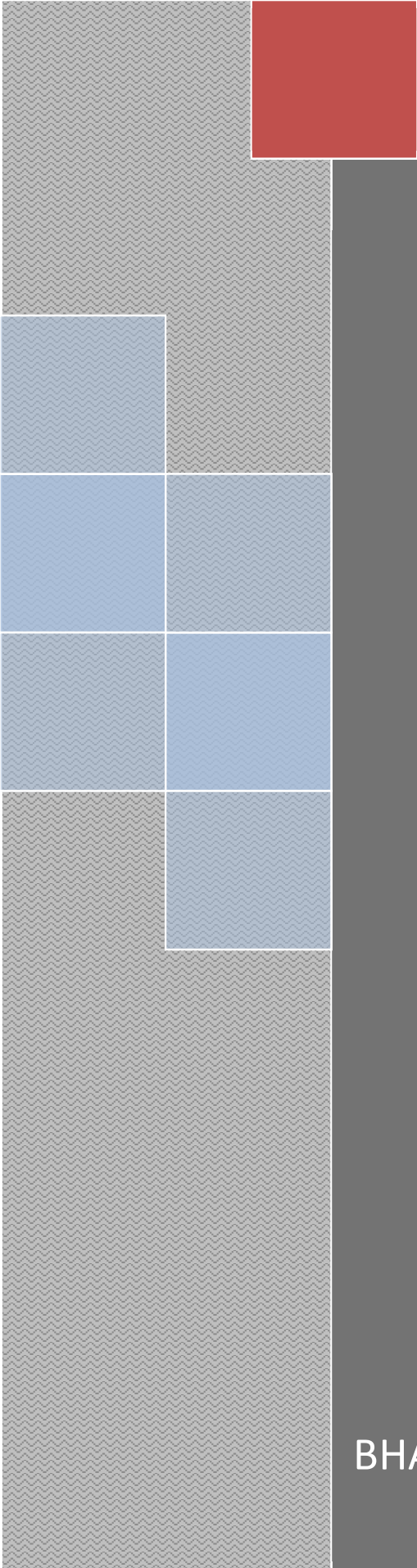




VOLUME - IA TECHNICAL CONDITIONS OF CONTRACT (TCC)

BHARAT HEAVY ELECTRICALS LIMITED



TECHNICAL CONDITIONS OF CONTRACT (TCC)

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Chapter-I Project Information

1.0 Project Information (2x4 MLD Sewage Treatment Plat)			
1	Customer	:	Bharat Heavy Electricals Limited, HPEP, R.C. Puram, Hyderabad - 502032
2	Project Title	:	Civil, structural & Architectural works, rerouting of sewer lines, connection pipeline of factory & township sewage & permeate pipeline to Lake for 2x4 MLD Sewage Treatment Plant
3	Location	:	BHEL Township, R.C. Puram, Hyderabad
4	Address Detail	:	BHEL Township, R.C. Puram, Near Petrol Pump, Hyderabad-502032
5	Nearest Railway Station	:	Lingampally, MMTS station/ Secunderabad/ Nampally station
6	Road Approach	:	Mumbai Highway
7	Nearest Air Port	:	Hyderabad
11	Ambient Air Temperature (Average)	:	a) Maximum : 16 ^o C b) Minimum : 39 ^o C
12	Average Relative Humidity	:	23-95 %
13	Climatic Condition	:	Tropical Climate

Bidder is advised to visit the project site and appraise himself about the local conditions and infrastructure available in the area for fulfilling their commitments under the contract. BHEL will not admit any claims whatsoever on account of Contractor's non-familiarization of local conditions.

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Chapter-II Scope of Works

2.0 SCOPE OF WORK

This section list major scope of work for civil, structural & Architectural works for 2x4 MLD Sewage Treatment Plant for BHEL Township, R.C. Puram, Hyderabad to be carried out by contractor, but not limited to following for safe, speedy completion of this package.

2.1 The work to be performed under the scope of this tender mainly consists of but not limited to complete Civil , Structural and Architectural work and their maintenance for specified period of the following plant buildings, structural equipment foundations and other miscellaneous structures.

2.1.1 Plant Buildings:-

- i. Blower Room
- ii. MBR Building
- iii. DG room
- iv. Shed for centrifuge
- v. Any other building/shed which may be introduced with revision in drawing at a later date

2.1.2 Equipment foundations/Tank foundations:-

- a) DAF feed pumps
- b) Air blower
- c) DAF recirculation pumps
- d) DAF Air compressor
- e) Air compressor
- f) Coagulant dosing system
- g) Polymer dosing system
- h) Oil & grease skimmer
- i) Equilisation tank transfer pumps
- j) Mixing blower
- k) Polymer dosing system
- l) Centrifuge
- m) Screw pump
- n) Auto Drum screen
- o) Coagulant dosing system
- p) Anoxic tank mixer
- q) Process blowers
- r) UF permeate/ backpulse pumps
- s) RAS pumps
- t) Membrane aeration blowers
- u) Sodium hypochlorite dosing system
- v) Citric acid dosing system
- w) Sodium hypochlorite dosing system
- x) DAF Floating Oil Collection Chamber Steel Tank
- y) Backpulse tank

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Chapter-II Scope of Works

- z) UF membrane cassettes
- aa) Any other foundation which may be introduced a later date

2.1.3 Reservoirs/Storage Tanks/Pits/Underground Structures

1. Pits, Manholes
2. Industrial equalization tank, coarse screen chambers(manual and auto), grit chamber
3. DAF system tank
4. Equalisation tank, Sludge holding tank, Oil & Grease screen, Grit chamber 3 and Manual screens
5. Aerobic/Bioreactor splitter channel
6. Anoxic tank
7. Aerobic/Bioreactor tank
8. Membrane tank splitter channel
9. Membrane Tank
10. RCC Reservoir for permeate water
11. RCC Overhead Tank for distribution
12. Any other structure which may be introduced with revision in drawing at a later date

2.1.4 Services:-

- a) Storm water drains.
- b) Concrete paving.
- c) Pipe trenches & Cable trenches within the boundary.
- d) Pipelines for connecting STP with (i) Factory effluents, (ii)Township effluents
- e) Rerouted piping for sewage
- f) Permeate water distribution

2.1.5 Miscellaneous:-

Culverts, thrust blocks etc., shall be provided as per requirement.

