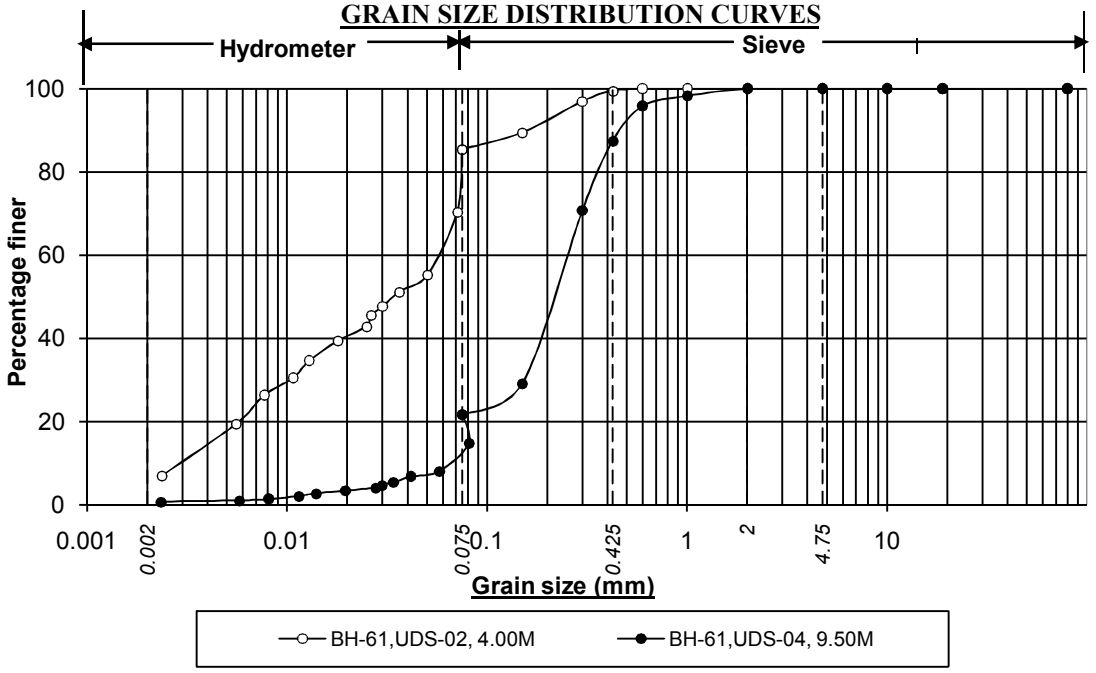
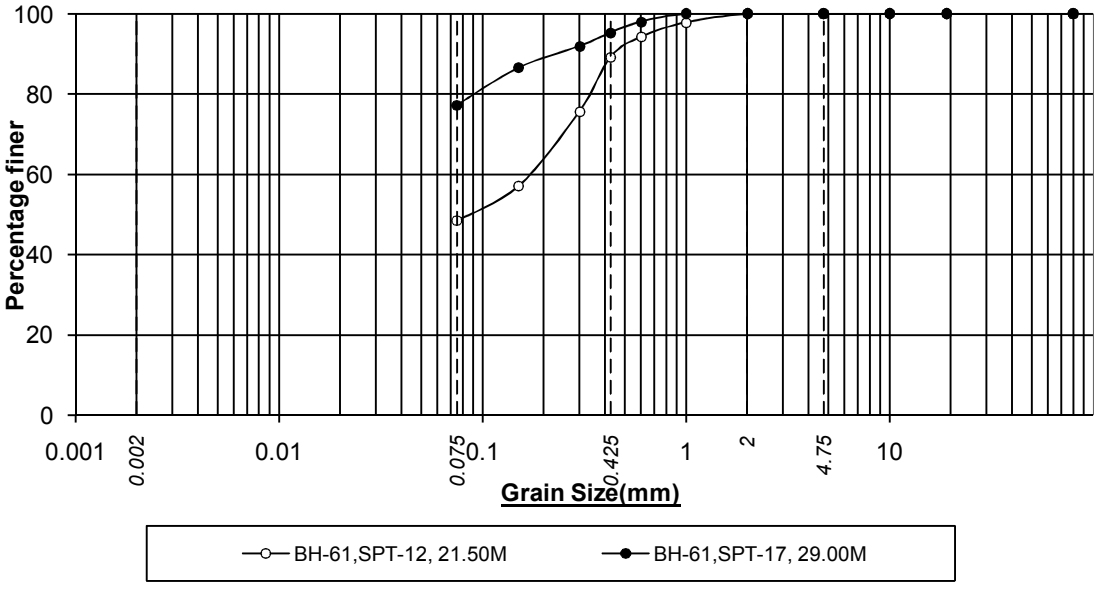
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-61,UDS-02, 4.00M	4.5	81.0	14.0	0.5	0.0	14.5		0.0
BH-61,UDS-04, 9.50M	0.6	21.1	65.8	12.5	0.0	78.3		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-61,SPT-12, 21.50M		48.6	40.7	10.7	0.0	51.4		0.0
BH-61,SPT-17, 29.00M		77.3	18.0	4.7	0.0	22.7		0.0

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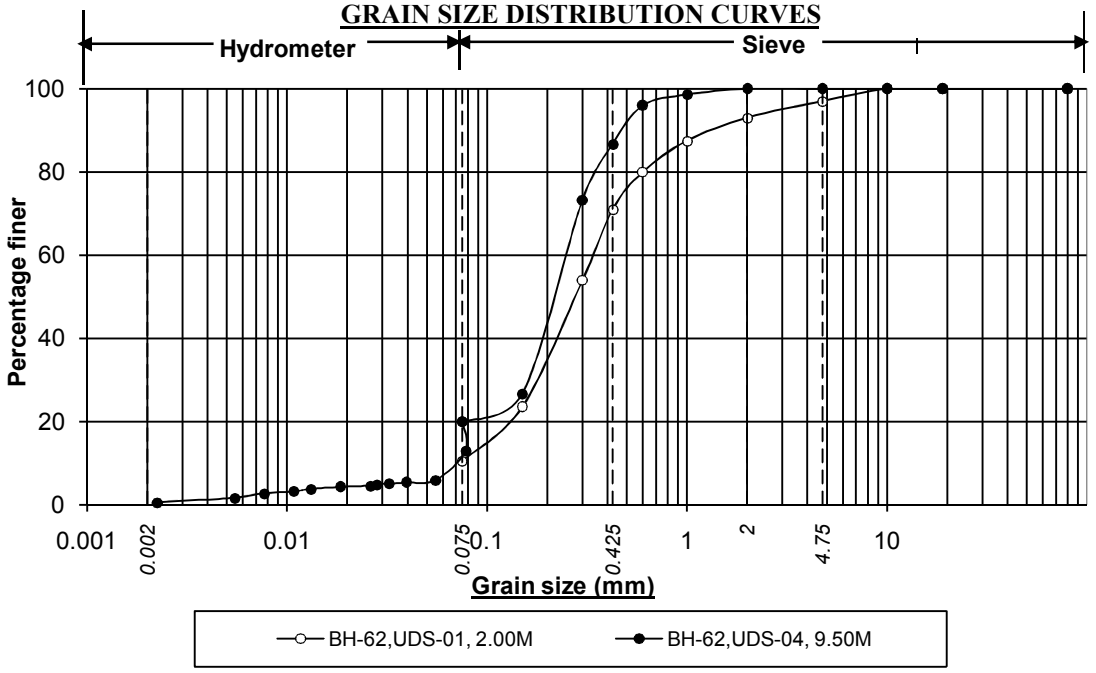
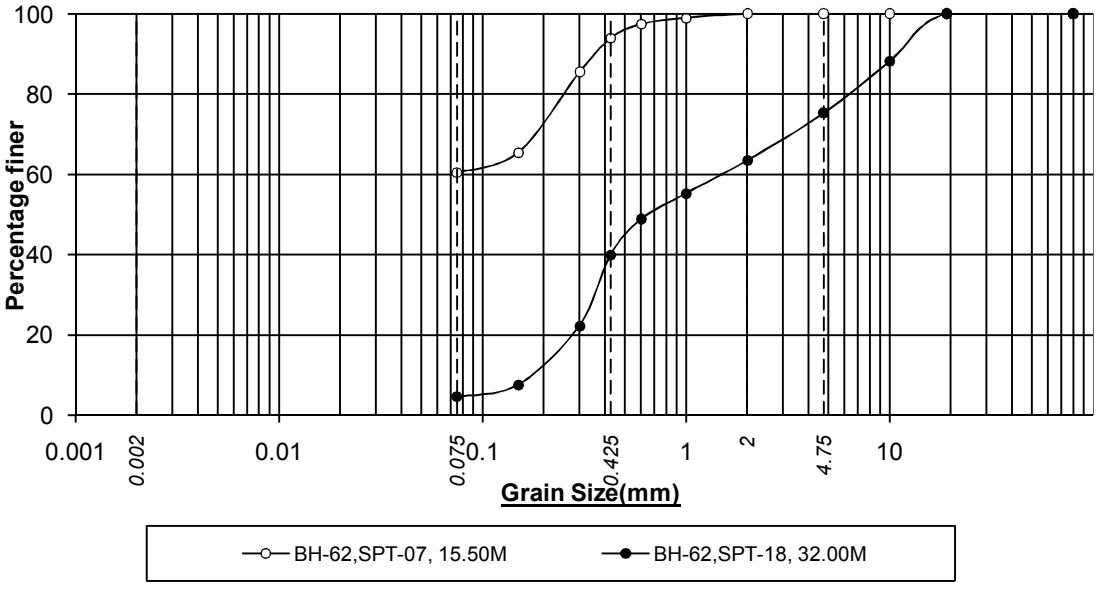
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	Total sand	Cu/Cc	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-62,UDS-01, 2.00M		10.5	60.5	22.0	4.0	86.5		3.0
BH-62,UDS-04, 9.50M	0.4	19.6	66.7	13.3	0.0	80.0		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	Total sand	Cu/Cc	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-62,SPT-07, 15.50M		60.5	33.5	6.0	0.0	39.5		0.0
BH-62,SPT-18, 32.00M		4.7	35.3	23.5	11.8	70.6	8.531/0.5	24.7

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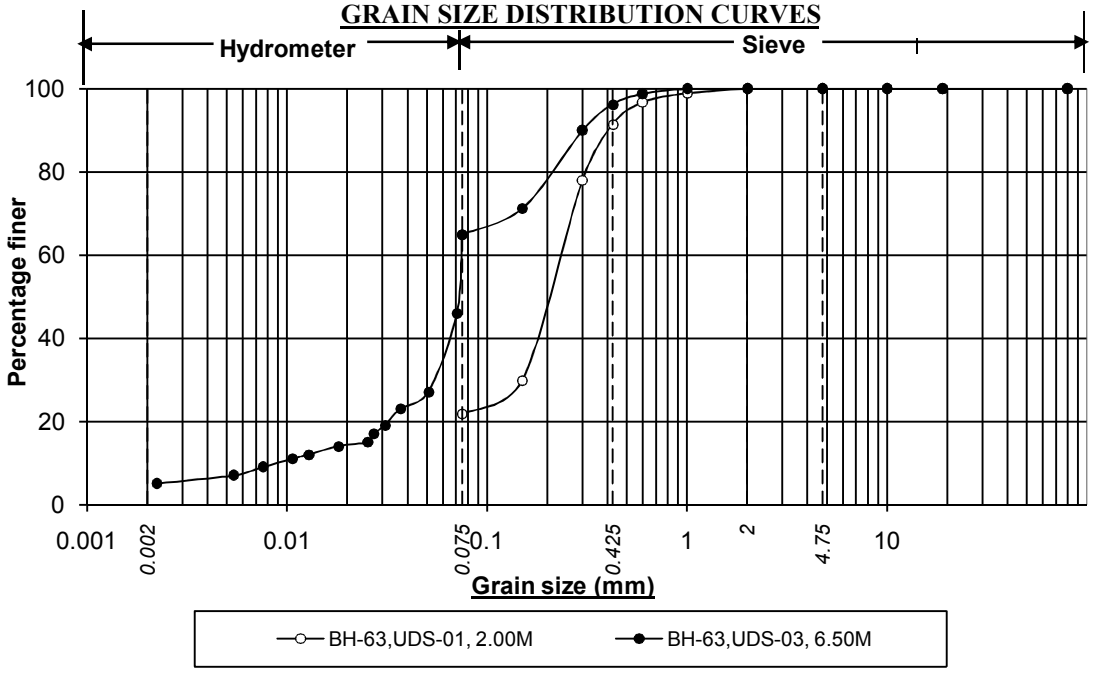
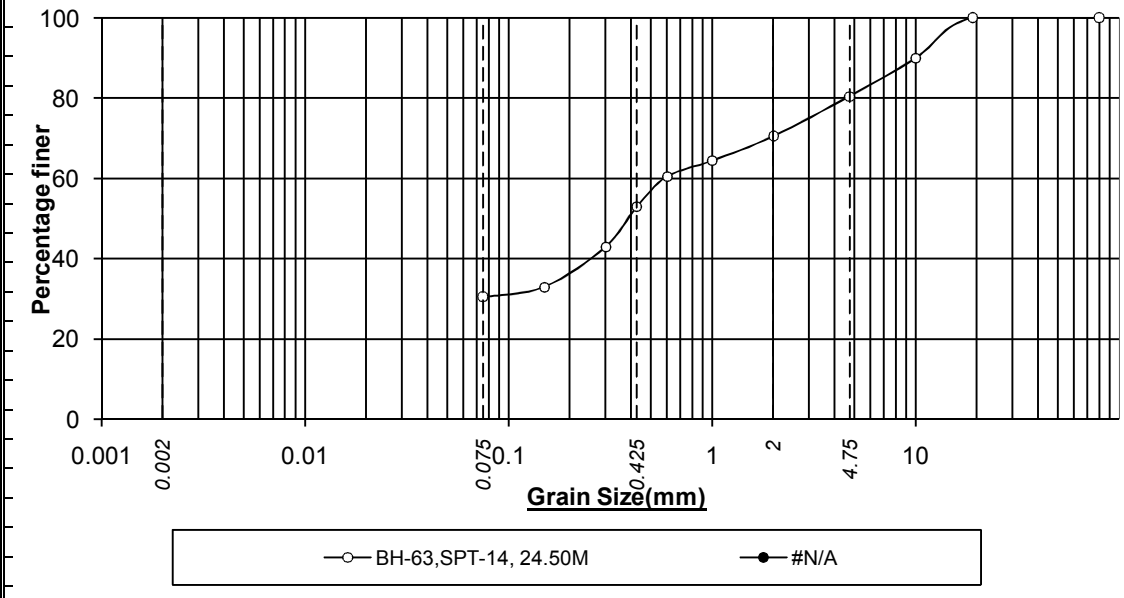
C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-63,UDS-01, 2.00M		21.9	69.5	8.6	0.0	78.1		0.0
BH-63,UDS-03, 6.50M	4.8	60.2	31.2	3.8	0.0	35.0		0.0

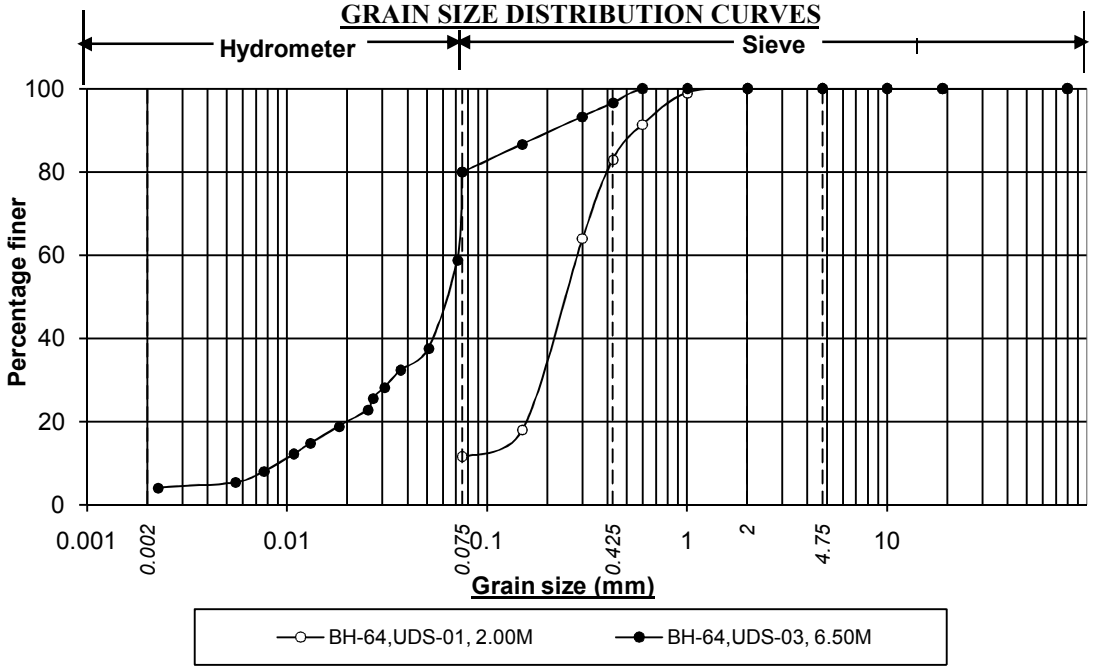


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-63,SPT-14, 24.50M		30.5	22.5	17.5	10.0	50.0		19.5

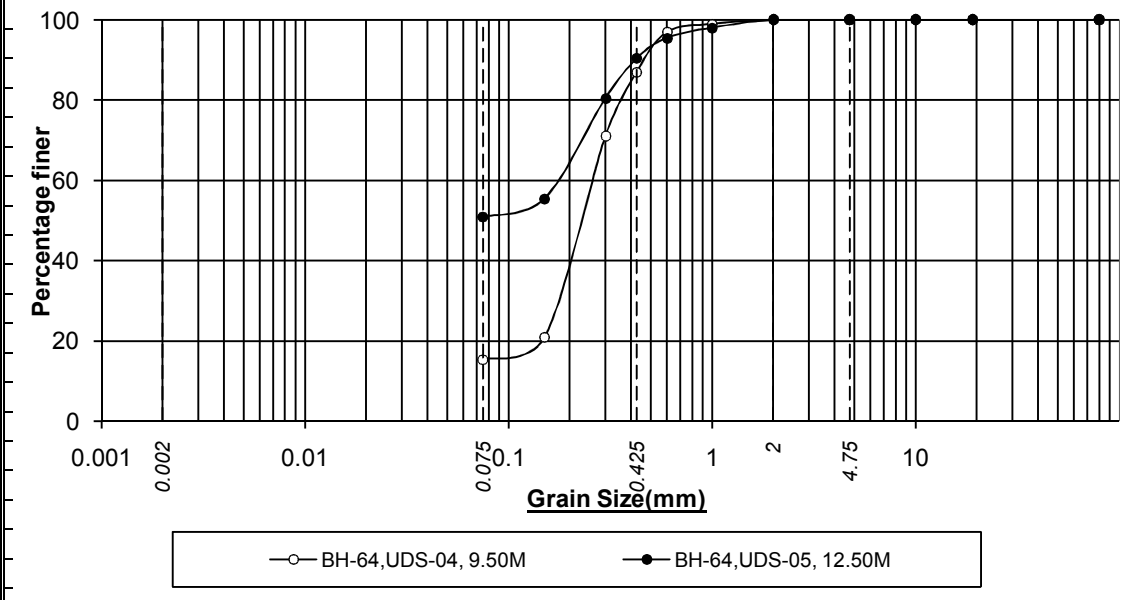
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-64,UDS-01, 2.00M		11.5	71.5	17.0	0.0	88.5		0.0
BH-64,UDS-03, 6.50M	3.9	76.1	16.7	3.3	0.0	20.0		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-64,UDS-04, 9.50M		15.5	71.5	13.0	0.0	84.5		0.0
BH-64,UDS-05, 12.50M		51.0	39.5	9.5	0.0	49.0		0.0