2.1.6 Terminal Points:-

- a) Strom water drains shall be connected to main road drains (if any) or left outside plant boundary limit.
- b) All Pipe trenches, Cable Trenches, etc. shall be terminated at boundary limit.

2.1.7 Exclusions:-

- a) Dismantling of existing pipeline
- b) Dismantling and relaying of roads at crossings

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Chapter-II Scope of Works

2.1.8 GENERAL

2.1.8.1 The drawings enclosed with this tender are intended to give the tenderer a general idea of the type and extent of work involved. The drawings are as such only indicative and not to be considered as the exact construction drawings.

Further this is to be noted that the drawings and the documents furnished along with this specification are the sole property of BHEL. It must not be used directly or indirectly in any way detrimental to the interest of the company.

2.1.8.2 The scope of work will also include such other related works although they may not be specifically mentioned in the above paragraph and all such incidental items not specified but reasonably imply and necessary for completion of the job as a whole all as desired and as directed by the engineer.

2.1.8.3 The detail scope of work covered above is not a comprehensive list of items of work involved. The detail scope of work may vary considerably depending on the actual construction requirements.

2.1.9 ALSO INCLUDED IN THE SCOPE

Unless otherwise specified, the work to be provided by the contractor for the items mentioned in the “Schedule of items”, shall include but not be limited to the following.

2.1.9.1 Furnishing all labour, materials, supervision, construction plans, equipment, supplies, transport, to and from the site, fuel, electricity, compressed air, water, transit and storage insurance and all other incidental items and temporary works not shown on specified but reasonably implied or necessary for the proper completion, maintenance and handling over the works, except in accordance with the stipulations laid down in the contract documents and additional stipulations as may be provide by the engineer during the course of works.

2.1.9.2 Furnishing samples of all materials required by the engineers for testing/inspection and approval for use in the works. The samples may be retained by the engineer for final incorporation in the works.

2.1.9.3 Furnishing test reports for the products used or intended to be used, if called for the specifications or if so desired by the engineer.

2.1.9.4 Giving all notices, paying all fees, taxes etc., in accordance with the general conditions of contract, that are required for all works including temporary works.

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Chapter-II Scope of Works

2.1.9.5 Arranging manufacturer's supervision for items of work done as per manufacturer's specifications when so specified.

2.1.9.6 Carrying out topographic survey of the entire and establish levels and coordinates at suitable intervals from existing grid levels and coordinates furnished by the owner established bench marks, setting out the locations and levels of proposed structures, constructions and marking of reference pillars and other identification works etc., The contractor shall provide the owner/BHEL such a assistance, instruments, machines, labour and materials as are normally required for examining, measuring and testing any work and the quality, weight or quantity of any material used.

2.1.9.7 Providing all incidental items not shown or specified but reasonably implied or necessary for the successful completion of the work in accordance with contract.

2.1.10 WORK BY OTHERS

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

**FOR FURTHER DETAILED SCOPE OF WORKS REFER RELEVANT
TECHNICAL SPECIFICATIONS PROVIDED IN THE SUBSEQUENT
CHAPTERS IN THE TCC**

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

S. No.	Description PART I	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.1	ESTABLISHMENT			
3.1.1	FOR CONSTRUCTION PURPOSE:			
a	Open space for office (as per availability)	Yes		Location will be finalized after joint survey with customer(HPEP)
b	Open space for storage (as per availability)	Yes		Location will be finalized after joint survey with customer(HPEP)
c	Construction of bidder's office, canteen and storage building including supply of materials and other services		Yes	
d	Bidder's all office equipments, office / store / canteen consumables		Yes	
e	Canteen facilities for the bidder's staff, supervisors and engineers etc		Yes	
f	Fire fighting equipments like buckets, extinguishers etc		Yes	
g	Fencing of storage area, office, canteen etc of the bidder		Yes	
3.1.2	FOR LIVING PURPOSES OF THE BIDDER			
a	Open space for labour colony (as per availability)	Yes*		Can be provided as per availability on chargeable basis
b	Labour Colony with internal roads, sanitation, complying with statutory requirements		Yes	
3.2.0	ELECTRICITY			

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

S. No.	Description PART I	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.2.1	Electricity For construction purposes of Voltage 415/440 V	Yes		On chargeable basis @ Rs.4.95 per unit consumption of electricity. Contractor has to provide a certified electricity meter for the purpose. If meter is not provided, electricity @ 70 units for each MT fabrication of structural steel will be considered.
a	Single point source	Yes		At a distance of approx. 1000 M from site (Distance is only estimated, it may vary up to an extent depending on site condition)
b	Further distribution including all materials, Energy Meter, Protection devices and its service		Yes	
c	Duties and deposits including statutory clearances if applicable		Yes	
3.2.2	Electricity for the office, stores, canteen etc. of the bidder			On chargeable basis @ Rs.4.95 per unit consumption of electricity.
a	Single point source	Yes		At a distance of approx. 1000 M from site (Distance is only estimated, it may vary up to an extent depending on site condition)
b	Further distribution including all materials, Energy Meter, Protection devices and its service		Yes	
c	Duties and deposits including statutory clearances if applicable		Yes	

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

S. No.	Description PART I	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.2.3	Electricity for living accommodation of the bidder's staff, engineers, supervisors etc			Not applicable
a	Single point source			
b	Further distribution including all materials, Energy Meter, Protection devices and its service			
c	Duties and deposits including statutory clearances if applicable			
3.3.0	WATER SUPPLY			
3.3.1	For construction purposes			On chargeable basis @ Rs. 15/- per 1000Lit. Contractor is required to provide water meter for this purpose. In case contractor does not provide the water meter, recovery towards water will be made @ 1.00% of the value of respective items of the work.
a	Making the water available at single point	Yes		
b	Further distribution as per the requirement of work including supply of materials and execution		Yes	

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

S. No.	Description PART I	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.3.2	<u>Water supply for bidder's office, stores, canteen etc</u>			On chargeable basis @ Rs. 15/- per 1000Lit. Contractor is required to provide water meter for this purpose. In case contractor does not provide the water meter, recovery towards water will be made @ 1.00% of the value of respective items of the work.
a	Making the water available at single point	Yes		
b	Further distribution as per the requirement of work including supply of materials and execution		Yes	
3.3.3	<u>Water supply for Living Purpose</u>			Not applicable
a	Making the water available at single point			
b	Further distribution as per the requirement of work including supply of materials and execution			
3.4.0	LIGHTING			
a	For construction work (supply of all the necessary materials) 1. At office/storage area 2. At the preassembly area 3. At the construction site /area		Yes	
b	For construction work (execution of the lighting work/ arrangements) 1. At office/storage area 2. At the preassembly area 3 At the construction site /area		Yes	
c	Providing the necessary consumables like bulbs, switches, etc during the course of project work		Yes	
d	Lighting for the living purposes of the bidder at the colony / quarters		Yes	

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

S. No.	Description PART I	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.5.0	COMMUNICATION FACILITIES FOR SITE OPERATIONS OF THE BIDDER			
a	Téléphone, fax, internet, intranet, e-mail etc.		Yes	
3.6.0	COMPRESSED AIR wherever required for the work		Yes	
3.7.0	Demobilization of all the above facilities		Yes	
3.8.0	TRANSPORTATION			
a	For site personnel of the bidder		Yes	
b	For bidder's equipments and consumables (T&P, Consumables etc)		Yes	

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

Sl. No	Description PART II 3.9.0 CONSTRUCTION FACILITIES	Scope / to be taken care by		Remarks
		BHEL	Bidder	
3.9.1	Engineering works for construction:			
a	Providing the construction drawings for all the works covered under this scope	Yes		
b	Drawings for construction methods	Yes		
c	As-built drawings – where ever deviations observed and executed and also based on the decisions taken at site- example – routing of small bore pipes		YES	In consultation with BHEL
d	Shipping lists etc for reference and planning the activities	Yes		In consultation with BHEL
e	Preparation of construction (Concreting B/W, etc.) schedules and other input requirements		Yes	In consultation with BHEL
f	Review of performance and revision of site construction schedules in order to achieve the end dates and other commitments	Yes	Yes	In consultation with BHEL
g	Weekly construction schedules based on S. No. e. hard copy to Construction manager, by email to HO.		Yes	In consultation with BHEL
h	Daily construction / work plan based on S. No. g. hard copy to Construction manager, by email to HO.		Yes	In consultation with BHEL
i	Periodic visit of senior official of the bidder to site to review the progress so that works are completed as per schedule. It is suggested this review by the senior official of the bidder should be done once in every two months.		Yes	

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – III: Facilities in the scope of Contractor/BHEL

Sl. No	Description PART II 3.9.0 CONSTRUCTION FACILITIES	Scope / to be taken care by		Remarks
		BHEL	Bidder	
j	Arranging the materials required for Work		Yes	
k	Coordination for inspection & checking and getting clearance from customer		Yes	
l	Preparation of formats for completion of activities		Yes	

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – IV: T&Ps to be deployed by Contractor

F. LIST OF TOOLS AND PLANT:

The following tools and equipment but not limited to, are required for the efficient execution of the civil works. The contractor shall make them available for construction purposes, including all consumables likely to be used at his own cost at the time of mobilization.

S.No.	Description	Minimum Quantity	Remarks
1.	Concrete Mixer 0.25 to 0.40 cum with hopper	2 nos.	
2.	Needle Vibrator (Needle type 40mm)	4 nos.	
3.	Needle Vibrator (Needle type 25mm)	2 nos.	
3.	Surface Vibrator	1 no.	
4.	Concrete Pump	1 no.	
5.	Dewatering Pump	2 nos.	
6.	Earth Compactor	2 nos.	Need based
7.	Reinforcement steel cutting & Bending machine	2 nos.	
8.	Welding Machine	2 nos.	
9.	Grinding Machine	4 nos.	
10.	Excavator	1 no.	Need based
11.	Theodolite with staff	1 no.	
12.	Dumpy level with staff	1 no.	
13.	Compression testing machine (for concrete cubes)		
14.	Cube mould (15cm.x15cm.x15cm.)	6 nos.	
15.	Sieve analysis sieve sets for coarse & fine aggregates	1 set	
14.	Jar/Beaker for Bulk density test of sand	1 no.	

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter – V: T&Ps to be deployed by BHEL on sharing basis

BHEL will not provide any tool, plants or any testing facility/apparatus for the work. It will be contractor's responsibility to arrange all required tools, plants and other testing apparatus, etc. at their own cost. The prices quoted & finalized are inclusive of the charges towards providing such T&P. No extra payment will be entertained on account of this.

However, subject to availability, BHEL may provide few T&P to the contractor for expediting and in larger interest of the project. In case any such facility is provided to the contractor, BHEL will make necessary recovery in the running account/final bills towards the hire charges. A departmental charge @ 5% will also be affected such cases. The decision of BHEL on the hire charges will be final and binding on contractor.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-VI: Time Schedule

6.1 TIME SCHEDULE

6.1.1

The entire work of erection testing and commissioning of the Steam Turbine, Generator & their auxiliaries as detailed elsewhere in the Tender Specification shall be completed within 6 (Six) months from the date of commencement of work at site.