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

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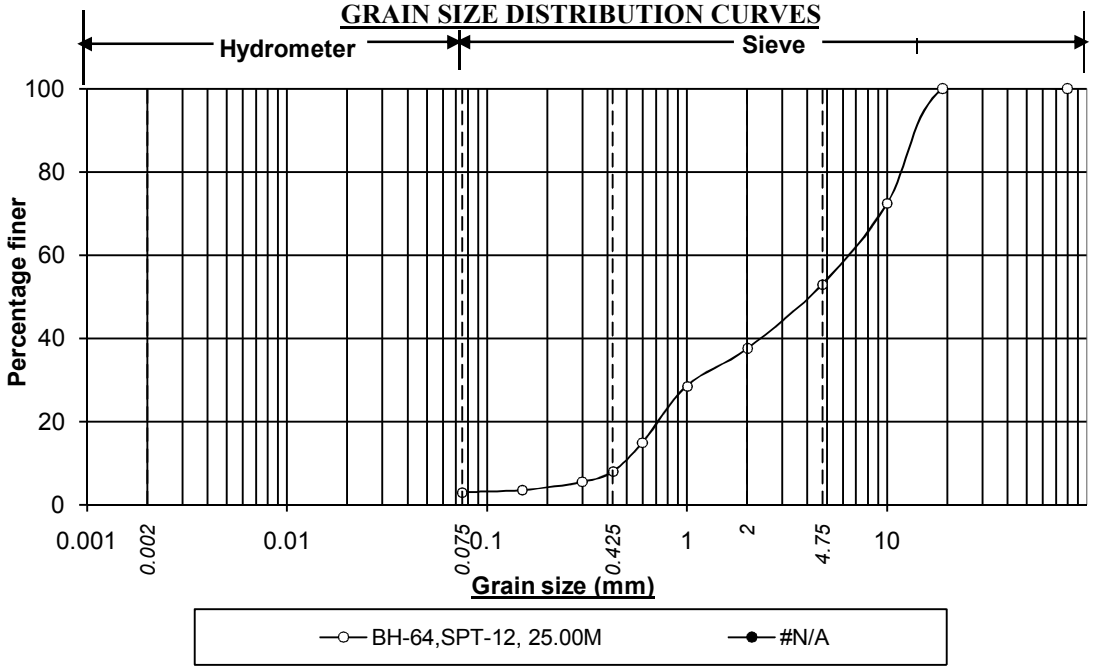
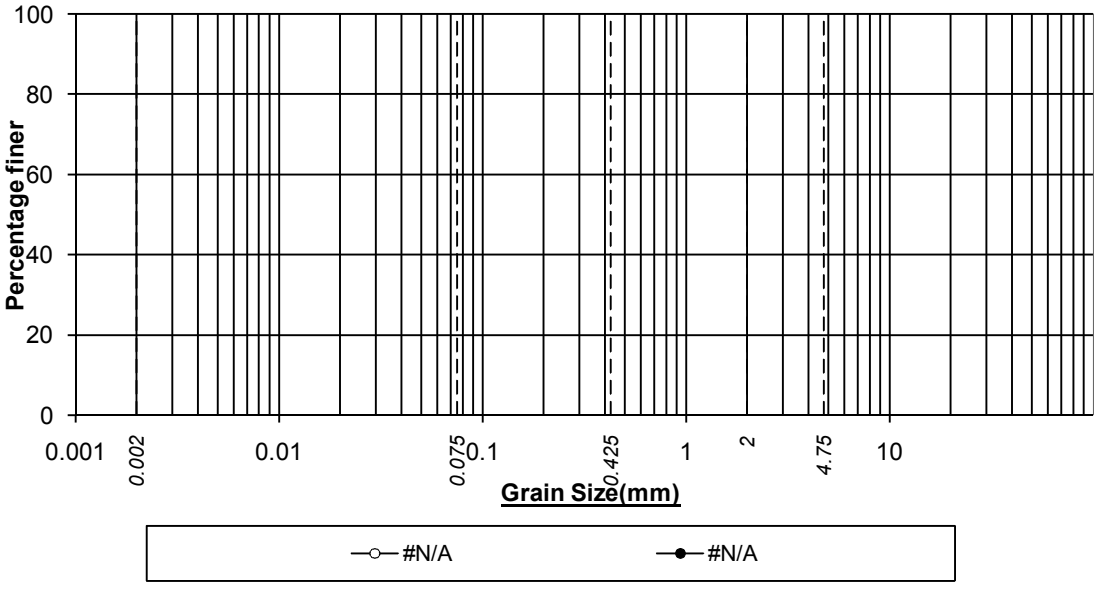
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)
BH-64,SPT-12, 25.00M		3.0	5.0	29.5	15.5	50.0	13.583/0.412	47.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	Clay (%)	Silt (%)	Fine sand (%)	Medium sand (%)	Coarse sand (%)			Gravel (%)

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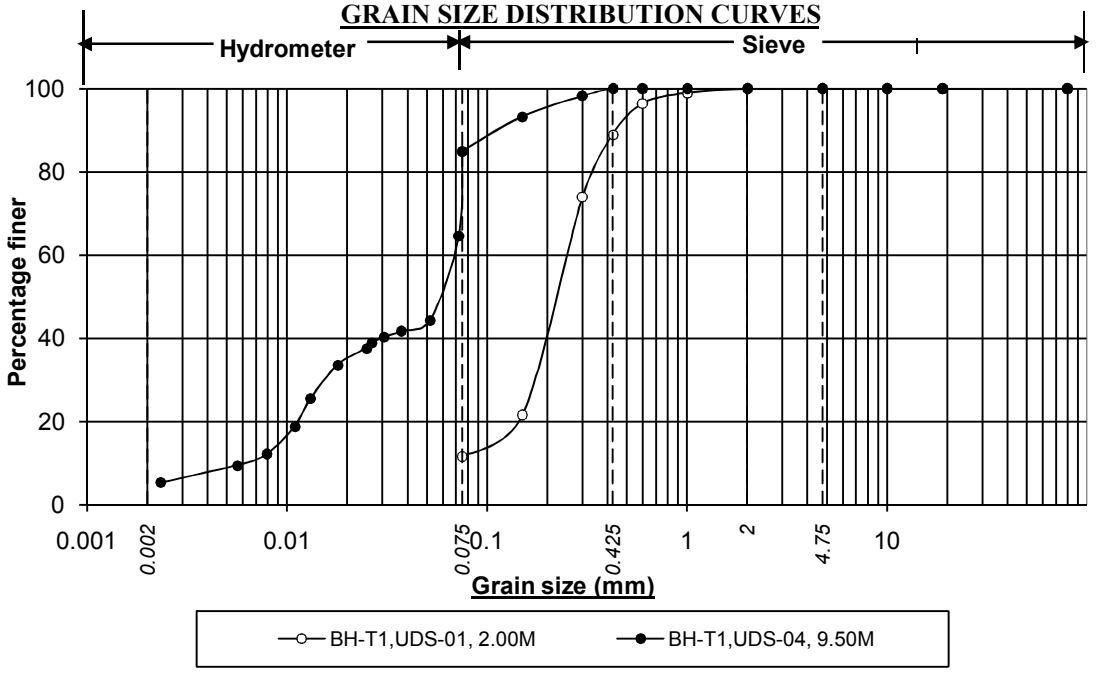
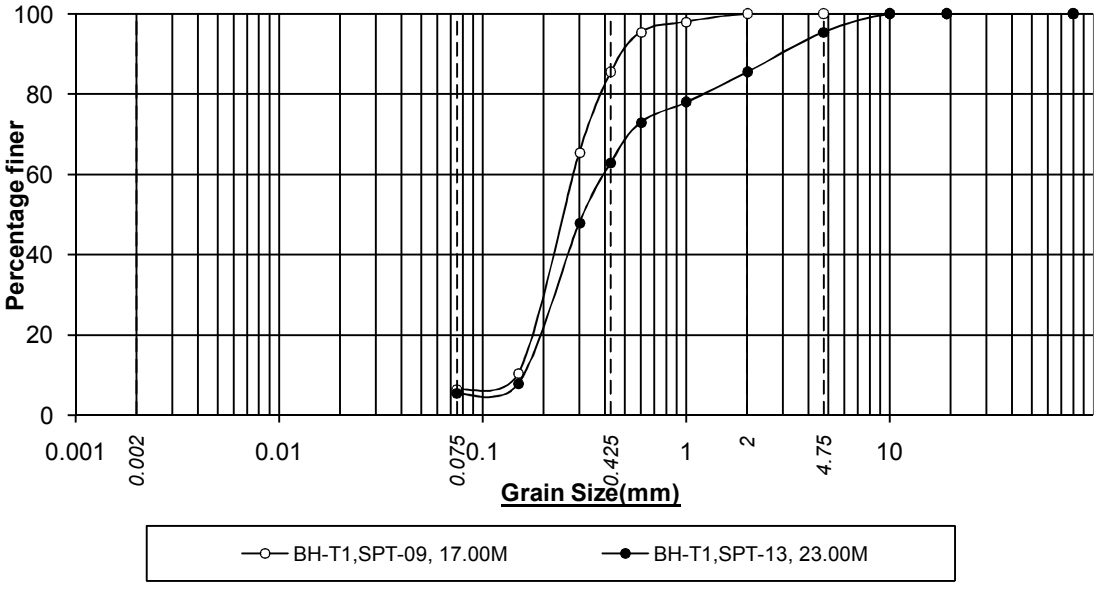
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-T1,UDS-01, 2.00M		11.5	77.5	11.0	0.0	88.5		0.0
BH-T1,UDS-04, 9.50M	4.7	80.3	15.0	0.0	0.0	15.0		0.0



Grain size (mm)	*<0.002*	*0.002-0.075*	*0.075-0.425*	*0.425-2.00*	*2.0-4.75*	**Total sand**	**Cu/Cc**	*>4.75*
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-T1,SPT-09, 17.00M		6.5	79.0	14.5	0.0	93.5	1.945/0.849	0.0
BH-T1,SPT-13, 23.00M		5.5	57.5	22.5	10.0	90.0	2.426/0.872	4.5

Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

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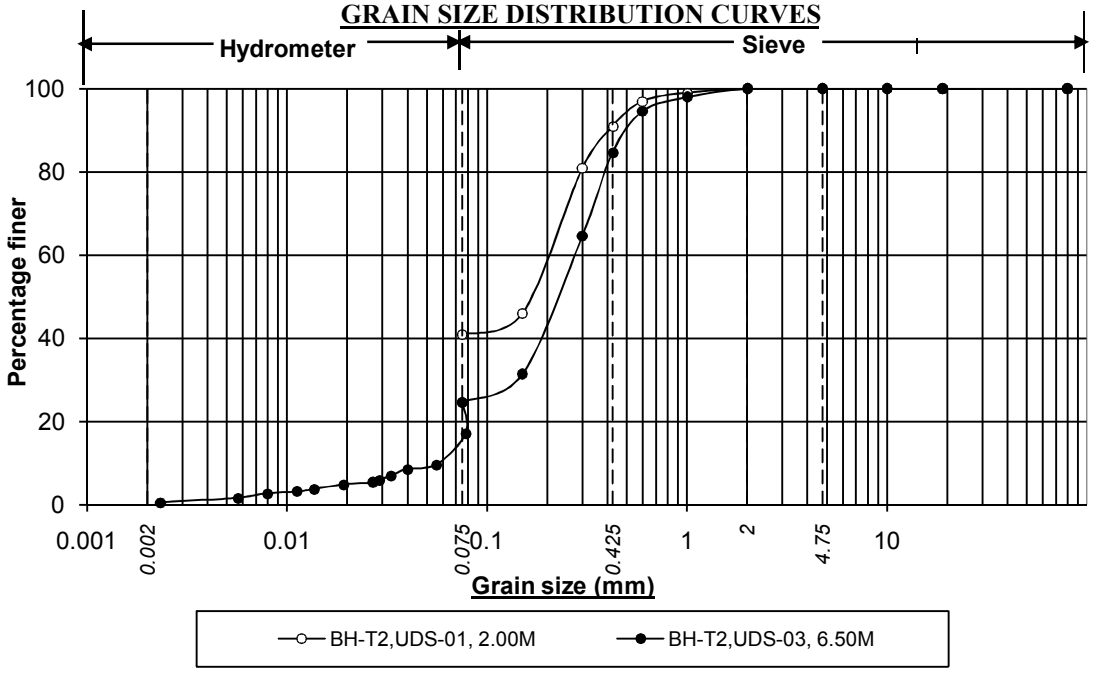
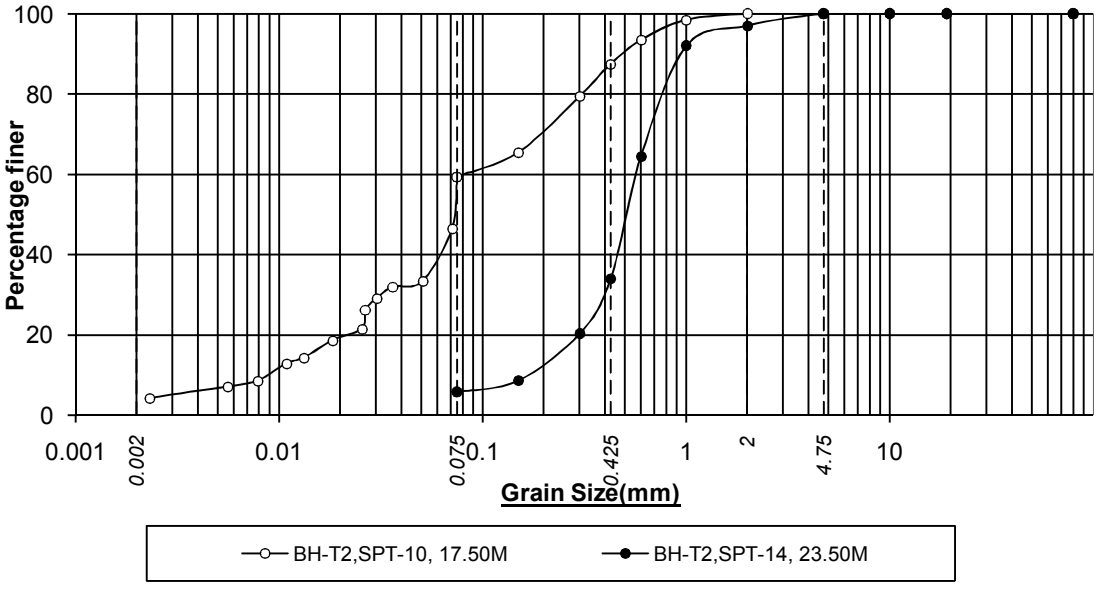
GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-T2,UDS-01, 2.00M		41.0	50.0	9.0	0.0	59.0		0.0
BH-T2,UDS-03, 6.50M	0.3	24.3	60.1	15.3	0.0	75.4		0.0

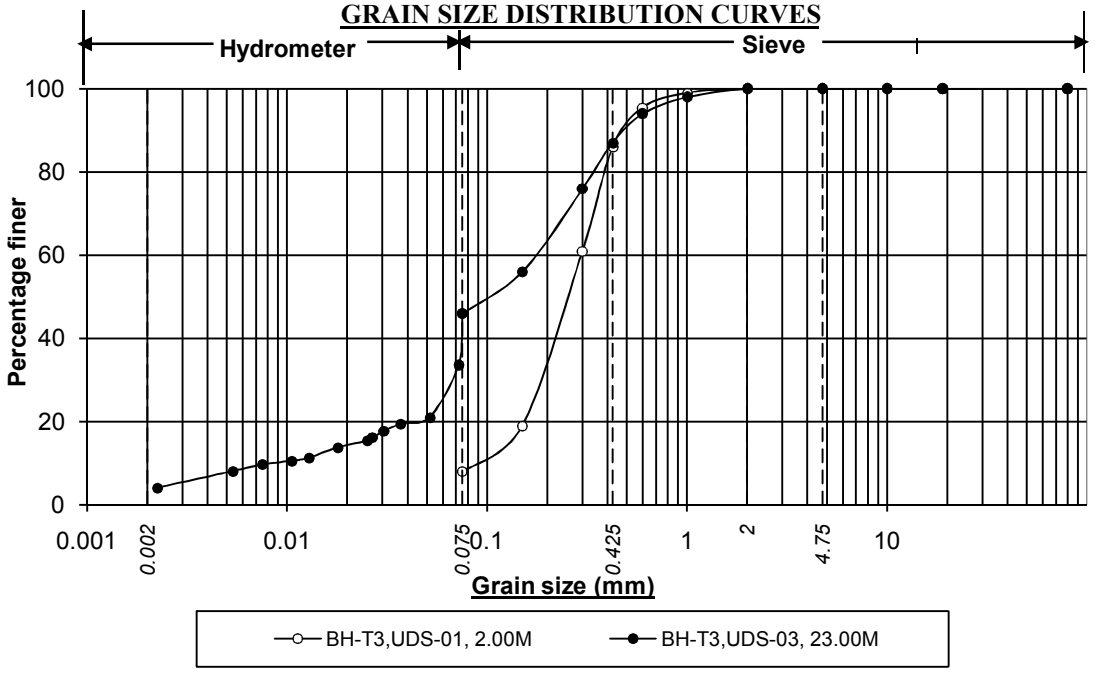


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-T2,SPT-10, 17.50M	3.8	55.7	28.0	12.5	0.0	40.5		0.0
BH-T2,SPT-14, 23.50M		5.8	28.3	63.0	2.9	94.2	3.396/1.648	0.0

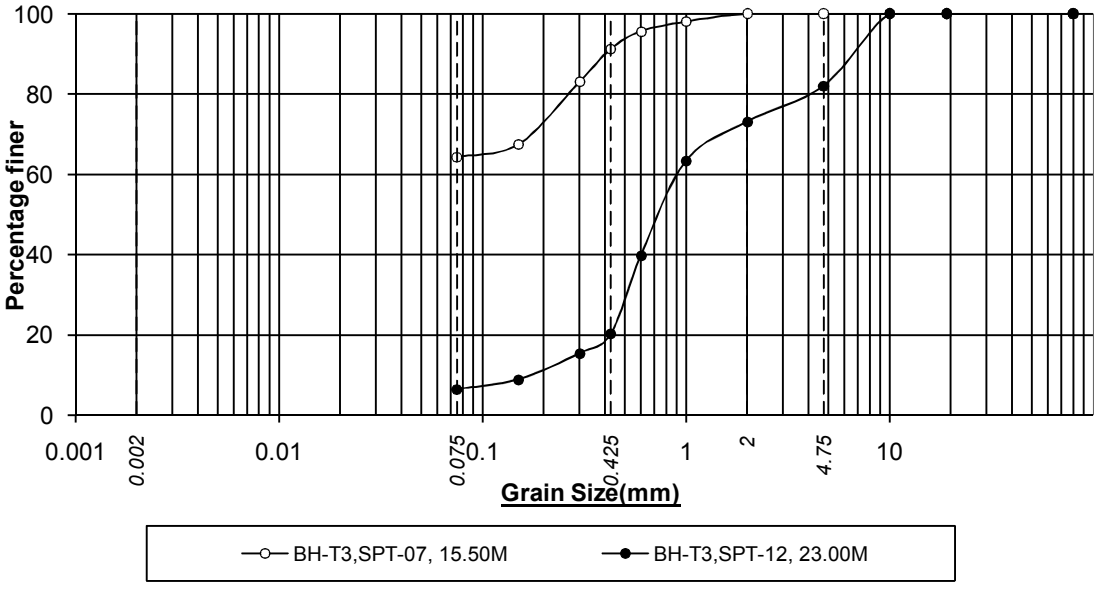
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-T3,UDS-01, 2.00M		8.0	78.0	14.0	0.0	92.0	3.396/1.415	0.0
BH-T3,UDS-03, 23.00M	3.5	42.5	41.0	13.0	0.0	54.0		0.0