6.1.2

During the total period of contract, the contractor has to carry out the activities in a phased manner as required by BHEL and the program of milestone events.

6.1.3

The erection work shall be commenced on the mutually agreed date between the bidder and BHEL engineer and shall be deemed as completed in all respect only when the unit is in operation. The decision of BHEL in this regard shall be final and binding on the contractor. The scope of work under this contract is deemed to be completed only when so certified by the site Engineer.

6.2 COMMENCEMENT OF CONTRACT PERIOD

The date of commencement of contract period shall be the mutually agreed date between the bidder and BHEL engineer to start the work. In case of discrepancy the decision of BHEL engineer will be final.

6.3 MOBILISATION FOR ERECTION, TESTING, ASSISTANCE FOR COMMISSIONING ETC.,

6.3.1

The activities for Excavation, Concreting, Architectural, structural & other civil construction works, etc. shall be started as per directions of Construction manager of BHEL.

6.3.2

The contractor has to augment his resources in such a manner that following major milestones of the project are achieved on specified schedules:

TENTATIVE SCHEDULE

Activity	Tentative schedule	
	Start Month	End Month
Mobilization for Site Establishment	Nov'14	Nov'14
Plant Buildings	Nov'14	March'15
Equipment/tank foundation.	Dec'14	March'15
Reservoirs/Storage Tanks/Pits/Underground Structures	Nov'14	Feb'15
Services(Storm water drains, laying of sewage pipelines), etc.	Jan'15	March'15
Handing Over	April'14	April'14

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-VI: Time Schedule

In order to meet above schedule in general, and any other intermediate targets set, to meet customer/project schedule requirements, contractor shall arrange & augment all necessary resources from time to time on the instructions of BHEL.

6.2 CONTRACT PERIOD

For the purpose of contract, the period shall be taken as 6 (Six) months. Completion of the work shall be as per BHEL Bar Charts revised from time to time. In order to expedite the work, the contractor has to deploy manpower on two-shift basis during erection and during pre-commissioning and commissioning period manpower should be provided round the clock basis as per site requirement without any extra cost to BHEL.

6.3 GUARANTEE PERIOD

The guarantee period of twelve months shall commence from the date of completion of all works as certified by the BHEL site engineer

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-VII: Payment Terms

The progressive payment for the work on accepted price of contract value will be released on the basis of running account bills & other bills as per the provisions of relevant clauses of GCC and SCC.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-VIII: Taxes, Duties & Levies

8.0 TAXES, DUTIES, LEVIES

8.1. For All types of works

8.1.1

The contractor shall pay all (save the specific exclusions as enumerated in this contract) taxes, fees, license charges, deposits, duties, tools, royalty, commissions or other charges which may be levied on the input goods & services consumed and output goods & services delivered in course of his operations in executing the contract. In case BHEL is forced to pay any of such taxes, BHEL shall have the right to recover the same from his bills or otherwise as deemed fit.

However, provisions regarding Service Tax and Value Added Tax (VAT) on output services and goods shall be as per following clauses.

Service Tax & Cess on Service Tax

Contractor's price/rates shall be exclusive of Service Tax and Cess on Services. In case, it becomes mandatory for the contractor under provisions of relevant act/law to collect the Service Tax & Cess from BHEL and pay the same to the concerned tax authorities, such applicable amount will be paid by BHEL at the prevailing Service Tax Rate (presently 12.36 %) on the admitted bill value.

Contractor shall submit to BHEL documentary evidence of Service Tax registration certificate specifying name of services covered under this contract. Contractor shall submit serially numbered Service Tax and Cess Invoice, signed by him or a person authorized by him in respect of taxable service provided, and shall contain the following, namely,
The name, address and the registration number of the contractor,
The name and address of the party receiving taxable service,
Description, classification and value of taxable service provided and,
The service tax payable thereon.

All the Four conditions shall be fulfilled in the invoice before release of service tax payment.

The contractor to submit proof of payment of service tax before submission of final bill.

Wherever, more than one route/option are available for discharge of service tax liability under a particular service, (e.g. "works contract Service"), contractor shall obtain prior written consent from BHEL site before billing the amount towards Service Tax.

In case, BHEL is forced to pay any Service Tax liability on behalf of contractor, the same will be recovered from contractor's bill or otherwise as deemed fit.

VAT (Sales Tax /WCT)

As regards Value Added Tax (VAT)/CST on transfer of property in goods involved in Works Contract (previously known as Works Contract Tax) applicable as per local laws, the price quoted by the contractor shall be inclusive of the same and in no case input or output VAT/CST will be reimbursed extra.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-VIII: Taxes, Duties & Levies

In any case the Contractor shall register himself with the respective Sales Tax authorities of the state and submit proof of such registration to BHEL along with the first RA bill. Contractor will submit all the details of VAT/CST paid for the contract in the prescribed format of the respective state VAT laws. Also, the contractor will issue the tax Invoices to BHEL as per the Tax laws of respective state on monthly basis. Contractor shall also be required to furnish to BHEL necessary proof of VAT remittance on monthly basis.

Deduction of tax at source shall be made as per the provisions of law and is to be construed as an advance tax paid by the contractor and no reimbursement thereof will be made.

Further, if BHEL, at the instance of customer or otherwise adopts the specific route for discharging output VAT liability itself, benefit of the reduction in liability of the contractor will be passed on to BHEL.

In case, BHEL is forced to pay any VAT liability on behalf of contractor, the same will be recovered from contractor's bill or otherwise as deemed fit.

8.2 New Taxes/Levies

In case the Government imposes any new levy/tax on the output service/ goods/work after award of the contract, the same shall be reimbursed by BHEL at actual.

In case any new tax/levy/duty etc. becomes applicable after the date of Bidder's offer, the Bidder/Contractor must convey its impact on his price duly substantiated by documentary evidence in support of the same before opening of Price Bid. Claim for any such impact after opening the Price Bid will not be considered by BHEL for reimbursement of tax or reassessment of offer.

No reimbursement/recovery on account of increase/reduction in the rate of taxes, levies, duties etc. on input goods/services/work shall be made. Such impact shall be taken care of by the Price Variation/Adjustment Clause (PVC) if any. In case PVC is not applicable for the contract, Bidder has to make his own assessment of the impact of future variation if any, in rates of taxes/duties/ levies etc. in his price bid.

8.3 BUILDING & OTHER CONSTRUCTION WORKERS (REGULATION OF EMPLOYMENT AND CONDITIONS OF SERVICE) ACT, 1996 (BOCW Act) AND RULES OF 1998 READ WITH BUILDING & OTHER CONSTRUCTION WORKERS CESS Act, 1996 & CESS RULES, 1998 and INTER-STATE MIGRANT WORKMEN ACT, 1979 (IN CASE BIDDER ENGAGE MANPOWER FROM OTHER STATE)

In case any portion of work involves execution through building or construction workers and/or inter-state migrant workmen, then compliance to the above titled Acts as applicable shall be ensured by the contractor and contractor shall obtain license and deposit the cess under the Act. In the circumstances it may be ensured as under:-

It shall be the sole responsibility of the contractor in the capacity of employer to forthwith (within a period of 15 days from the award of work) apply for a license to the Competent

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-VIII: Taxes, Duties & Levies

Authority under the BOCW Act and/or ISMW Act as applicable and obtain proper certificate thereof by specifying the scope of its work. It shall also be responsibility of the contractor to furnish a copy of such certificate of license / permission to BHEL within a period of one month from the date of award of contract.

It shall be the sole responsibility of the contractor as employer to ensure compliance of all the statutory obligations under these acts and rules including that of payment / deposit of cess as per the applicability under above referred Acts within a period of one month from the receipt of payment.

It shall be the responsibility of the sub-contractor to furnish the receipts / challans towards deposit of the cess together with the number, name and other details of beneficiaries (building/Inter-state Migrant workmen) engaged by the sub-contractor during the preceding month.

It shall be the absolute responsibility of the sub-contractor to make payment of all statutory payments & compensations to its workers including that is provided under the Workmen's Compensation Act, 1923.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-I General

1.1

The work covered under this specification is of highly sophisticated nature, requiring the best quality of workmanship for construction, engineering and construction management. The Bidder should ensure timely completion of work. The Bidder must have adequate quantity of tools, construction aids, equipment's etc., in his possession. He must also have on his rolls adequate, trained, qualified and experienced supervisory staff and skilled personnel.

1.2

The work shall be executed under the usual conditions affecting industrial construction and in conjunction with numerous other operations at site. The Bidder and his personnel shall co-operate with the personnel of other agencies, co-ordinate his work with others and proceed in a manner that shall not delay or hinder the progress of work as a whole.

1.3

All the work shall be carried out as per the instructions of BHEL engineer. BHEL engineer's decision regarding the correctness of the work and method of working shall be final and binding on the Bidder.

1.4

The Bidder shall at his cost perform any services, tests etc, although not specified but nevertheless required for the completion of work.

1.5

Contractor shall execute the work as per sequence prescribed by BHEL at site. The sequence of activities, methodology will be decided by the BHEL engineers depending upon the availability of material, drawings, work fronts etc. No claims for extra payment from the Contractor will be entertained on the grounds of deviation from the methods and sequence of construction advised and agreed by BHEL engineer or for any reasons whatsoever.

1.6

All the necessary certificates and licenses required to carry out this work are to be arranged by the Contractor expeditiously at his cost.

1.7

The work to be carried out under the scope of these specifications covers the complete work of collection from stores/storage yard(inside the factory), handling, transporting, unloading at construction site, temporary storage at site in open/closed stores of free issue of materials (cement, reinforcement & structural steel), temporary storing of contractor's own construction material, using the same in the work, carrying out all other activities, viz. survey, excavation, concreting, backfilling, and all the other activities as defined in the scope of work enumerated in chapter-2, Part-I of TCC document, Bill of Quantities and elsewhere till handing over of the entire work. The work shall conform to dimensions and tolerances specified in the various drawings, documents etc. That will be provided during the course of installation. If any portion of the work is found to be defective in workmanship or not conforming to drawings or other specifications, the Contractor shall dismantle and re-do

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-I General

the work duly replacing the defective materials at his cost failing which the work will be got done by BHEL at the cost and risk of the contractor.

1.8

The terminal points as decided by BHEL shall be final and binding on the Contractor.

1.9

During the course of execution of this work, certain rework/ modification/ rectification/ repairs/ fabrication/dismantling/reconcreting etc. will be necessary on account of feedback from various other units completed earlier and also on account of design discrepancies and manufacturing defects and site operation/maintenance requirements. Contractor shall carryout such rework/ modification/rectification/fabrication/repairs etc., promptly and expeditiously. Claims of contractor, if any, for such works will be dealt as per relevant clauses of General Conditions of Contract.

1.10

Daily log sheets indicating the details of work carried out, man-hours, consumables used etc, shall be maintained by the Contractor and got signed by BHEL engineer every day.

1.11

All tools and tackles, fixtures, equipment, materials, manpower, supervisors/ engineers, consumables etc. required for this scope of work shall be provided by the Contractor. All expenditure including taxes and incidentals in this connection will have to be borne by him unless otherwise specified in the relevant clause.

1.12

The contractor shall make adequate security arrangements including employment of security personnel and ensure protection from theft, fire, pilferage, damage and loss of materials/equipments issued to him for the work. Special care will have to be taken to guard against pilferage / theft of cement, steel and/or other materials.

1.13

Contractor shall ensure proper housekeeping and remove all scrap materials periodically from various work area covered in the scope and deposit the same at the place earmarked for this purpose. In case of contractor's failure to do the same, BHEL reserves the right to remove scrap at contractor's cost and risk.