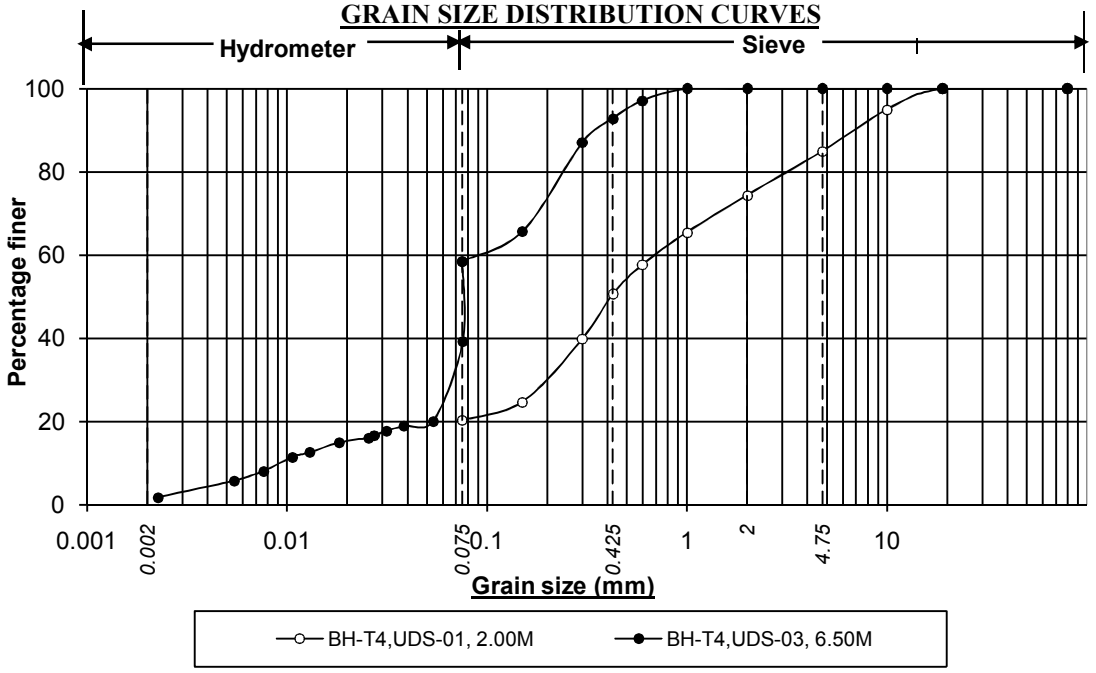


Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-T3,SPT-07, 15.50M		64.4	26.8	8.8	0.0	35.6		0.0
BH-T3,SPT-12, 23.00M		6.5	13.9	52.8	8.9	75.6	5.199/1.592	17.9

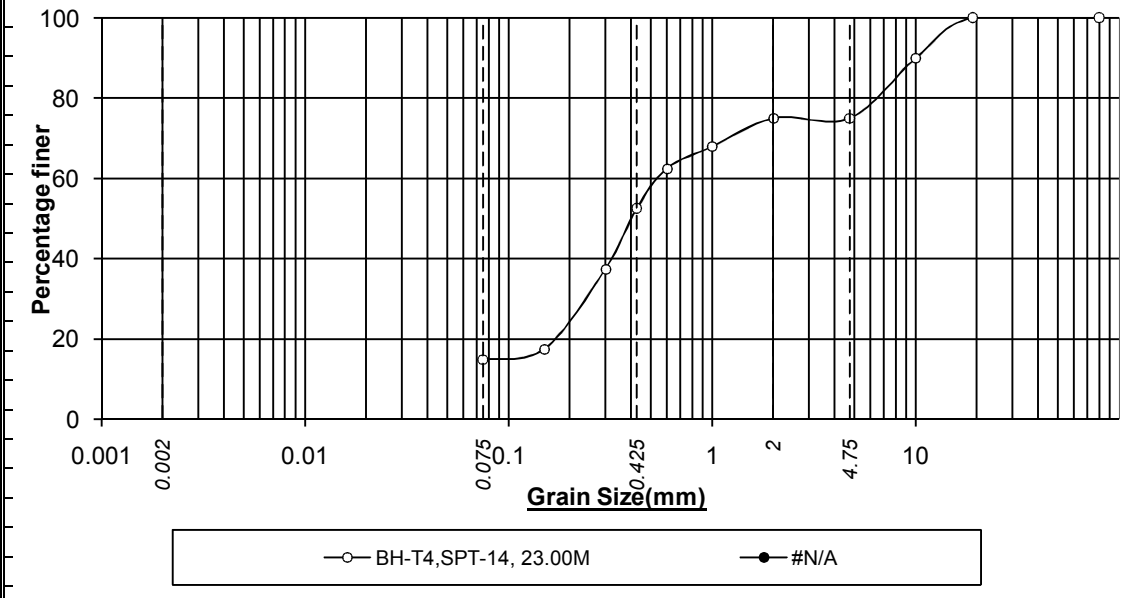
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C. E. Testing Company Pvt. Ltd.

GRAIN SIZE DISTRIBUTION CURVES



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-T4,UDS-01, 2.00M		20.4	30.2	23.8	10.6	64.6		15.0
BH-T4,UDS-03, 6.50M	1.2	57.4	34.3	7.1	0.0	41.4		0.0



Grain size (mm)	<0.002	0.002-0.075	0.075-0.425	0.425-2.00	2.0-4.75	Total sand	Cu/Cc	>4.75
Sample No.	**Clay (%)**	**Silt (%)**	**Fine sand (%)**	**Medium sand (%)**	**Coarse sand (%)**			**Gravel (%)**
BH-T4,SPT-14, 23.00M		15.0	37.5	22.5	0.0	60.0		25.0

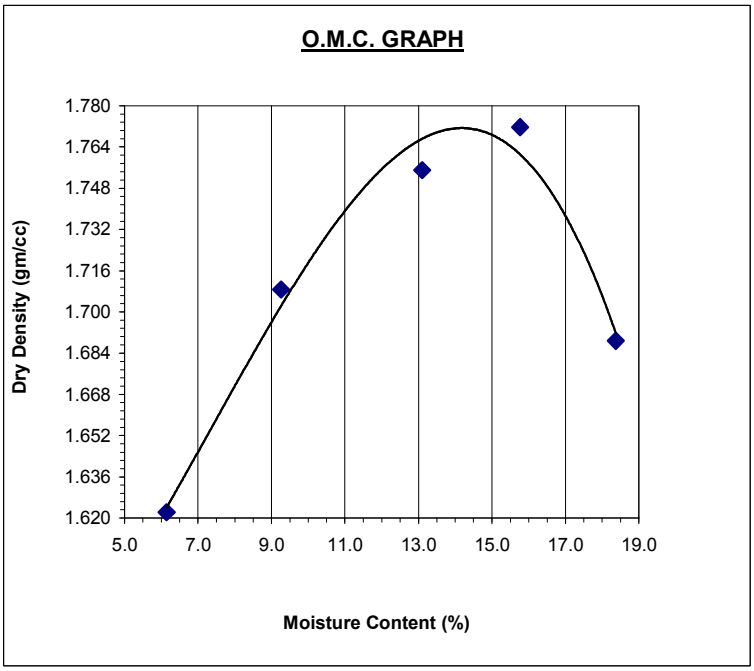
Project:- Geotech. Inv. work for 1 x 800 MW Wanakbori TPS, Gujarat | **Job No. 3369**

C.B.R. & STANDARD PROCTOR TEST RESULTS.

TP01 / DS01

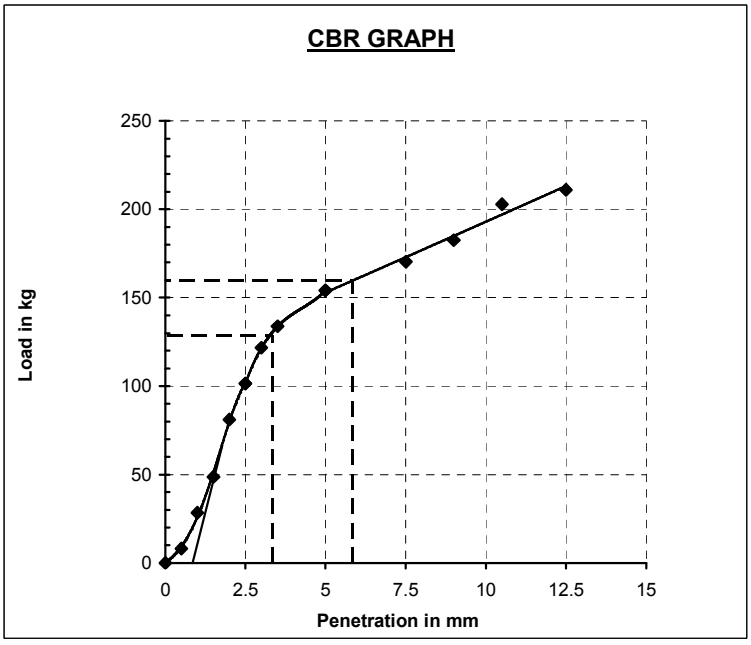
Depth = 1.00m

Maximum Dry Density : 1.770 gm/cc
Optimum Moisture Content: 14.00 %



TYPE :- SOAKED

Penetration (mm)	CBR (%)
2.5	9.40
5.0	7.76

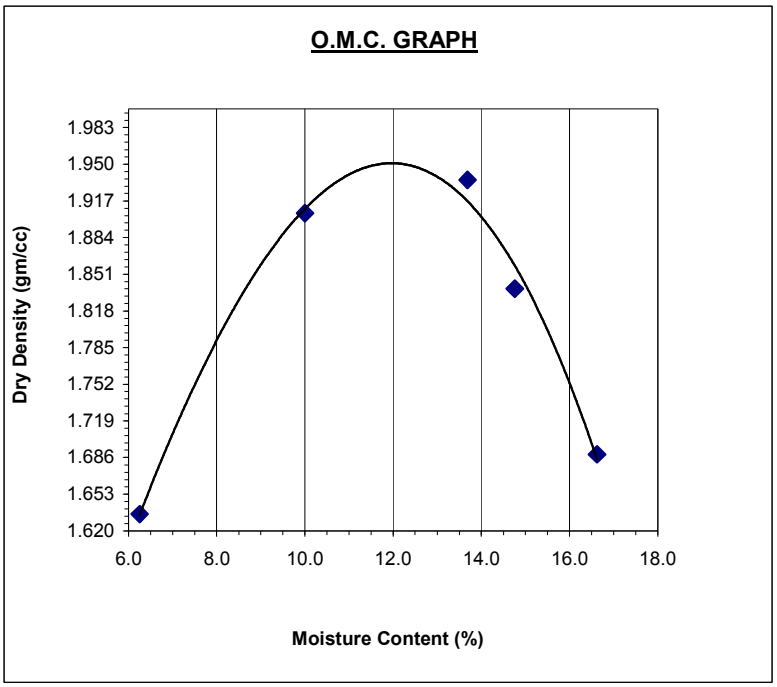


MODIFIED PROCTOR TEST RESULTS.

TP01 / DS02

Depth = 2.00m

Maximum Dry Density : 1.950 gm/cc
Optimum Moisture Content: 12.00 %

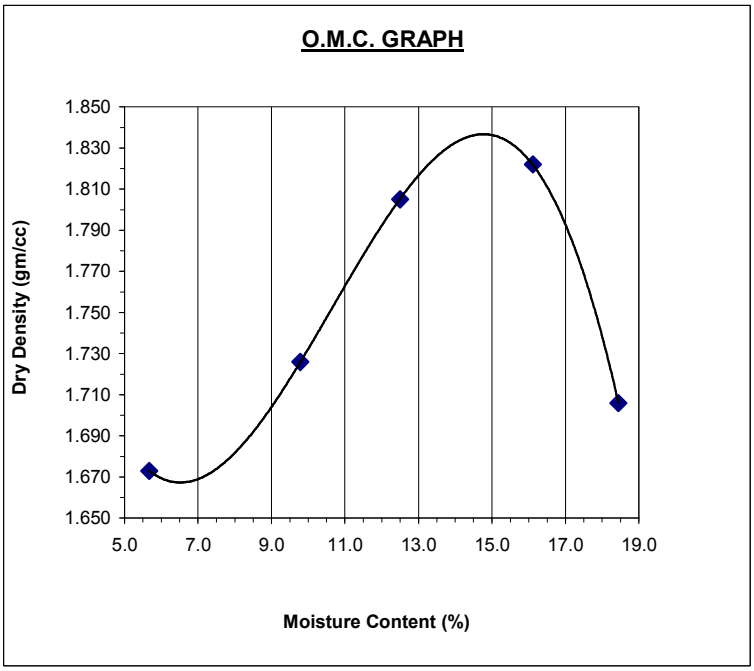


C.B.R. & STANDARD PROCTOR TEST RESULTS.

TP02 / DS02

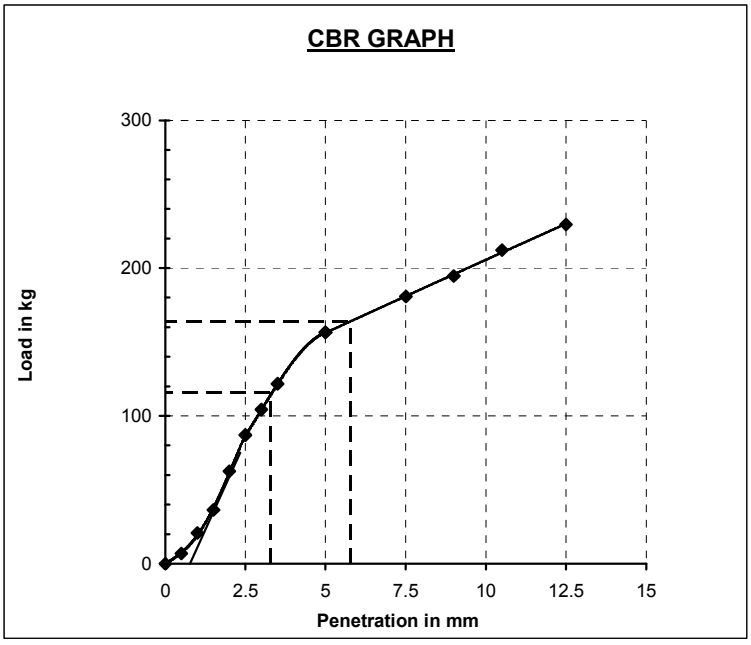
Depth = 2.00m

Maximum Dry Density : 1.836 gm/cc
Optimum Moisture Content: 14.75 %



TYPE :- SOAKED

Penetration (mm)	CBR (%)
2.5	8.47
5.0	7.97

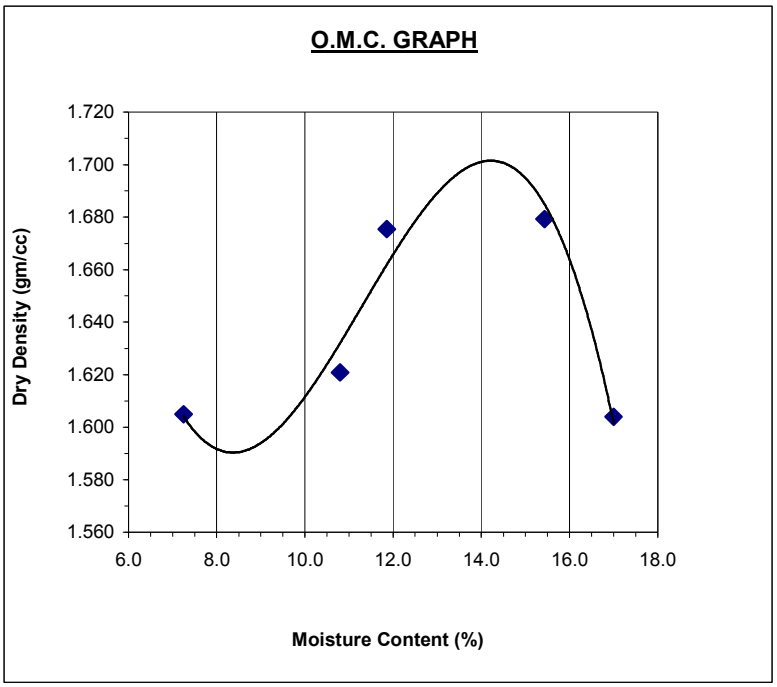


STANDARD PROCTOR TEST RESULTS.

TP03 / DS01

Depth = 1.00m

Maximum Dry Density : 1.701 gm/cc
Optimum Moisture Content: 14.26 %

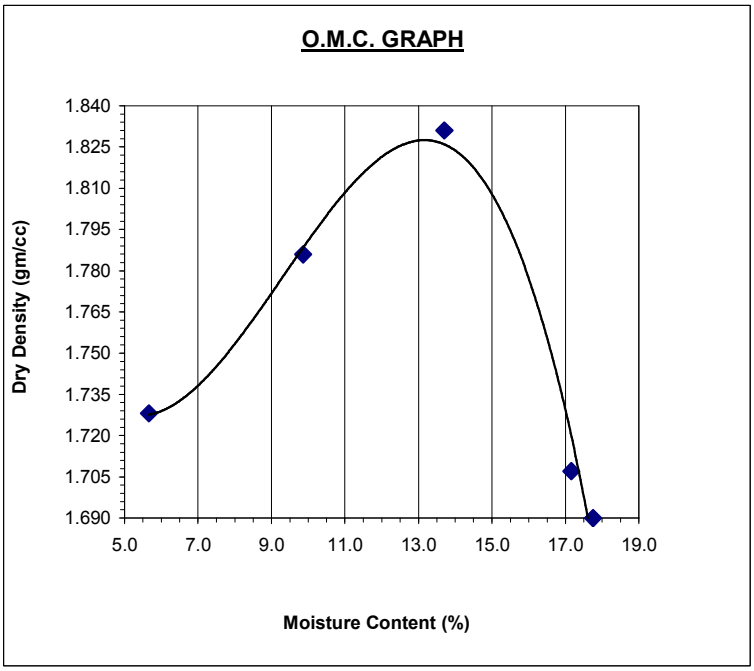


C.B.R. & MODIFIED PROCTOR TEST RESULTS.