1.14

Access to site for inspection by BHEL and customer engineers shall be made available by the contractor at all times.

1.15

As Built Drawings : Contractor shall be supplied with two extra copies of the layout & detailed drawings. Contractor to incorporate in one of the copy with Red ink all the changes / deviations / alterations etc carried out at site due to various reasons, with site engineer's endorsement. Marked up drawings shall be submitted to BHEL for approval.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-I General

1.16

Site Inspection : The owner / employer or his authorized agents may inspect various stages of work during the currency of the contract awarded to him. The contractor shall make necessary arrangements for such inspection and carry out the rectification pointed out by the owner / employer without any extra cost to the owner / employer. No cost whatsoever such duplication of inspection of work be entertained.

1.17

Field Quality Assurance Formats: It is the responsibility of the contractor to collect and fill up the relevant concrete pour card/FQA Log sheets and present the same to BHEL after carrying out the necessary checks as per the log sheets and obtaining the signature of BHEL / Customer in token of their acceptance. Monthly Running Bill Payment to the contractor will be linked with the submission of these Log sheets.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-II: Civil and Architectural Works

2.0 SCOPE

The work will involve all civil, structural and architectural works connected with the above mentioned structures such as earth work, concrete work, brick work, steel work, embedment, plastering and painting, wooden and metal doors, windows and partitions, waterproofing, flooring, plumbing, road work, drainage, grouting, laying of RCC sewer lines, etc.

The scope covers all Civil and Architectural within the battery limits. The important works covered are as below:

- 2.1 Excavation of earth and backfilling including dewatering of excavations for foundations, trenches, tunnels pits, etc. till the construction of the same is completed and disposal of surplus.
- 2.2 Foundation footing for structures, trenches, tunnels, sumps, grade beams, tie beams at foundation level, grade slabs, floor slabs and roof slabs, equipment foundations etc.
- 2.3 Complete civil and architectural works such as brick work, plastering, painting, all types of floor/roof finishes, all types joinery etc.
- 2.4 Preparation and submission of detailed calculations, arrangement drawings and detail drawings of formwork, staging and scaffolding for all reinforced concrete structures and foundations as directed by the Engineer for his checking and approval.
- 2.5 Preparation of detailed working drawings and bar bending schedules for all reinforced concrete work and getting them approved by the BHEL Engineer.
- 2.6 Taking deliver from BHEL stores, fabrication and fixing structural steelwork for cable trench covers, plates etc.
- 2.7 Fabrication supply and fixing of anchor bolts, sleeves, fixing frames, embedment etc. in concrete.
- 2.8 Supply of all instruments and personnel for conducting necessary tests at site as specified/as directed by the Engineer.
- 2.9 Making appropriate fabrication drawing as per agreed schedule before starting fabrication work for any structural GA drawing.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-II: Civil and Architectural Works

- 2.10 Taking delivery from BHEL stores and fabrication and erection of structural steel work including all interfacing works and miscellaneous works, supply of steel will be made by BHEL. The nature of work shall include columns , beams, splicing of steel works as needed, bracings, sheeting runners , sag rods, ties struts, walkways , galleries, stairs, ladders, hand railing , floor gratings, chequered plate work ,M.S pipes, equipment supporting platform, and all other structures required for the successful completion of the project.
- 2.11 Taking delivery from BHEL stores (Located inside the factory), temporary storage in contractor's storage go-down/open yard cement and reinforcement steel, proportioning of the various concrete ingredient materials, viz. cement, fine & coarse aggregate, chemical admixtures, etc. as per the approved concrete mix design for various grades of concrete, transporting to the work location, pouring the concrete in the specified formworks for foundation, column, beam, floors, etc. as the case may be as per the latest approved construction drawings & Bill of Quantities.
- 2.12 All other works, viz. Brickwork, Plastering, waterproofing works, backfilling, painting, etc. as defined in Bill/Schedule of quantities, construction drawings and time to time instructions issued by BHEL engineer required for completion of the work will be in the scope of the contractor.
- 2.13 All the works should conform to the specification provided in the Bill/Schedule of Quantities, relevant Indian Standards and best engineering practices.
- 2.14 Laying of RCC sewer lines including excavation, laying, jointing of pipes, road cutting, backfilling, etc. as per detailed item description of SOQ and direction and instruction of engineer-in-charge.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-III Structural Works

3.0 SCOPE:

The works involve:

- 3.1 Taking delivery from BHEL stores (Located inside the factory), temporary storage in contractor's storage cum fabrication yard allotted to them near the work area, fabrication and erection of structural steel work including all interfacing work and miscellaneous work. Supply of steel will be made by BHEL. The nature of work shall include columns, beams, splicing of steel works as needed, bracings, purling, sheeting runners, sag rods, ties, struts walkways, galleries, stairs, ladders, handrails, floor gratings, chequered plate work , M.S, pipes, equipment supporting platforms and all other structures required for successful completion of project.
- 3.2 Taking delivery of M.S pipes from BHEL stores(Located inside the factory), temporary storage in contractor's storage cum fabrication yard allotted to them near the work area, fabrication and erection of handrail as per drawing and specifications.
- 3.3 Supply and fixing of floor gratings as per Specifications.
- 3.4 Supply of high tensile bolts, mild steel bolts, nuts, plain/taper and spring washers, all electrodes required for shop and field work.
- 3.5 Shop and final painting as per Technical Specification after properly cleaning the steel surfaces.
- 3.6 Grouting under stanchion bases.
- 3.7 All the works should conform to the specification provided in the Bill/Schedule of Quantities, relevant Indian Standards and best engineering practices.

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-IV ISSUE OF MATERIALS TO THE CONTRACTOR

4.0 ISSUE OF MATERIALS TO THE CONTRACTOR

The following materials will be issued to the contractor free of cost from the BHEL stores inside the factory:

4.1 FREE ISSUE ITEMS: Cement, Reinforcement steel (Tor steel), Raw structural steel, at BHEL stores inside the factory premises.