TP03 / DS02

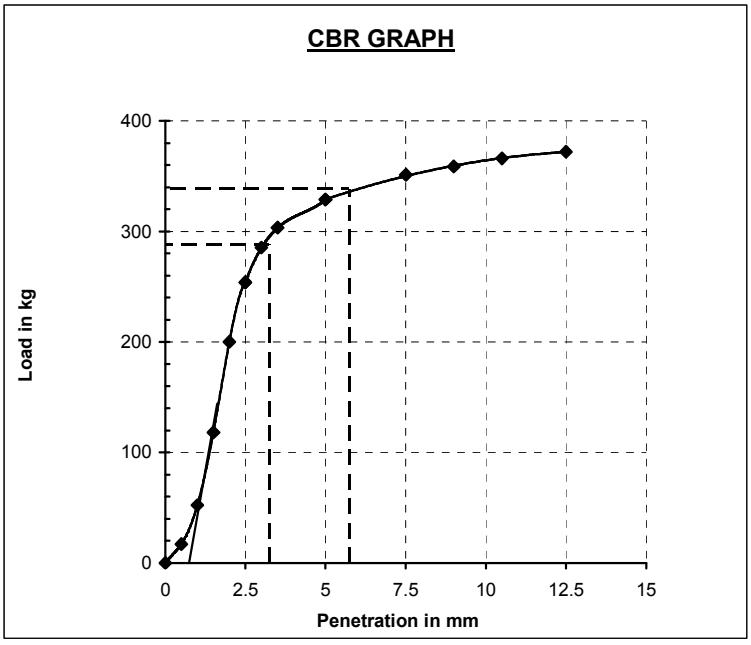
Depth = 2.00m

Maximum Dry Density : 1.827 gm/cc
Optimum Moisture Content: 13.30 %



TYPE :- SOAKED

Penetration (mm)	CBR (%)
2.5	21.05
5.0	16.48

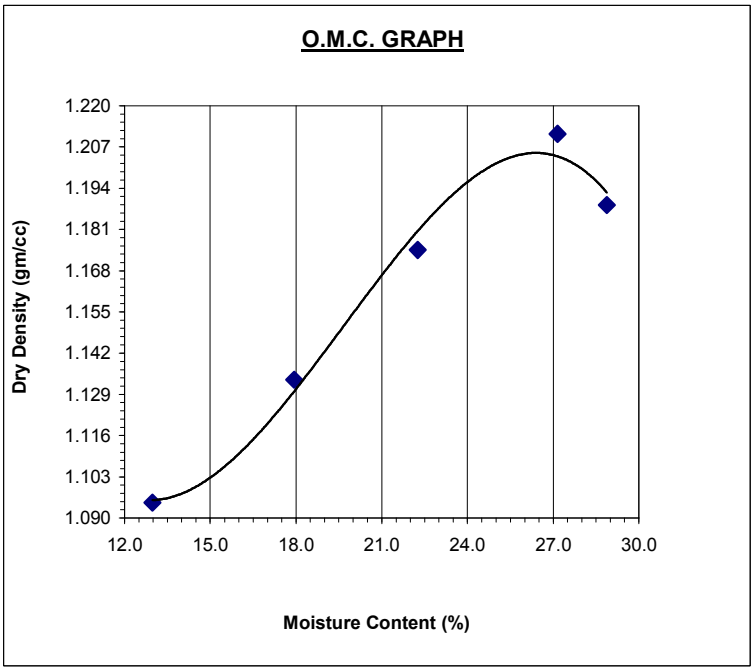


C.B.R. & MODIFIED PROCTOR TEST RESULTS.

TP07 / DS01

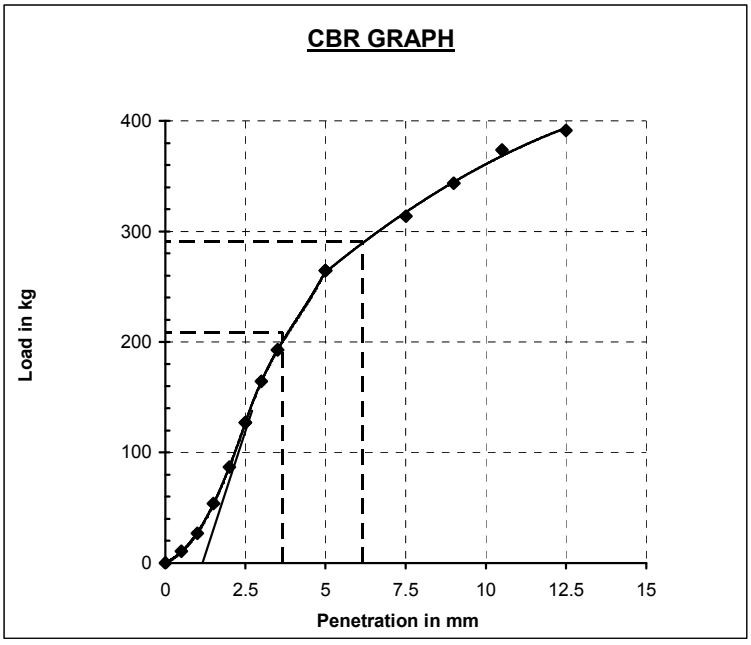
Depth = 1.00m

Maximum Dry Density : 1.205 gm/cc
Optimum Moisture Content: 26.50 %



TYPE :- SOAKED

Penetration (mm)	CBR (%)
2.5	15.24
5.0	14.14

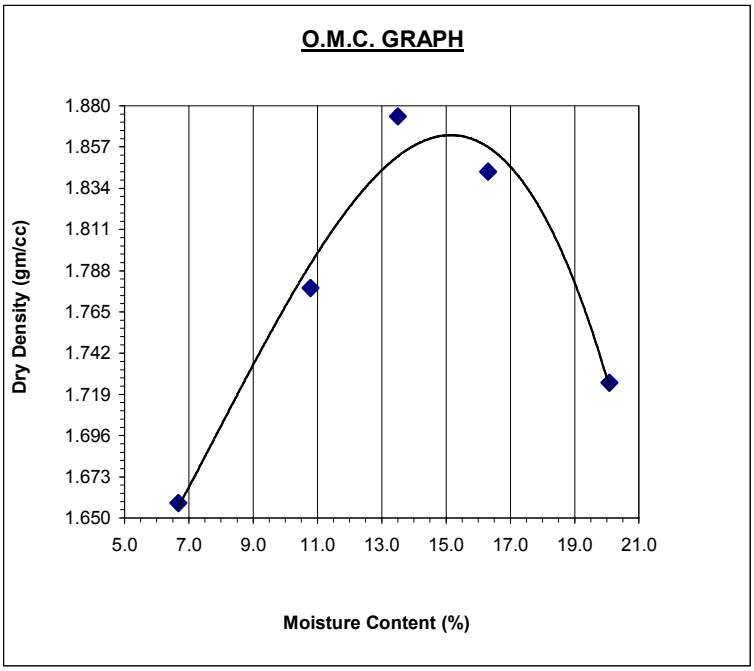


C.B.R. & STANDARD PROCTOR TEST RESULTS.

TP08 / DS01

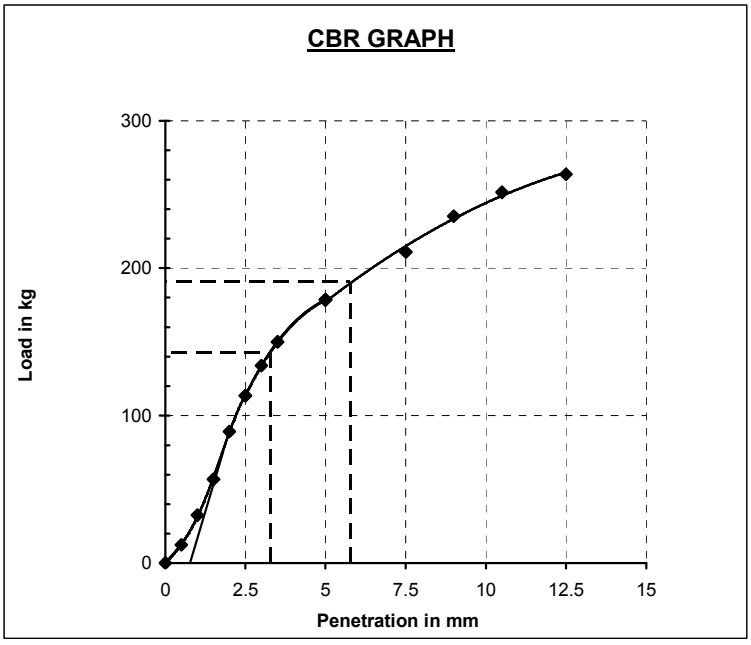
Depth = 1.00m

Maximum Dry Density : 1.863 gm/cc
Optimum Moisture Content: 15.20 %



TYPE :- SOAKED

Penetration (mm)	CBR (%)
2.5	10.41
5.0	9.28

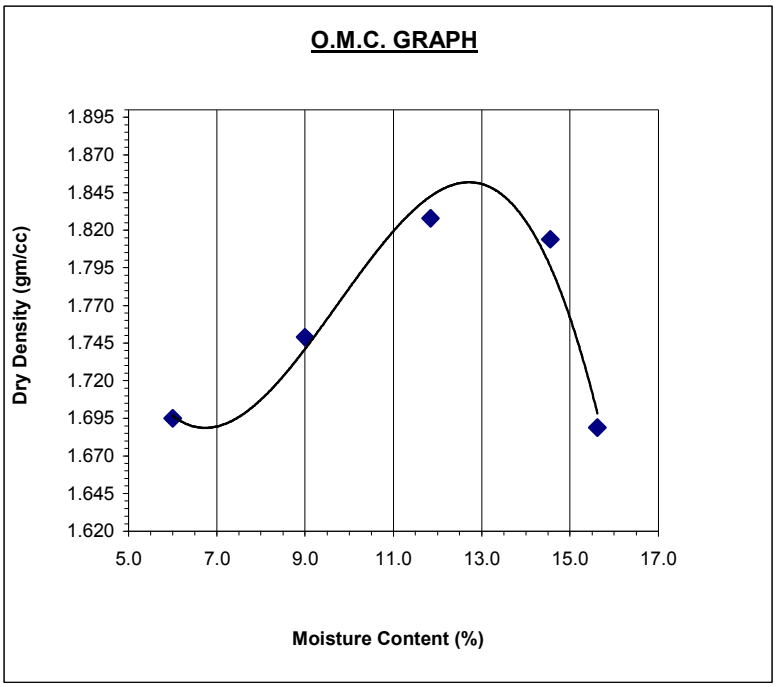


MODIFIED PROCTOR TEST RESULTS.

TP09 / DS01

Depth = 1.00m

Maximum Dry Density : 1.851 gm/cc
Optimum Moisture Content: 12.74 %

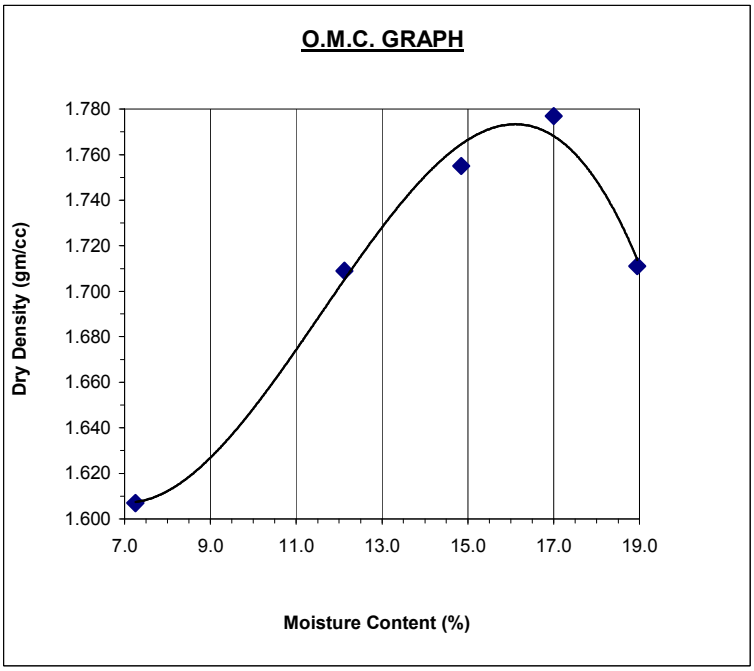


C.B.R. & STANDARD PROCTOR TEST RESULTS.

TP-09 / DS03

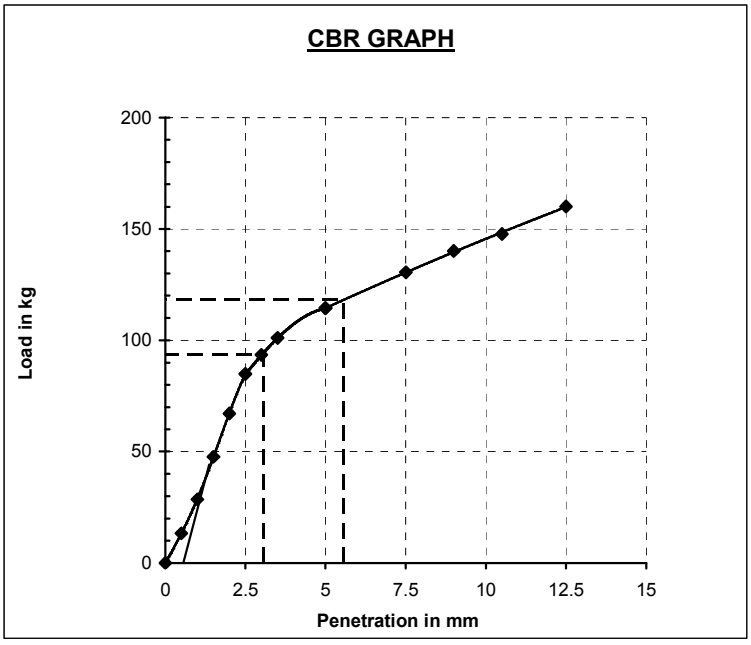
Depth = 3.00m

Maximum Dry Density : 1.773 gm/cc
Optimum Moisture Content: 16.10 %



TYPE :- SOAKED

Penetration (mm)	CBR (%)
2.5	6.83
5.0	5.75

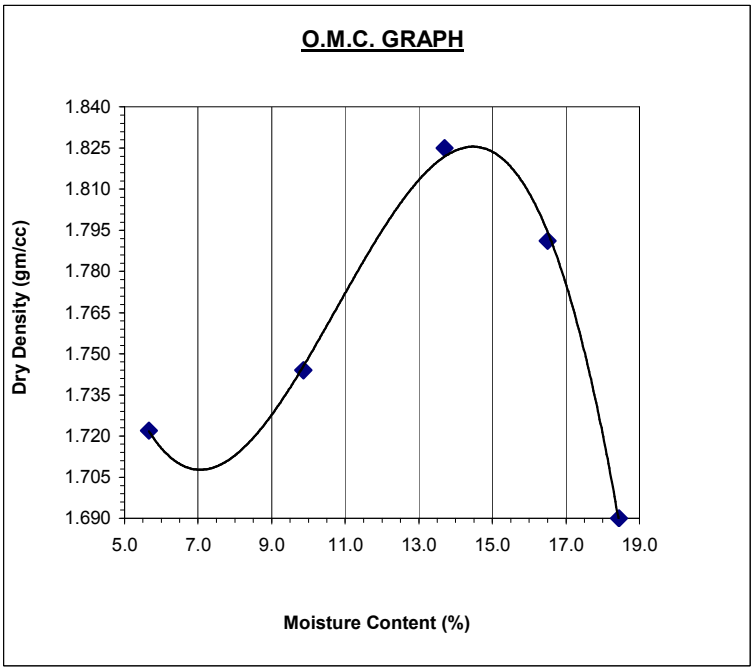


C.B.R. & MODIFIED PROCTOR TEST RESULTS.

TTP01 / DS02

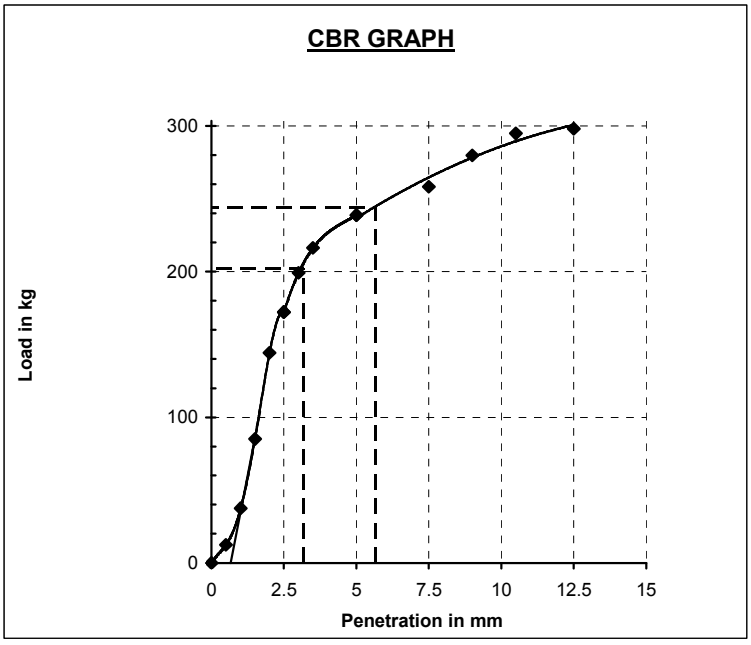
Depth = 2.00m

Maximum Dry Density : 1.825 gm/cc
Optimum Moisture Content: 14.55 %



TYPE :- SOAKED

Penetration (mm)	CBR (%)
2.5	14.77
5.0	11.89

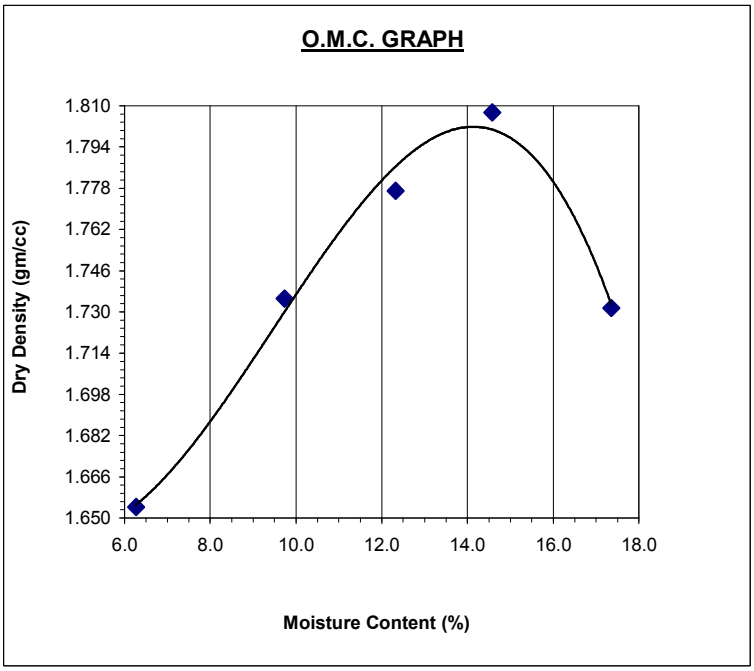


C.B.R. & STANDARD PROCTOR TEST RESULTS.

PLT-03 / DS02

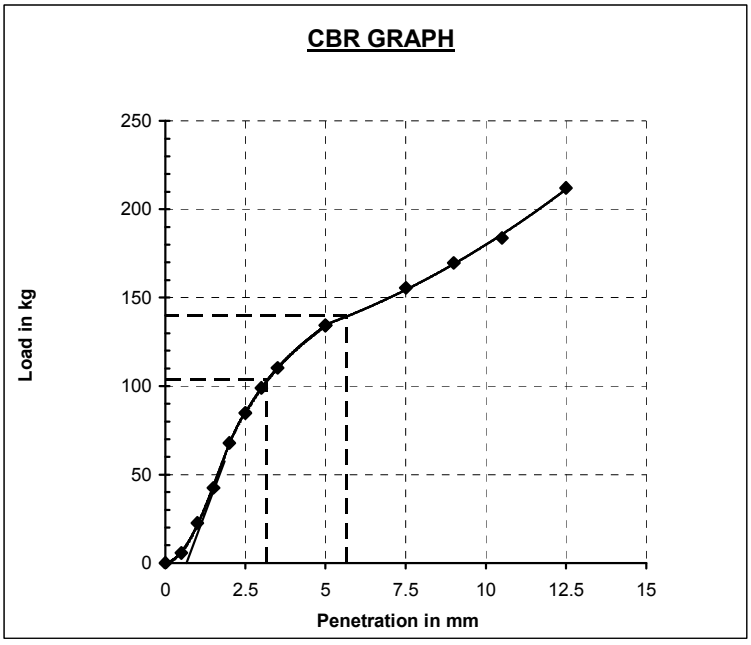
Depth = 2.00m

Maximum Dry Density : 1.801 gm/cc
Optimum Moisture Content: 14.00 %



TYPE :- SOAKED

Penetration (mm)	CBR (%)
2.5	7.57
5.0	6.80

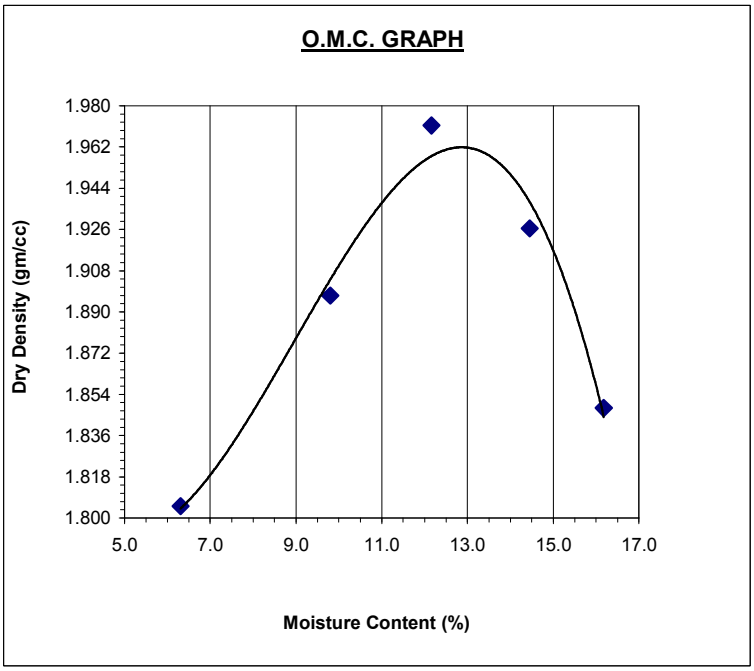


C.B.R. & MODIFIED PROCTOR TEST RESULTS.

PLT-05 / DS01

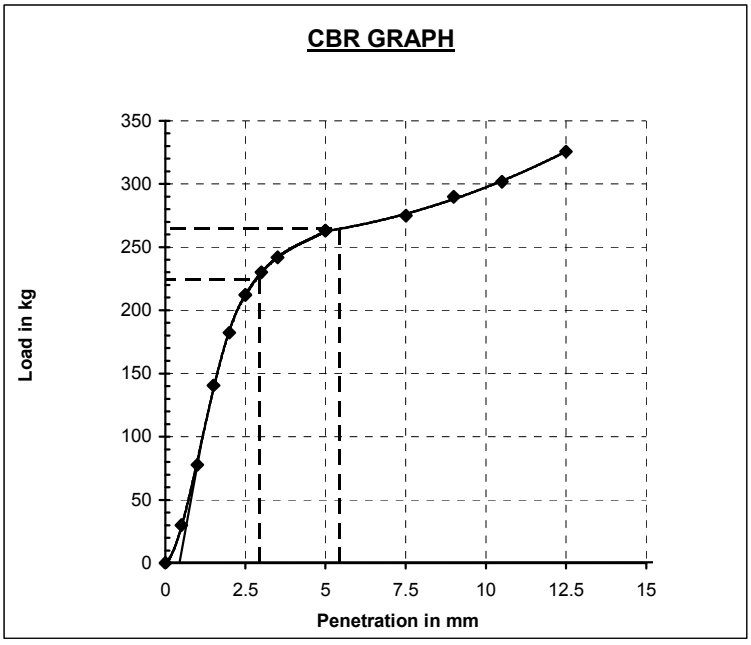
Depth = 1.00m

Maximum Dry Density : 1.961 gm/cc
Optimum Moisture Content: 12.90 %



TYPE :- SOAKED

Penetration (mm)	CBR (%)
2.5	16.36
5.0	12.87

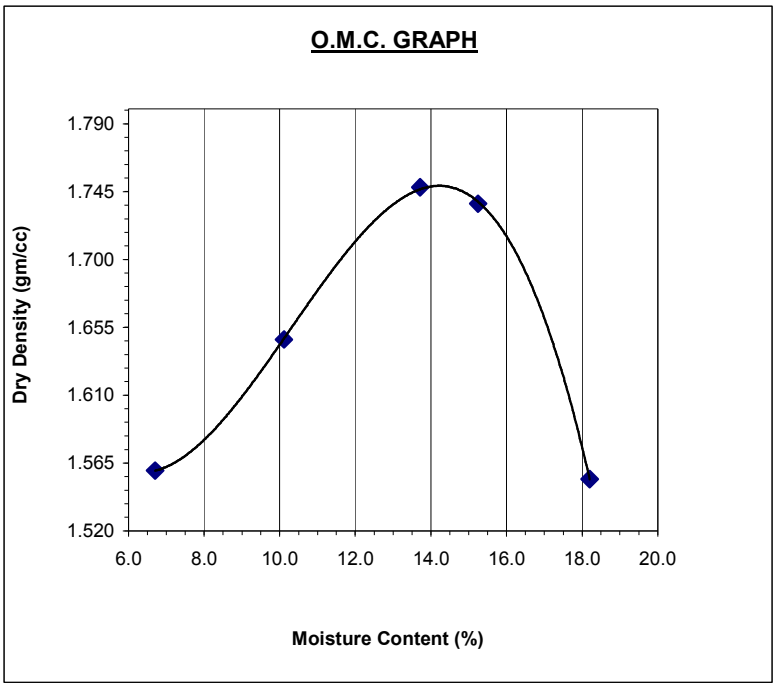


STANDARD PROCTOR TEST RESULTS.

PLT05 / DS02

Depth = 1.00m

Maximum Dry Density : 1.749 gm/cc
Optimum Moisture Content: 14.25 %

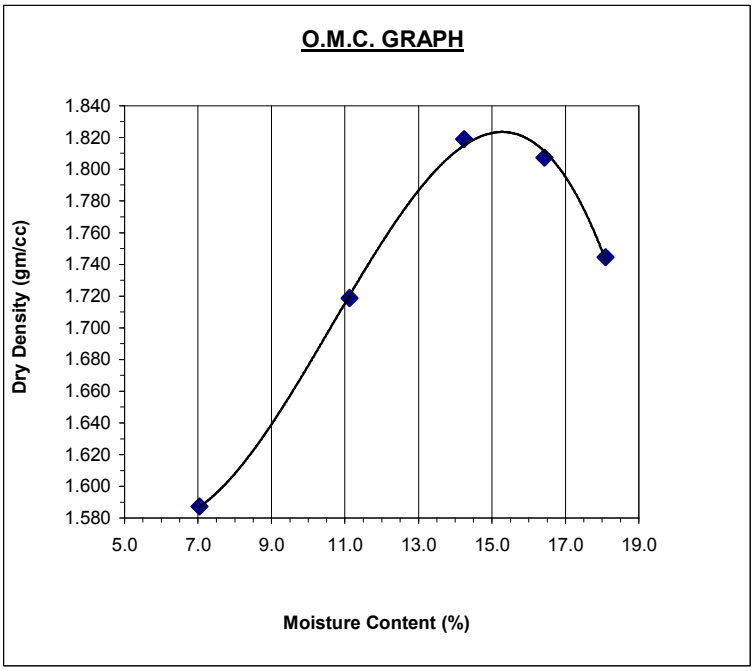


C.B.R. & STANDARD PROCTOR TEST RESULTS.

CPLT-01 / DS01

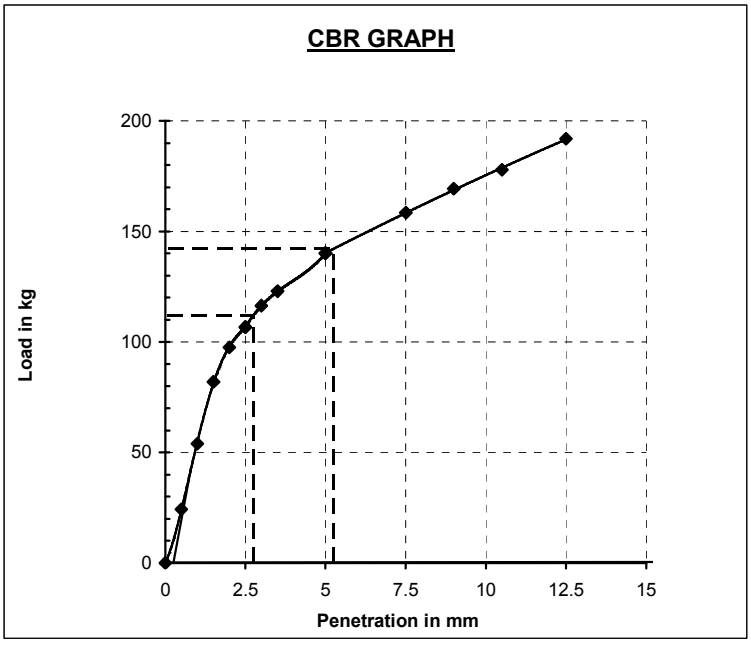
Depth = 1.00m

Maximum Dry Density : 1.822 gm/cc
Optimum Moisture Content: 15.32 %



TYPE :- SOAKED

Penetration (mm)	CBR (%)
2.5	8.16
5.0	6.92

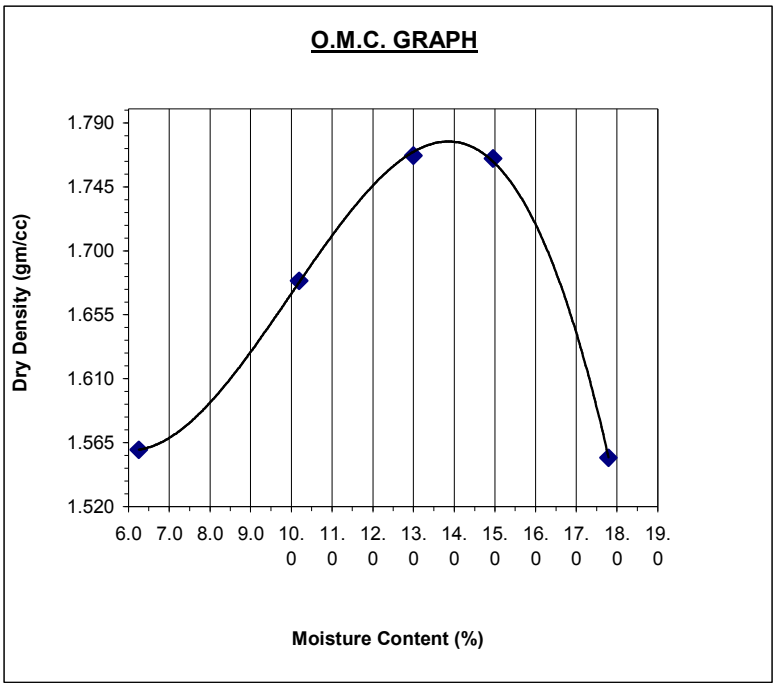


STANDARD PROCTOR TEST RESULTS.

CPLT01 / DS02

Depth = 2.00m

Maximum Dry Density : 1.777 gm/cc
Optimum Moisture Content: 13.85 %

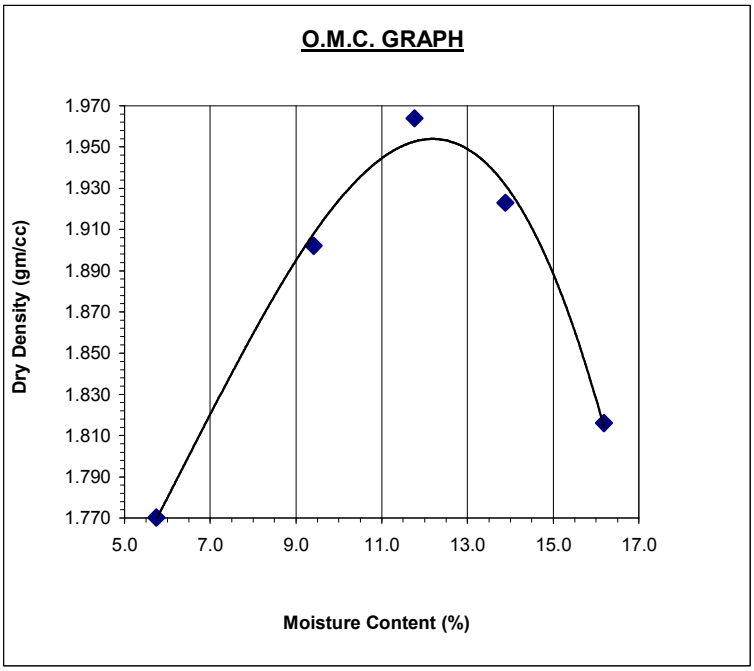


C.B.R. & MODIFIED PROCTOR TEST RESULTS.

CPLT-02 / DS02

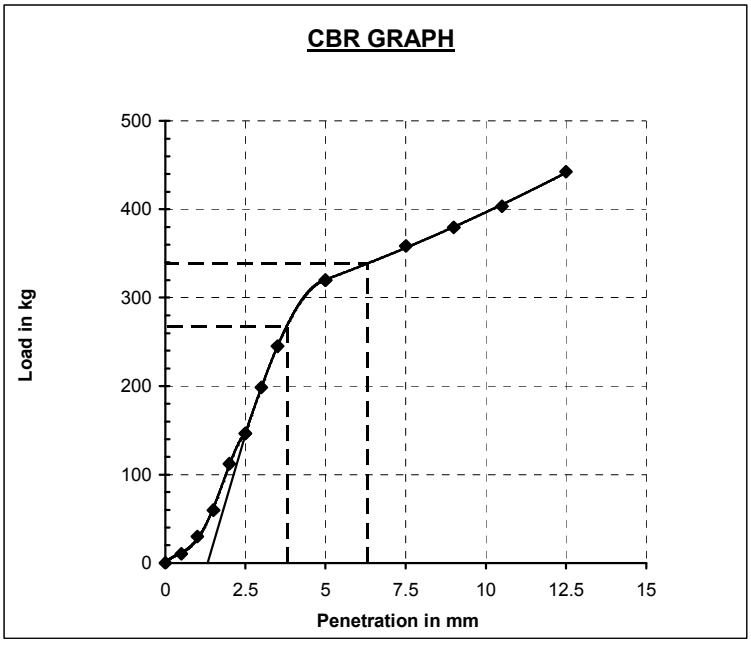
Depth = 2.00m

Maximum Dry Density : 1.954 gm/cc
Optimum Moisture Content: 12.20 %



TYPE :- SOAKED

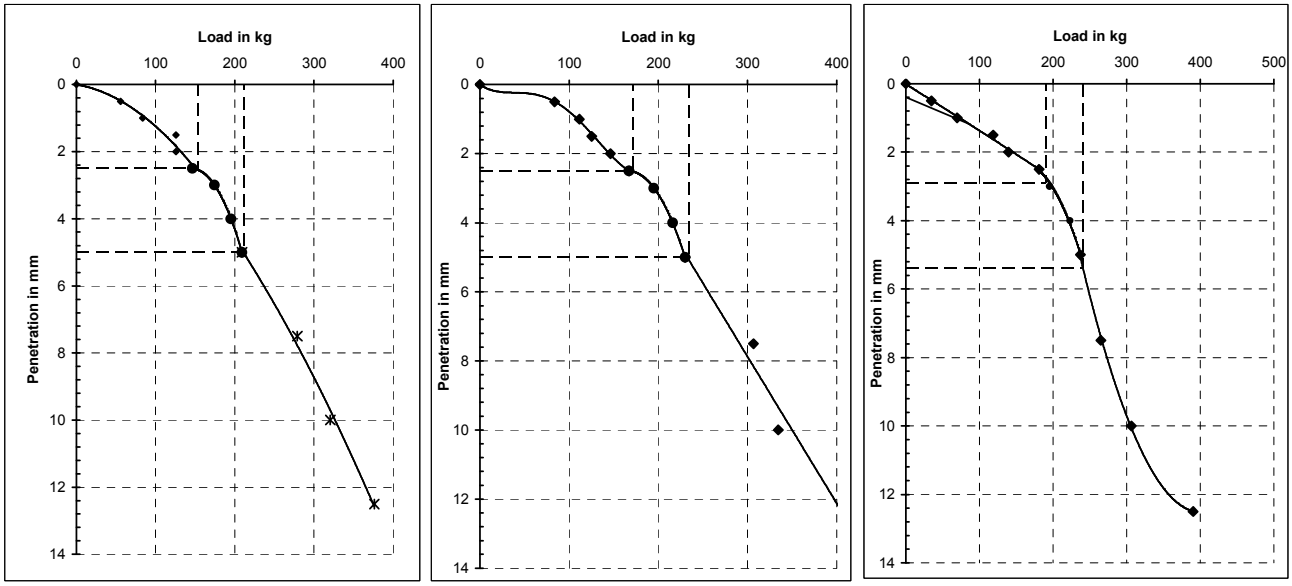
Penetration (mm)	CBR (%)
2.5	19.56
5.0	16.50



Load Penetration Curve of Field C.B.R. Test

Field CBR NO.-01 (Unsoaked)

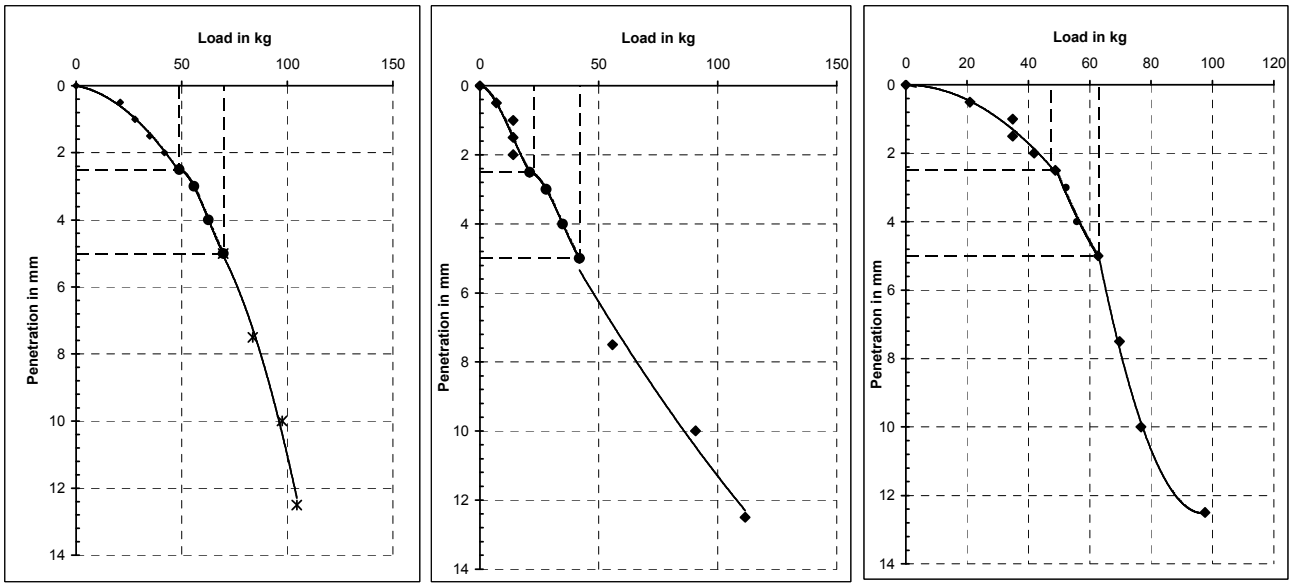
Test - 1		Test - 2		Test - 3	
Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)
2.5	11.21	2.5	12.49	2.5	13.89
5.0	10.31	5.0	11.41	5.0	11.71