- 4.2 For RMC (Ready mix concrete) items contractor has to arrange the cement quantity on their own cost. (The cement cost is inclusive in these items).
- 4.3 It will be the responsibility of the contractor to submit his demands for stores in writing at least 7 days in advance of the actual requirements.
- 4.5 Issue of all stores in subject to the extent of their availability at the place of issue noted above. The contractor should bring any of the materials shown above in case the BHEL desire so. The contractor shall not be entitled to any claim or compensation for non-supply of the materials, for delay in the supply of stores under any circumstances.
- 4.6 The materials will be issued only during the working hours. The contractors should have to transport them to site of work at his own cost as soon as there are issued to him.
- 4.7 The contractor shall from time to time, render proper account of all materials issued to him by BHEL. If he fails to do so, no further issues of the materials will be made to him and he shall be held responsible for any delay in the execution of the work which may occur on this account.
- 4.8 Where doors, windows, pipes, fittings, specials, glass, paints or others items are issued free of cost to the contractor, the contractor will have to make good at his own cost any loss or damage to part or whole of the items issued to him as above.
- 4.9 All surplus material in good condition whether issued free of cost or on cost recovery basis and which are not returned to the BHEL Central Stores and also quantities of materials consumed in excess of the actual requirements shall be charged for at punitive rates which will be 100% more than the issue rates of BHEL. The decision of the Senior Engineer / Civil as to the extent to which the materials have been rendered surplus or have been consumed in excess of the actual requirements shall be final and

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-IV ISSUE OF MATERIALS TO THE CONTRACTOR

binding on the contractor.

- 4.10 For the purpose of determining the actual requirement of cement, the theoretical consumption of cement as per Delhi Schedule of Rates 2012 of CPWD will be considered by BHEL Engineer. For items not covered in DSR 2012, the consumption will be calculated based on the technical specification & similar items of DSR. The decision of BHEL engineer in this regard will be final and binding on the contractor.
- 4.11 The contractor shall construct store shed for storing cement, at his own cost and required site will be shown by the engineer-in-charge. Contractor shall store cement as directed by the Engineer-in-charge and shall maintain the record by entering day to day consumption and receipts. The contractors shall dismantle the temporary shed as soon as completion of work. Final bill will be forwarded subject to above conditions and certification by stores-in charge of factory civil department.
- 4.12 ~~Contractor shall maintain a record of cement consumption and shall submit the same to the Engineer-in-charge for verification. The surplus cement shall be the property of the contractor and shall be returned to the scrap yard BHEL against SDN (Scrap delivery note).~~ Steel (reinforcement/structural steel) will be issued at lengths as stocked by the Bharat Heavy Electricals Limited. The surplus steel is represented by the difference between the quantity received and the quantity required and utilised on the work with an allowance of 5% towards scrap. The scrap will be the property of the contractor; the contractor will be responsible for the removal from the site in time as directed by the Senior Engineer / Civil. The cut pieces and surplus returned shall not be shorted than three meters in length.
- 4.13 Excess consumption of structural steel/reinforcement steel over the actual quantities of materials consumed in excess of the actual requirements as per design/drawing shall be charged for at punitive rates which will be 100% more than the purchased rates of BHEL (i.e., @ Rs. 84,000/ton) after allowance of 5% towards scrap, will be recovered. The scrap material has to be returned to scrap yard BHEL against SDN (Scrap delivery note).

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-V LIST OF TECHNICAL SPECIFICATIONS

5.0 PREAMBLE TO THE SCHEDULE OF QTS. (SOQ) PROVIDED IN PRICE BID SPECIFICATION

- 5.1 Details of the items in this Schedule shall be read in conjunction with the corresponding BHEL specifications, drawings and other documents and shall have precedence over any contrary statement mentioned anywhere in this document.
- 5.2 The work shall be carried out as per construction drawings, specifications, the description of the items in this schedule and/or Engineer's instructions. Drawings enclosed with these documents are only indicative giving some idea of the type of work involved. The layout, sizes and details of the building, structures and foundations shown in tender drawings may vary at a large extent during actual construction. Final drawings will be issued progressively during the execution of the work.
- 5.3 Items of work provided in this schedule but not covered in the specifications shall be executed strictly as per instructions of the Engineer.
- 5.4 Unless specifically mentioned otherwise in the contract, the bidder shall quote his rates for the finished items and shall provide for the complete cost towards fuel, tools, tackle, equipment, constructional plant, temporary works, labour materials, levies, taxes, transport, layout, repairs, rectification, maintenance till handing over, supervision, shops, establishments, services, temporary roads, revenue expenses, contingencies, overheads, profits and all incidental items not specifically mentioned but reasonably implied and necessary to complete the works according to the contract.
- 5.5 The rate quoted shall be inclusive of cleaning the site of any vegetations, dressing and leveling etc., required for commencement of site activities. No separate payment will be made towards the same.
- 5.6 The rate shall also be inclusive of carrying out topography survey of site to establish levels and coordinates at suitable intervals, from existing grid levels and coordinates furnished by the owner, establish bench marks, setting out the location and levels of the proposed structures, constructions and making references, pillars and other identification marks etc. No separate payment will be made towards the same.
- 5.7 The quantities of the various items mentioned in the schedule are approximate and may vary up to any extent or be deleted altogether. The quoted rates of each item shall remain firm as long as the variation in the total value of the works remain within +/- 15% (thirty percent) of the Bid

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-V LIST OF TECHNICAL SPECIFICATIONS

Price of the work. For any increase or decrease in quantity beyond +/- 15%, the rates for execution of such work will be governed by clause no. 2.14 of GCC. The contractor, in his own interest, should get an indication of the probable extent of the work to be executed under any particular item in this schedule, before, under taking any preliminary work or purchasing bought out component related to the work.