Load Penetration Curve of Field C.B.R. Test

Field CBR NO.-01 (Soaked)

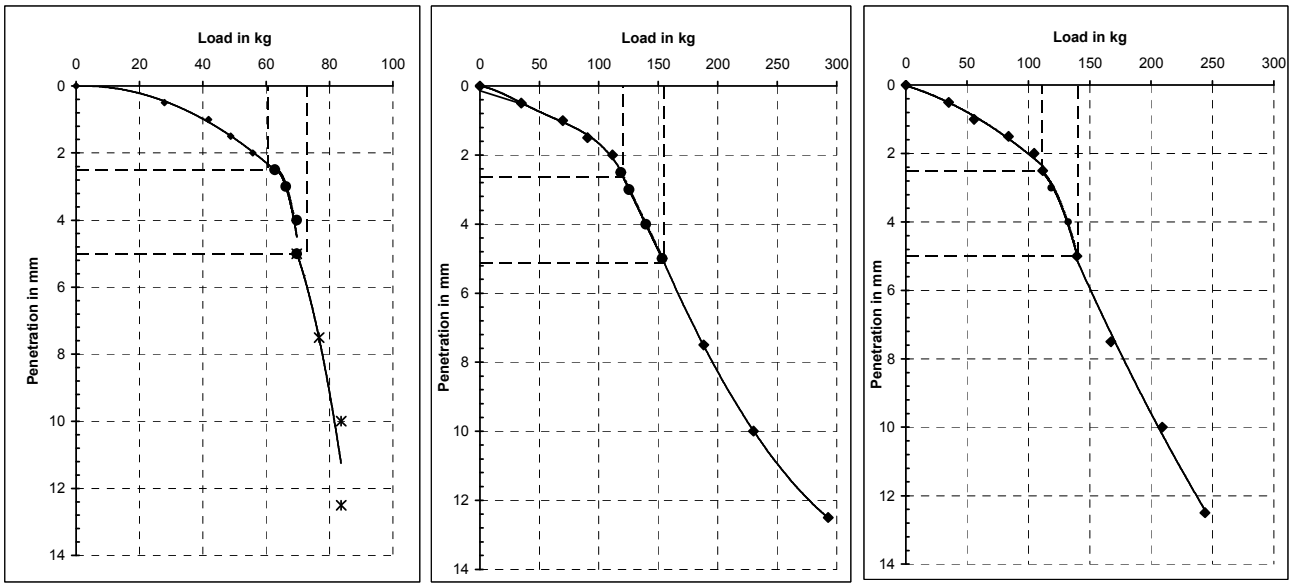
Test - 1		Test - 2		Test - 3	
Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)
2.5	3.57	2.5	1.65	2.5	3.46
5.0	3.41	5.0	2.05	5.0	3.06



Load Penetration Curve of Field C.B.R. Test

Field CBR NO.-02 (Unsoaked)

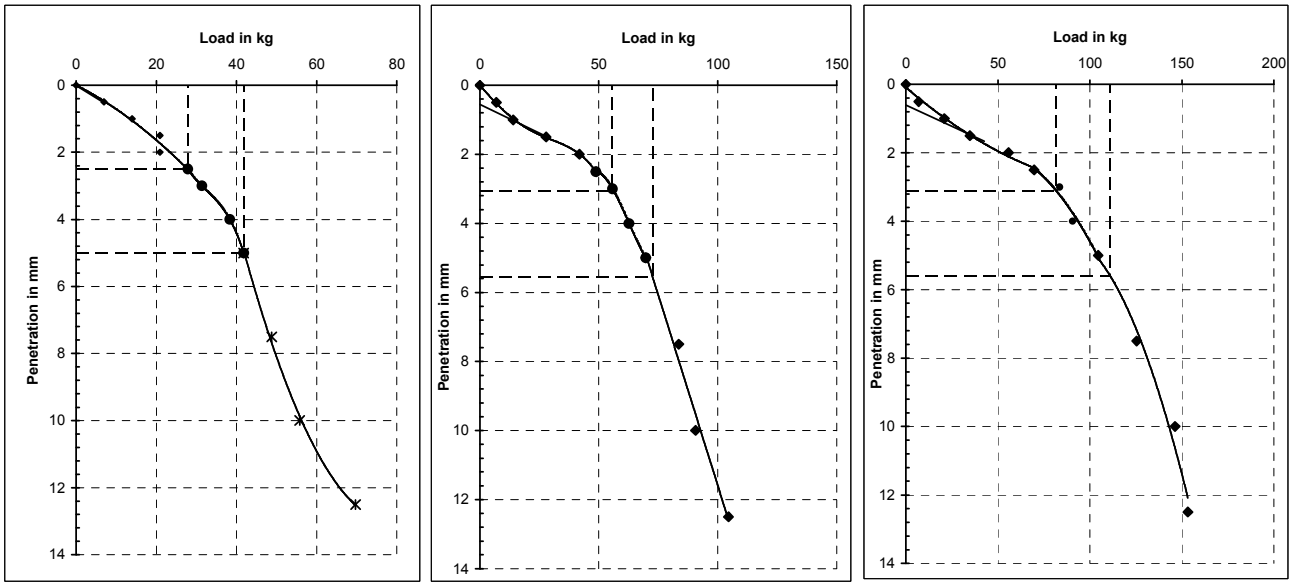
Test - 1		Test - 2		Test - 3	
Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)
2.5	4.42	2.5	8.79	2.5	8.12
5.0	3.54	5.0	7.55	5.0	6.84



Load Penetration Curve of Field C.B.R. Test

Field CBR NO.-02 (Soaked)

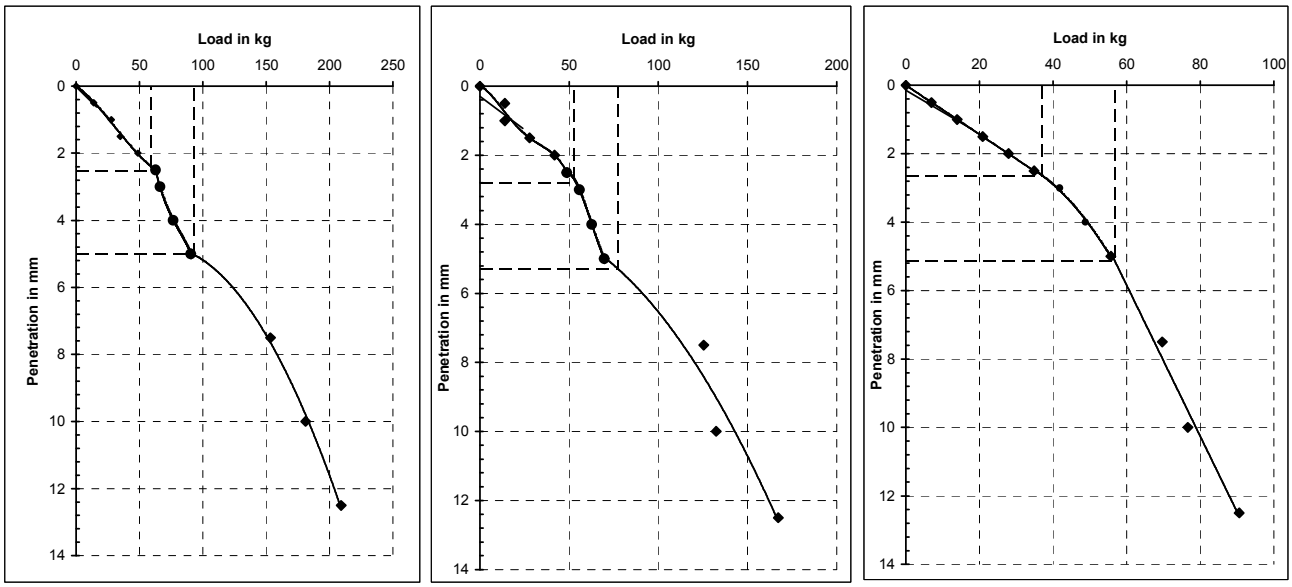
Test - 1		Test - 2		Test - 3	
Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)
2.5	2.04	2.5	4.06	2.5	5.97
5.0	2.04	5.0	3.54	5.0	5.41



Load Penetration Curve of Field C.B.R. Test

Field CBR NO.-03 (Unsoaked)

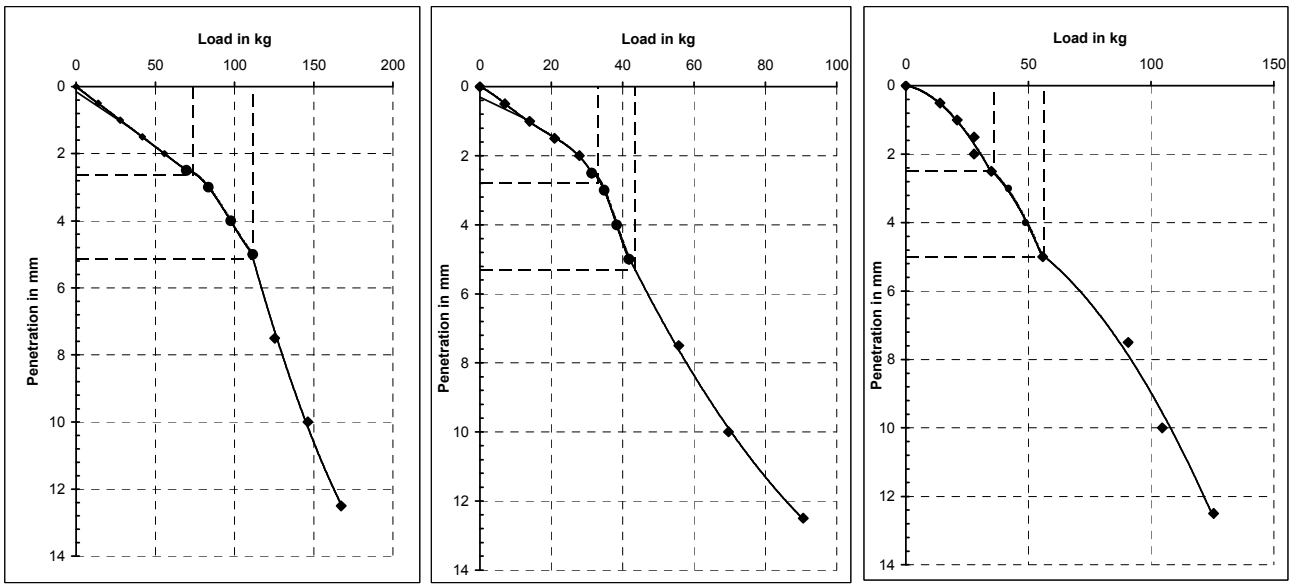
Test - 1		Test - 2		Test - 3	
Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)
2.5	4.29	2.5	3.84	2.5	2.70
5.0	4.51	5.0	3.78	5.0	2.77



Load Penetration Curve of Field C.B.R. Test

Field CBR NO.-03 (Soaked)

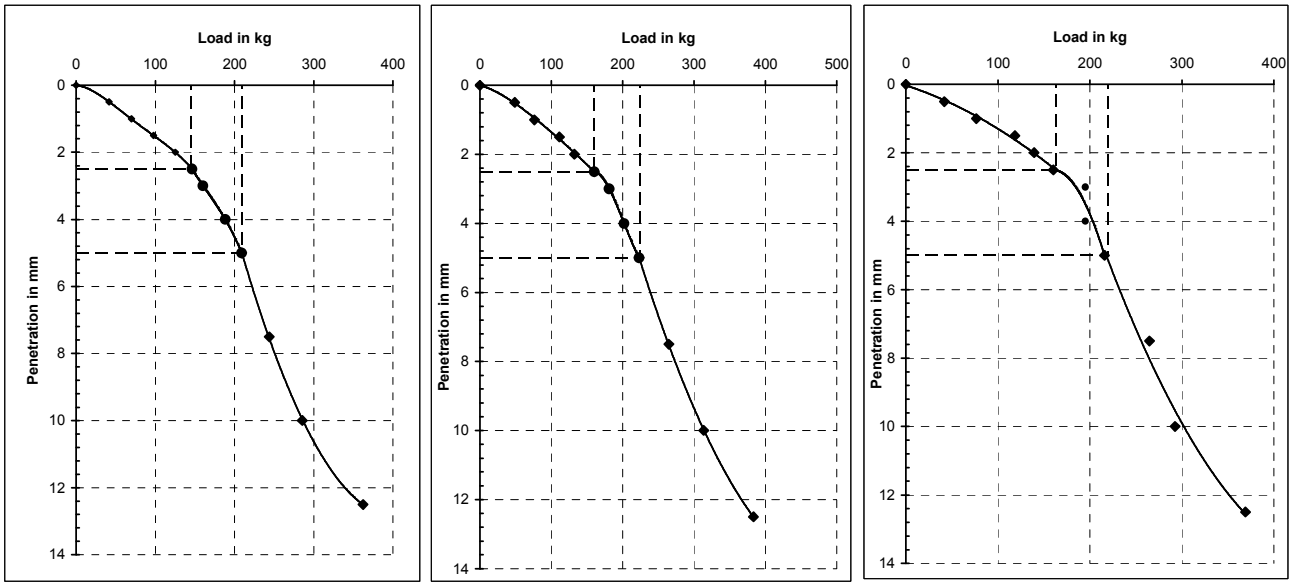
Test - 1		Test - 2		Test - 3	
Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)
2.5	5.39	2.5	2.42	2.5	2.63
5.0	5.44	5.0	2.12	5.0	2.73



Load Penetration Curve of Field C.B.R. Test

Field CBR NO.-04 (Unsoaked)

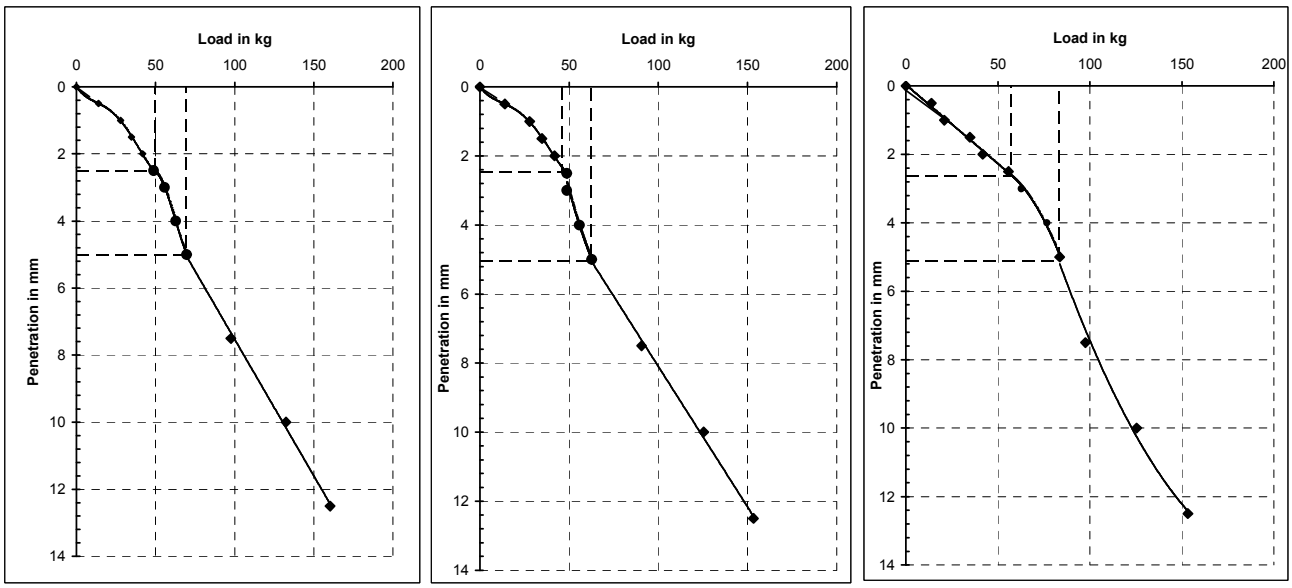
Test - 1		Test - 2		Test - 3	
Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)
2.5	10.55	2.5	11.64	2.5	11.94
5.0	10.19	5.0	10.90	5.0	10.69



Load Penetration Curve of Field C.B.R. Test

Field CBR NO.-04 (Soaked)

Test - 1		Test - 2		Test - 3	
Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)	Penetration (mm)	CBR (%)
2.5	3.60	2.5	3.36	2.5	4.17
5.0	3.36	5.0	3.04	5.0	4.05



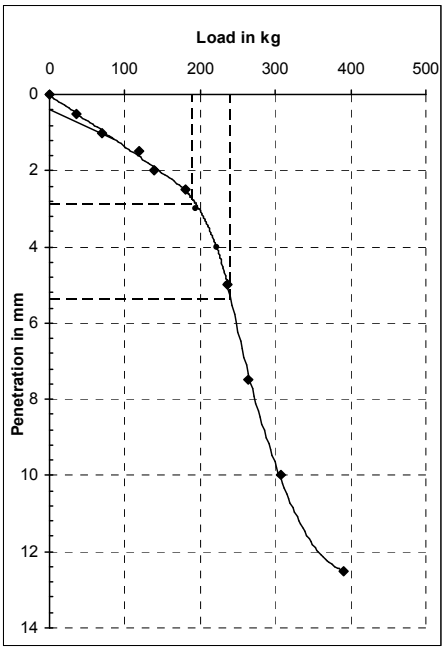
PART IV: SAMPLE CALCULATION

SAMPLE FIELD CBR CALCULATION

Test No. CBR-01
Depth: 0.50m
Description: Yellowish grey, silty sand / sandy silt.

Field CBR Test Results

CBR Type: *Unsoaked*		
Weight of Surcharge = 10 kg		
Proving Ring Constant = 6.97 kg/division		
Penetration (mm)	Proving Ring Reading	Load (in kg)
0	0.00	0.00
0.50	5.00	34.9
1.00	10.00	69.7
1.50	17.00	118.5
2.00	20.00	139.4
2.50	26.00	181.2
3.00	28.00	195.2
4.00	32.00	223.0
5.00	34.00	237.0
7.50	38.00	264.9
10.00	44.00	306.7
12.50	56.00	390.3



From graph,

Load for 2.50mm penetration = 190.3 kg
Hence CBR for 2.50mm penetration = (190.3 / 1370) x 100 = 13.89 %

Load for 5.00mm penetration = 240.7 kg
Hence CBR for 5.00mm penetration = (240.7 / 2055) x 100 = 11.71 %

IN-SITU PERMEABILITY TEST IN OVERBURDEN (FALLING HEAD METHOD)

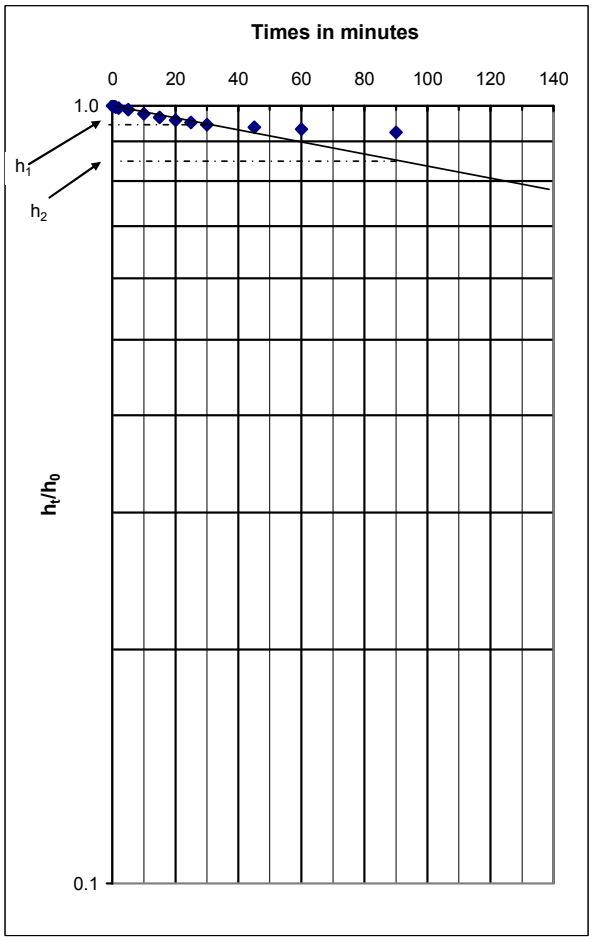
Test location	BH-31		
Ground elevation	79.905M	Static water level	26.00m below G.L.
Diameter of hole (2R)	174.0mm	Ht. of casing from GL	0.50m
Inner diameter of casing/ intake pipe (d)	150.0mm		
Depth tested	1.30m to 2.00m		
Length of test section (L)	0.70m		

Data sheet

Time interval (minute)	Water level in intake pipe (cm)	h_t (cm)	h_t/h_0
0	0.00	2650.000	1.0000
0.5	6.00	2644.000	0.9977
1	10.70	2639.300	0.9960
2	16.40	2633.600	0.9938
5	30.20	2619.800	0.9886
10	63.40	2586.600	0.9761
15	87.80	2562.200	0.9669
20	112.30	2537.700	0.9576
25	128.70	2521.300	0.9514
30	143.20	2506.800	0.9460
45	164.80	2485.200	0.9378
60	179.40	2470.600	0.9323
90	200.00	2450.000	0.9245
		2650.000	1.0000
		2650.000	1.0000
From the above Graph, We have			
h1	0.950	t1	30 min
h2	0.850	t2	90 min

$$K = \frac{d^2}{8L}\log_e \frac{L}{R}\frac{\log_e(h_1/h_2)}{t_2 - t_1}$$ 2.588E-05cm/sec

Time vs. h_t/h_0 plot



Legend: h_1 = head of water in the intake pipe at time t_1 above static water level,
h_2 = head of water in the intake pipe at time t_2 above static water level;
h_0 = depth of static water level at time t_0,
h_t = head of water in the intake pipe at any time t

PART V: PHOTOGRAPHS

SPEED CONTROL UNIT

Annexure -1

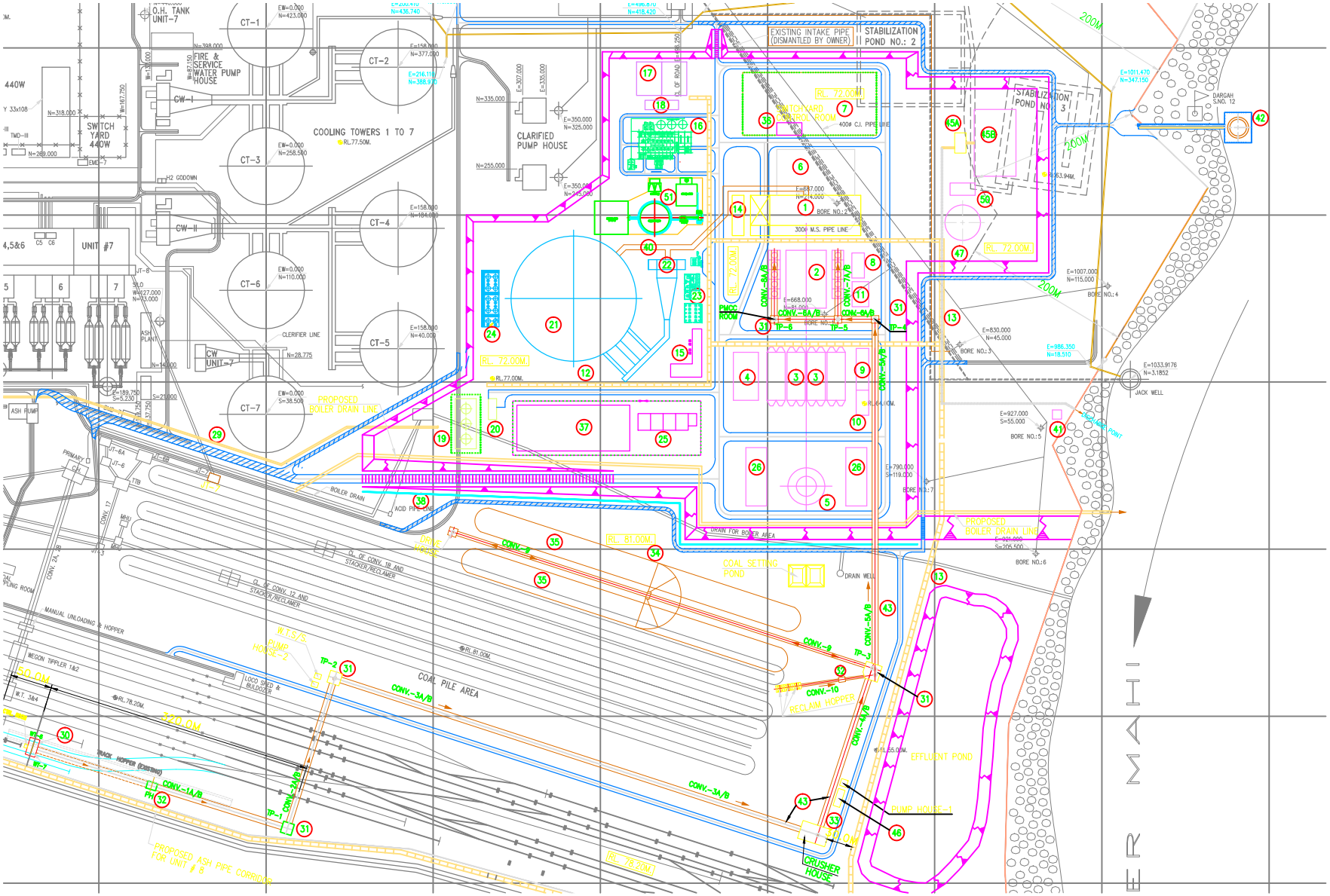
PERMISSIBLE LIMIT FOR CHEMICAL IN SOIL & WATER SAMPLE:

FOR SOIL SAMPLES:-

Permissible Limit (as per IS: 456 2000)	
pH value	6 to 9
Sulphate as SO_3 %	<0.2

FOR WATER SAMPLES:-

Permissible Limit (as per IS: 456 2000)	
pH value	6 to 9
Sulphate as (mg/litre)	400
Chloride as (mg/litre)	500
Organic matter (mg/litre)	200


O.H. TANK UNIT-7
FIRE & SERVICE WATER PUMP HOUSE
SWITCH YARD 440V
COOLING TOWERS 1 TO 7
CLARIFIED PUMP HOUSE
EXISTING INTAKE PIPE (DISMANTLED BY OWNER)
STABILIZATION POND NO.: 2
STABILIZATION POND NO.: 3
SWITCH YARD CONTROL ROOM
UNIT #7
CW UNIT-7
ASH PLANT
ASH PUMP
PROPOSED BOILER DRAIN LINE
BOILER DRAIN
ACID PIPE LINE
DRAIN FOR BOILER AREA
COAL SETTING POND
DRAIN WELL
COAL PILE AREA
MANUAL UNLOADING HOPPER
MEGON TIPPLER 1&2
TRACK HOPPER (EXISTING)
W.T.S/S. PUMP HOUSE-2
RECLAIM HOPPER
EFFLUENT POND
PUMP HOUSE-1
CRUSHER HOUSE
PROPOSED ASH PIPE CORRIDOR FOR UNIT # 8
JACK WELL
DARGAH S.NO. 12
PMCC ROOM
3000 M.S. PIPE LINE
400ø C.I. PIPE LINE
CONV.-1A/B
CONV.-2A/B
CONV.-3A/B
CONV.-4A/B
CONV.-5A/B
CONV.-6A/B
CONV.-7A/B
CONV.-8
CONV.-9
CONV.-10
TP-1
TP-2
TP-3
TP-5
TP-6
RL. 72.00M.
RL. 81.00M.
RL. 78.20M.
RL. 55.00M.
200M
EASTERN MAIN

DRAWING NO. PE-DC-408-607-C003
FIRST ANGLE PROJECTION
ALL DIMENSIONS ARE IN MM
CUSTOMER'S DRAWING NO.
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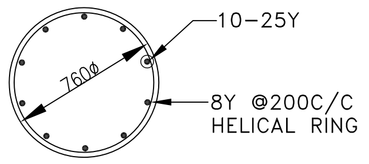
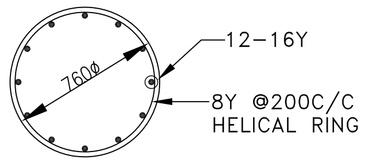
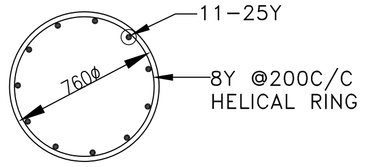


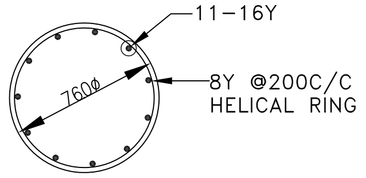
SECTION A-A



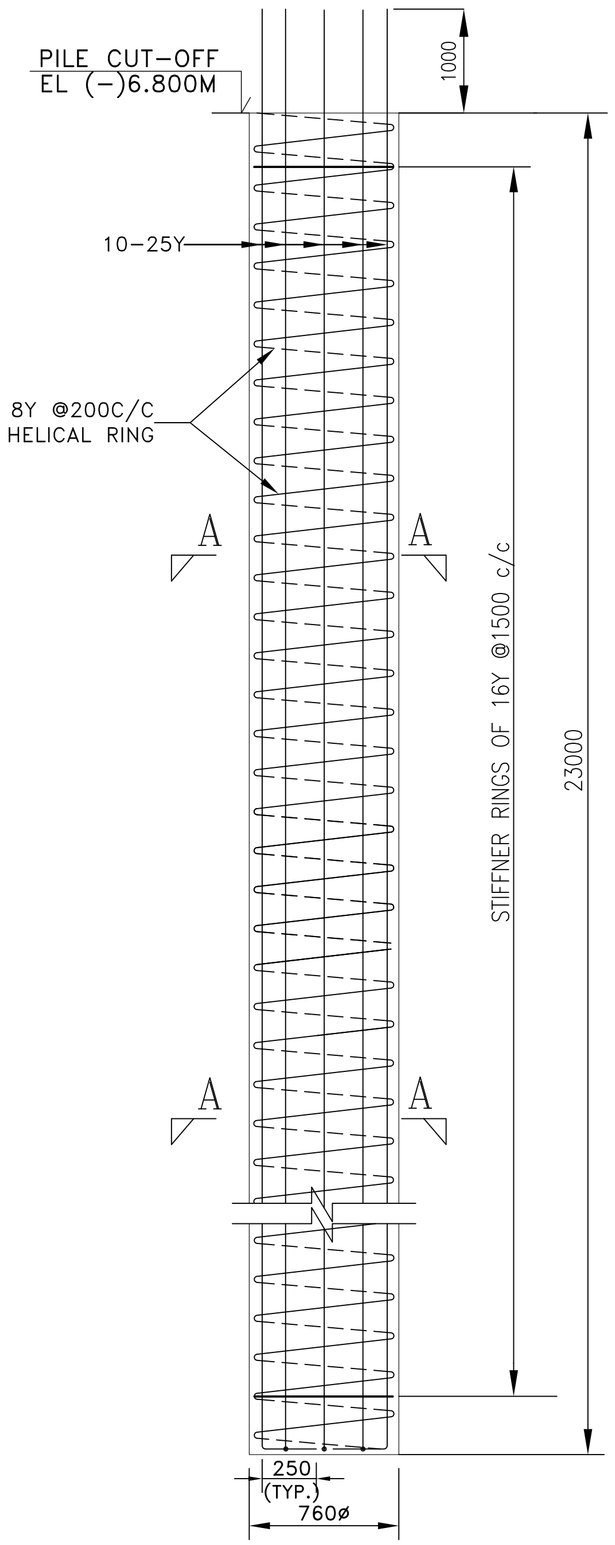
SECTION B-B



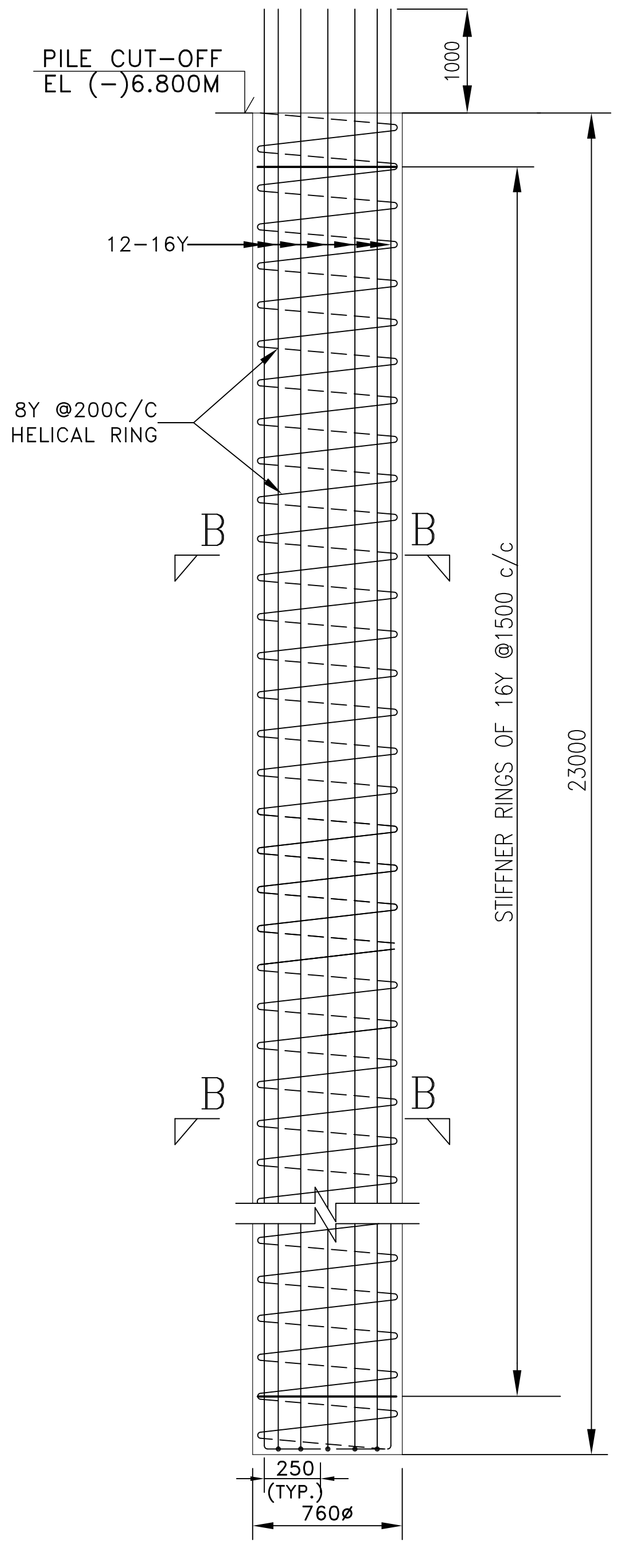
SECTION C-C



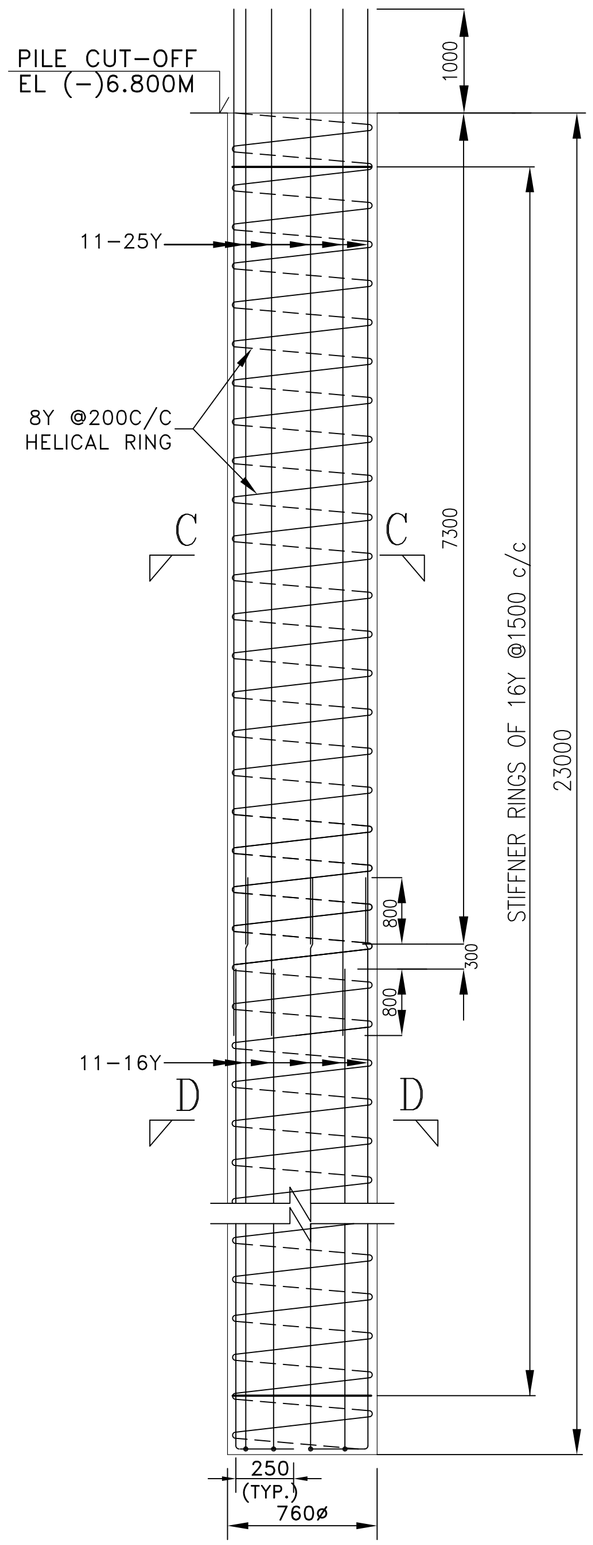
SECTION D-D



FOR VERTICAL COMPRESSION



FOR PULL-OUT



FOR LATERAL LOAD

REINFORCEMENT DETAILS OF 760MM DIAMETR INITIAL LOAD TEST PILES

LOCATION OF TEST PILE (REF.NOTE-13)

TEST NO.	COORDINATES		DIA OF PILE (MM)	REMARKS
TPH1	549 E	43 S	760	TPH-TEST PILE FOR LATERAL LOAD TPV-TEST PILE FOR VERTICAL COMPRESSION TPP-TEST PILE FOR PULL-OUT
TPV1	549 E	38 S		
TPP1	549 E	33 S		
TPH2	692 E	62 N	760	
TPV2	692 E	67 N		
TPP2	692 E	72 N		
TPH3	739 E	137 N	760	
TPV3	739 E	142 N		
TPP3	739 E	147 N		

SAFE LOAD CARRYING CAPACITY OF PILE

DIAMETER OF PILE (MM)	SAFE LOAD (MT)		
	VERTICAL COMPRESSION	PULL OUT	HORIZONTAL
760	200	40	9.8

NOTES:

1. ALL DIMENSIONS ARE IN MM AND ELEVATION/LEVEL ARE IN METER UNLESS NOTED OTHERWISE.
2. EL.(±) 0.00M CORRESPONDS TO R.L. (+) 72.30M.
3. BORED CAST-IN-SITU CONCRETE PILE CONFORMING TO IS:2911 (PART-1/SEC.-2) SHALL BE USED.
4. GRADE OF CONCRETE SHALL BE M25 CONFORMING TO IS:456 WITH MINIMUM CEMENT CONTENT OF 400 KG/M^3. ORDINARY PORTLAND CEMENT SHALL BE USED.
5. REINFORCEMENT STEEL SHALL BE HIGH STRENGTH DEFORMED TMT STEEL BARS OF GRADE Fe 500D CONFORMING TO IS:1786.
6. LAP LENGTH SHALL BE 50 TIMES DIAMETER OF BAR. LAPS SHALL BE STAGGERED ALTERNATIVELY.
7. CLEAR COVER TO LONGITUDINAL REINFORCEMENT SHALL BE 60MM.
8. INITIAL LOAD TEST SHALL BE CONDUCTED UPTO A MAXIMUM TEST LOAD OF TWO AND HALF TIMES THE SAFE LOAD CARRYING CAPACITY OF PILE. VERTICAL COMPRESSION TEST SHALL BE CARRIED OUT BY CYCLIC LOAD METHOD AS PER IS:2911 PART IV.
9. TEST SHALL BE CONDUCTED AT PILE CUT-OFF LEVEL.
10. CONCRETE SHALL BE CAST TO THE PILING PLATFORM LEVEL TO PERMIT OVERFLOW OF CONCRETE FOR VISUAL INSPECTION OR TO A MINIMUM OF 1000MM ABOVE CUT OFF LEVEL.
11. TEST RESULTS SHALL BE SUBMITTED TO OWNER/OWNER'S CONSULTANT/BHEL-PEM IMMEDIATELY AFTER COMPLETION OF THE SAME.
12. TREMIE CONCRETING SHALL BE ADOPTED.
13. TEST PILE LOCATIONS ARE INDICATIVE ONLY. MINOR MODIFICATIONS (IF REQUIRED) IN TEST LOCATIONS MAY BE DONE AT SITE IN CONSULTATION WITH OWNER.
14. LOW STRAIN PILE INTEGRITY TEST SHALL BE CARRIED OUT ON ALL TEST PILES AS PER SPECIFICATION.

REFERENCE:

1. REPORT ON GEOTECHNICAL INVESTIGATION WORK FOR 1x800MW WANAKBORI TPS, GUJARAT.
2. CUSTOMER'S TECHNICAL SPECIFICATION.
3. DRAWING NO. PE-DG-408-100-M001 TITLED, "PLOT PLAN".
4. DOCUMENT NO. PE-DC-408-607-C003 TITLED "DESIGN CALCULATION FOR 760MM DIAMETER INITIAL LOAD TEST PILES FOR MAIN PLANT AREA."

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

DEVELOPMENT CONSULTANTS PVT. LTD.
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KOLKATA · MUMBAI · CHENNAI · NEW DELHI

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NEW DELHI

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W.R.T.				
REV	DATE	ALT'D	CHD	APP'D

DEPT CODE		NAME	SIGN	DATE
C	DRN	S.ND	-sd-	16/02/15
	DES	V.K.	-sd-	16/02/15
	CHD	V.V/TMSR	-sd-	16/02/15
	APP'D	GM	-sd-	16/02/15

TITLE: R/C DETAILS OF 760MM DIAMETER INITIAL LOAD TEST PILE FOR MAIN PLANT AREA

DEPT. | SCALE | DRAWING NO. PE-DG-408-607-C003
SIGN
DATE
SHEET 1 OF 1 | REV 00
Feb 16, 2015 - 5:49pm
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DRAWING NO. PE-DG-408-607-C002
FIRST ANGLE PROJECTION
ALL DIMENSIONS ARE IN MM
CUSTOMER'S DRAWING NO.
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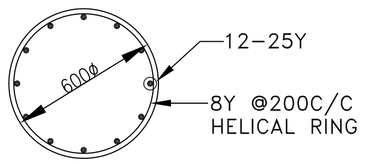

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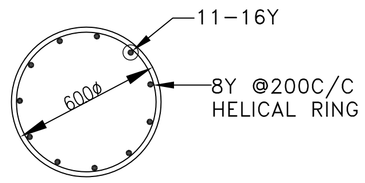

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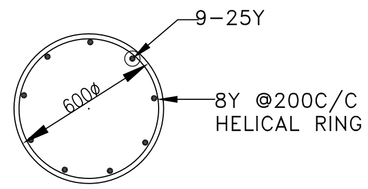

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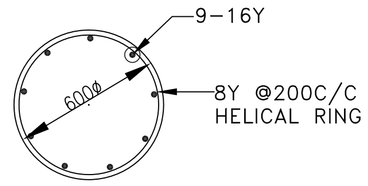

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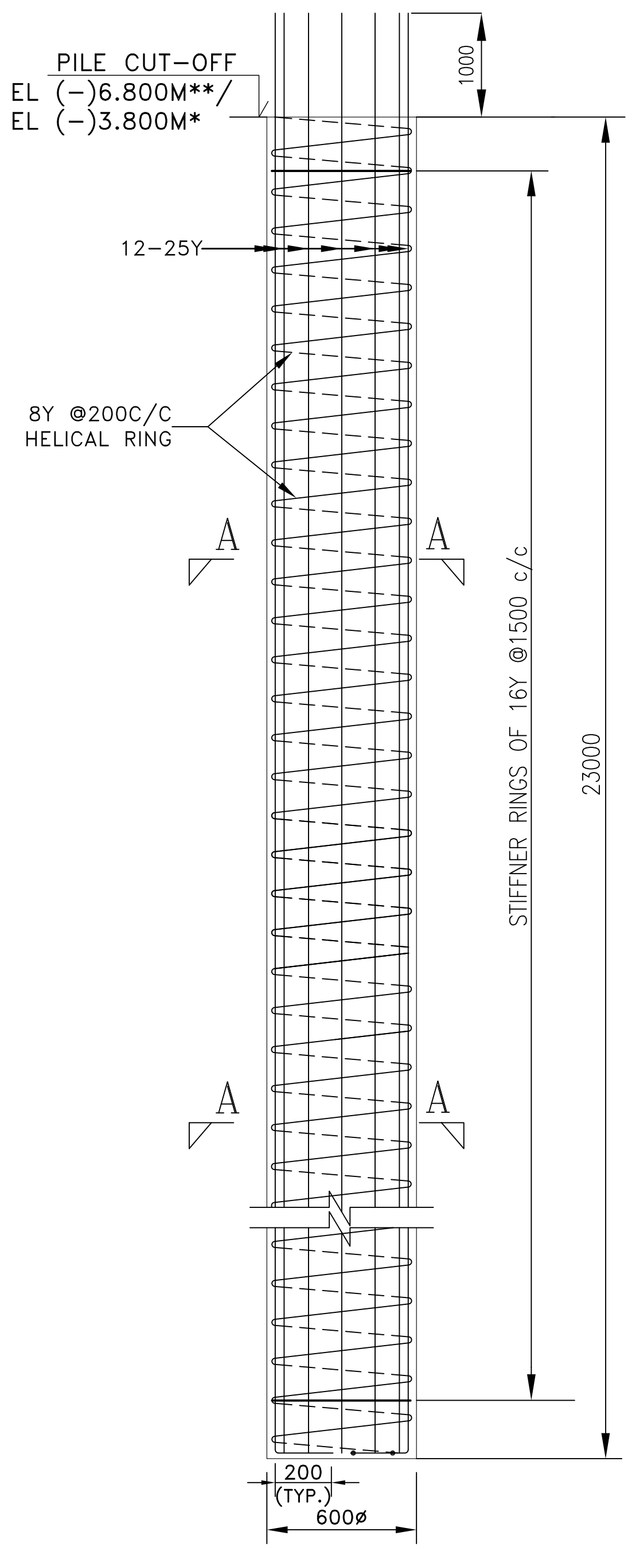
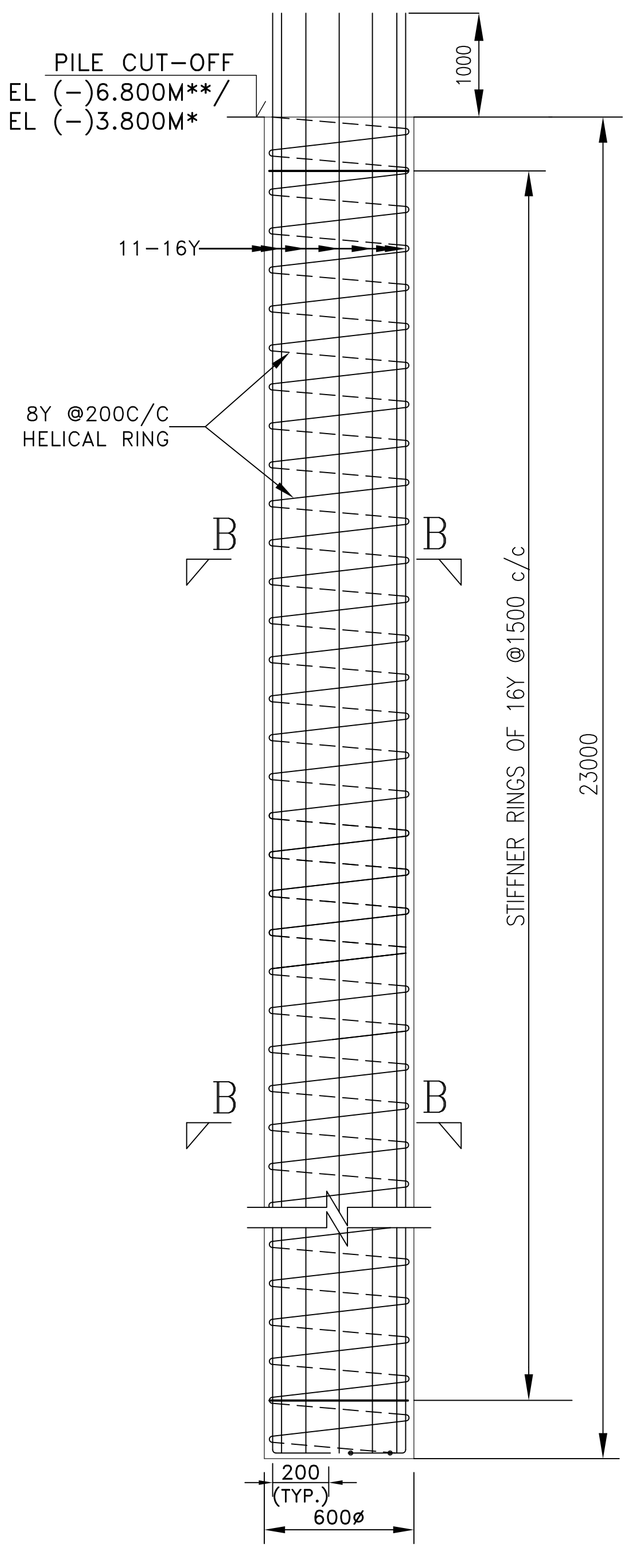
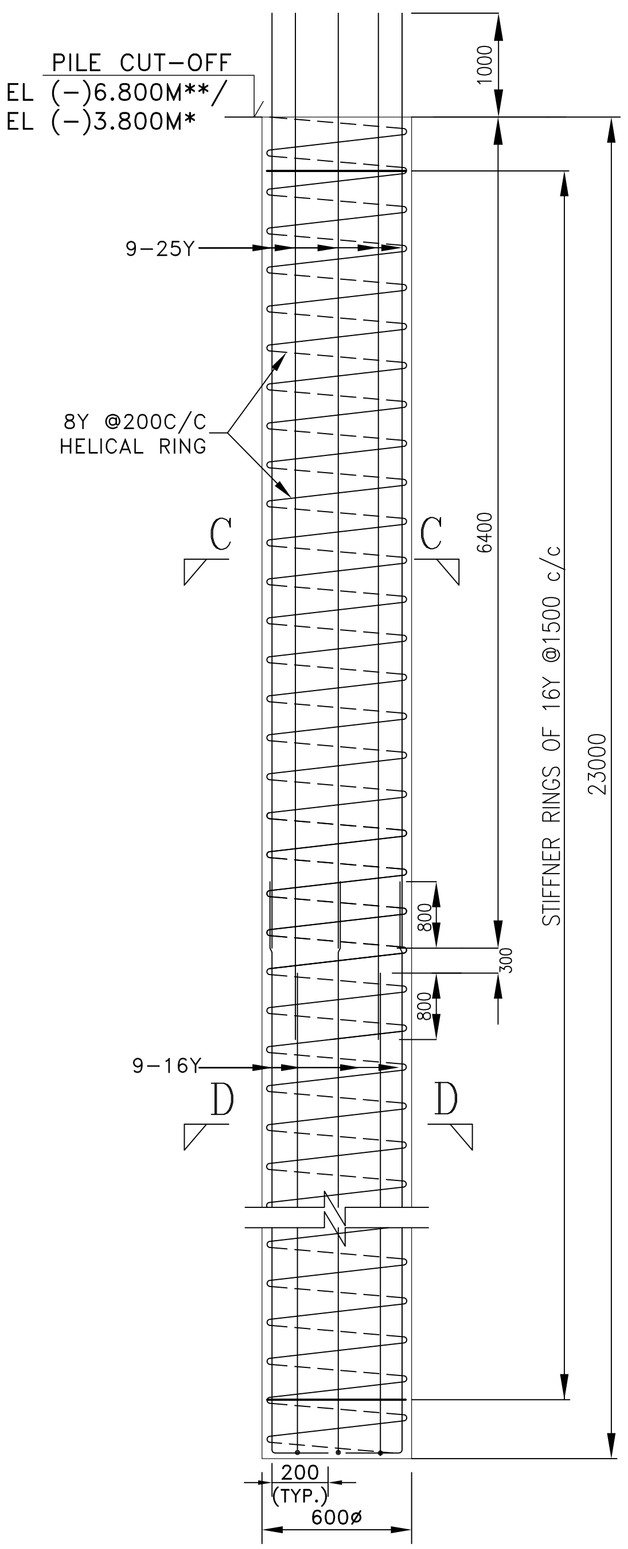


FOR VERTICAL COMPRESSION



FOR PULL-OUT



FOR LATERAL LOAD

* FOR BOP AREA, ** FOR MAIN PLANT AREA

REINFORCEMENT DETAILS OF 600MM DIAMETR INITIAL LOAD TEST PILES

LOCATION OF TEST PILE (REF.NOTE-13)

TEST AREA	TEST NO.	COORDINATES		DIA OF PILE (MM)	REMARKS
*BOP AREA CUT-OFF LVL EL(-)3.800M	TPH1	499 E	329 N	600	TPH-TEST PILE FOR LATERAL LOAD TPV-TEST PILE FOR VERTICAL COMPRESSION TPP-TEST PILE FOR PULL-OUT
	TPV1	504 E	329 N		
	TPP1	509 E	329 N		
**MAIN PLANT AREA CUT-OFF LVL EL(-)6.800M	TPH2	587 E	69 N	600	
	TPV2	587 E	74 N		
	TPP2	587 E	79 N		
	TPH3	636 E	95 S	600	
	TPV3	641 E	95 S		
	TPP3	646 E	95 S		

SAFE LOAD CARRYING CAPACITY OF PILE

DIAMETER OF PILE (MM)	SAFE LOAD (MT)		
	VERTICAL COMPRESSION	PULL OUT	HORIZONTAL
600	150	35	7.0

NOTES:

1. ALL DIMENSIONS ARE IN MM AND ELEVATION/LEVEL ARE IN METER UNLESS NOTED OTHERWISE.
2. EL.(±) 0.00M CORRESPONDS TO R.L. (+) 72.30M.
3. BORED CAST-IN-SITU CONCRETE PILE CONFORMING TO IS:2911 (PART-1/SEC.-2) SHALL BE USED.
4. GRADE OF CONCRETE SHALL BE M25 CONFORMING TO IS:456 WITH MINIMUM CEMENT CONTENT OF 400 KG/M^3. ORDINARY PORTLAND CEMENT SHALL BE USED.
5. REINFORCEMENT STEEL SHALL BE HIGH STRENGTH DEFORMED TMT STEEL BARS OF GRADE Fe 500D CONFORMING TO IS:1786.
6. LAP LENGTH SHALL BE 50 TIMES DIAMETER OF BAR. LAPS SHALL BE STAGGERED ALTERNATIVELY.
7. CLEAR COVER TO LONGITUDINAL REINFORCEMENT SHALL BE 60MM.
8. INITIAL LOAD TEST SHALL BE CONDUCTED UPTO A MAXIMUM TEST LOAD OF TWO AND HALF TIMES THE SAFE LOAD CARRYING CAPACITY OF PILE. VERTICAL COMPRESSION TEST SHALL BE CARRIED OUT BY CYCLIC LOAD METHOD AS PER IS:2911 PART IV.
9. TEST SHALL BE CONDUCTED AT PILE CUT-OFF LEVEL.
10. CONCRETE SHALL BE CAST TO THE PILING PLATFORM LEVEL TO PERMIT OVERFLOW OF CONCRETE FOR VISUAL INSPECTION OR TO A MINIMUM OF 1000MM ABOVE CUT OFF LEVEL.
11. TEST RESULTS SHALL BE SUBMITTED TO OWNER/OWNER'S CONSULTANT/BHEL-PEM IMMEDIATELY AFTER COMPLETION OF THE SAME.
12. TREMIE CONCRETING SHALL BE ADOPTED.
13. TEST PILE LOCATIONS ARE INDICATIVE ONLY. MINOR MODIFICATIONS (IF REQUIRED) IN TEST LOCATIONS MAY BE DONE AT SITE IN CONSULTATION WITH OWNER.
14. LOW STRAIN PILE INTEGRITY TEST SHALL BE CARRIED OUT ON ALL TEST PILES AS PER SPECIFICATION.

REFERENCE:

1. REPORT ON GEOTECHNICAL INVESTIGATION WORK FOR 1x800MW WANAKBORI TPS, GUJARAT.
2. CUSTOMER'S TECHNICAL SPECIFICATION.
3. DRAWING NO. PE-DG-408-100-M001 TITLED, "PLOT PLAN".
4. DOCUMENT NO. PE-DC-408-607-C002 TITLED "DESIGN CALCULATION FOR 600MM DIAMETER INITIAL LOAD TEST PILES FOR MAIN PLANT / BOP AREA."

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT
1x800 MW Wanakbori Thermal Power Station Extn. Unit-8

JOB NO. 408
STATUS CONTRACT
DISTRIBUTION

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CONSULTING ENGINEERS
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BHARAT HEAVY ELECTRICALS LTD
POWER GROUP
PROJECTS ENGINEERING MANAGEMENT
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DRN	S.KS	-sd-	17/02/15
DESN	V.K.	-sd-	16/02/15
CHD	V.V.THAKUR	-sd-	16/02/15
APPD	DPK	-sd-	16/02/15

TITLE
R/C DETAILS OF 600MM DIAMETER INITIAL LOAD TEST PILE FOR MAIN PLANT / BOP AREA

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