- 5.8 Rates shall be quoted both in figures and in words in clear legible writing. No over writing is allowed. All scoring and cancellation should be counter signed by the bidder. In case of illegibility, the interpretation of the engineer shall be final. All entries shall be in English language.
- 5.9 Payments will be made on the actual quantity of work executed against each SOQ item.
- 5.10 Engineers decision shall be final and binding on the contractors regarding clarification of items in this schedule with respect to the other section of the contract.
- 5.11 Unless otherwise specified in the schedule of items, cement, structural and reinforcement steel will be issued by BHEL free of cost from BHEL stores inside the factory premises.
- 5.12 For ready mix concrete, cement will not be provided to the contractor. The rates decided for the concreting works, using Ready Mix Concrete shall be inclusive of cost of all ingredient materials, including cement & transporting through transit mixer pouring in the specified forms & location, compacting, curing, testing, etc.
- 5.13 In case of any discrepancy between item description, relevant drawing and/or specification clarification shall be sought at tender stage itself. Otherwise it shall be assumed that the bidder has quoted for the more stringent requirement.
- 5.14 HIERARCHY

In case of any conflict/deviations amongst various documents, the order of precedence shall be as follows

- Statutory Regulations
- Items in Schedule of quantities
- IS/BS standards
- BHEL's standard specification (with prior approval of Engineer-in-charge).
- CPWD's technical specification

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-V LIST OF TECHNICAL SPECIFICATIONS

LIST OF TECHNICAL SPECIFICATIONS(Annexure-I)

SL. NO	DESCRIPTION	SPECIFICATION NUMBER	REV	PAGES
1	GENERAL SCOPE.	PEDC/STD.SPEC/001	0	4
2	PROPERTIES. STORAGE&HANDLING OF COMMON BUILDING MATERIALS.	PEDC/STD.SPEC/002	0	5
3	EARTHWORK INEXCAVATION & BACKFILLING.	PEDC/STD.SPEC/003	0	23
4	CEMENT CONCRETE-PLAIN& REINFORCED.	PEDC/STD.SPEC/004	0	56
5	FABRICATION & STRUCTURAL STEEL WORK.	PEDC/STD.SPEC/005	0	25
6	ERECTION OF STRUCTURAL STEEL WORK.	PEDC/STD.SPEC/006	0	15
7	MISCELLANEOUS STEEL WORK.	PEDC/STD.SPEC/007	0	5
8	MISCELLANEOUS METAL.	PEDC/STD.SPEC/008	0	6
9	PAINTING ON STRUCTURAL STEEL.	PEDC/STD.SPEC/009	0	5
10	INSERTS / EMBEDMENTS IN CONCRETE WORK.	PEDC/STD.SPEC/010	0	3
11	GROUTING.	PEDC/STD.SPEC/011	0	4
12	MASONRY & ALLIED WORKS.	PEDC/STD.SPEC/012	0	8
13	FINISH TO MASONRY &CONCRETE.	PEDC/STD.SPEC/013	0	7
14	PAINTING, WHITEWASHING,POLISHING ETC.	PEDC/STD.SPEC/014	0	11
15	FLOOR FINISHES & ALLIED WORKS.	PEDC/STD.SPEC/015	0	26
16	GLASS & GLAZING.	PEDC/STD.SPEC/016	0	3
17	METAL DOORS,WINDOWS, VENTILATORS, LOUVERS ETC.	PEDC/STD.SPEC/017	0	10
18	ROLLING STEEL SHUTTERS & GRILLS.	PEDC/STD.SPEC/018	0	4
19	ROOF WATER PROOFING, INSULATION & ALLIED WORKS.	PEDC/STD.SPEC/019	0	9
20	FALSE CEILING.	PEDC/STD.SPEC/020	0	5
21	WATER SUPPLY WORKS.	PEDC/STD.SPEC/022	0	11
22	DRAINAGE & SANITATION.	PEDC/STD.SPEC/023	0	17
23	SUPPLY & LAYING RCC PIPES.	PEDC/STD.SPEC/024	0	4

TECHNICAL CONDITIONS OF CONTRACT (TCC)

Chapter-V LIST OF TECHNICAL SPECIFICATIONS

24	PREMOULDED BITUMINOUS JOINT FILLER & SEALING COMPOUND.	PEDC/STD.SPEC/025	0	2
25	DEMOLITION & DISMANTLING.	PEDC/STD.SPEC/026	0	5
26	TYPE & MAKE OF MATERIALS TO BE USED.	PEDC/STD.SPEC/027	0	2
27	FALSE FLOORING.	PEDC/STD.SPEC/028	0	4
28	WATER BOUND MACADAM.	PEDC/STD.SPEC/030	0	7
29	RUBBLE MASONARY.	PEDC/STD.SPEC/031	0	4
30	CHAIN LINK FENCING.	PEDC/STD.SPEC/032	0	3
31	SHEETING WORK IN ROOF F / SIDING.	PEDC/STD.SPEC/033	0	4
32	TANK PADS.	PEDC/STD.SPEC/034	0	5
33	ANTI TERMITE TREATMENT.	PEDC/STD.SPEC/036	0	4
34	PILING.	PEDC/STD.SPEC/040	0	
	(A) PART I - PREAMBLE.	PEDC/STD.SPEC/0040 -a	0	2
	(B) PART II - GENERAL SPECIFICATIONS.	PEDC/STD.SPEC/0040 -b	0	4
	(C) PART III - SPECIFIC REQUIREMENTS.	PEDC/STD.SPEC/0040 -c	0	8
	(D)PILING PART-IV – MATERIAL FOR REINFORCED CONCRETE PILES	PEDC/STD.SPEC/0040 -d	0	8
	(E)PILING PART-V TESTING OF CONCRETE PILES	PEDC/STD.SPEC/0040 -e	0	11
35	ALL RELEVANT BHEL SPECIFICATIONS			

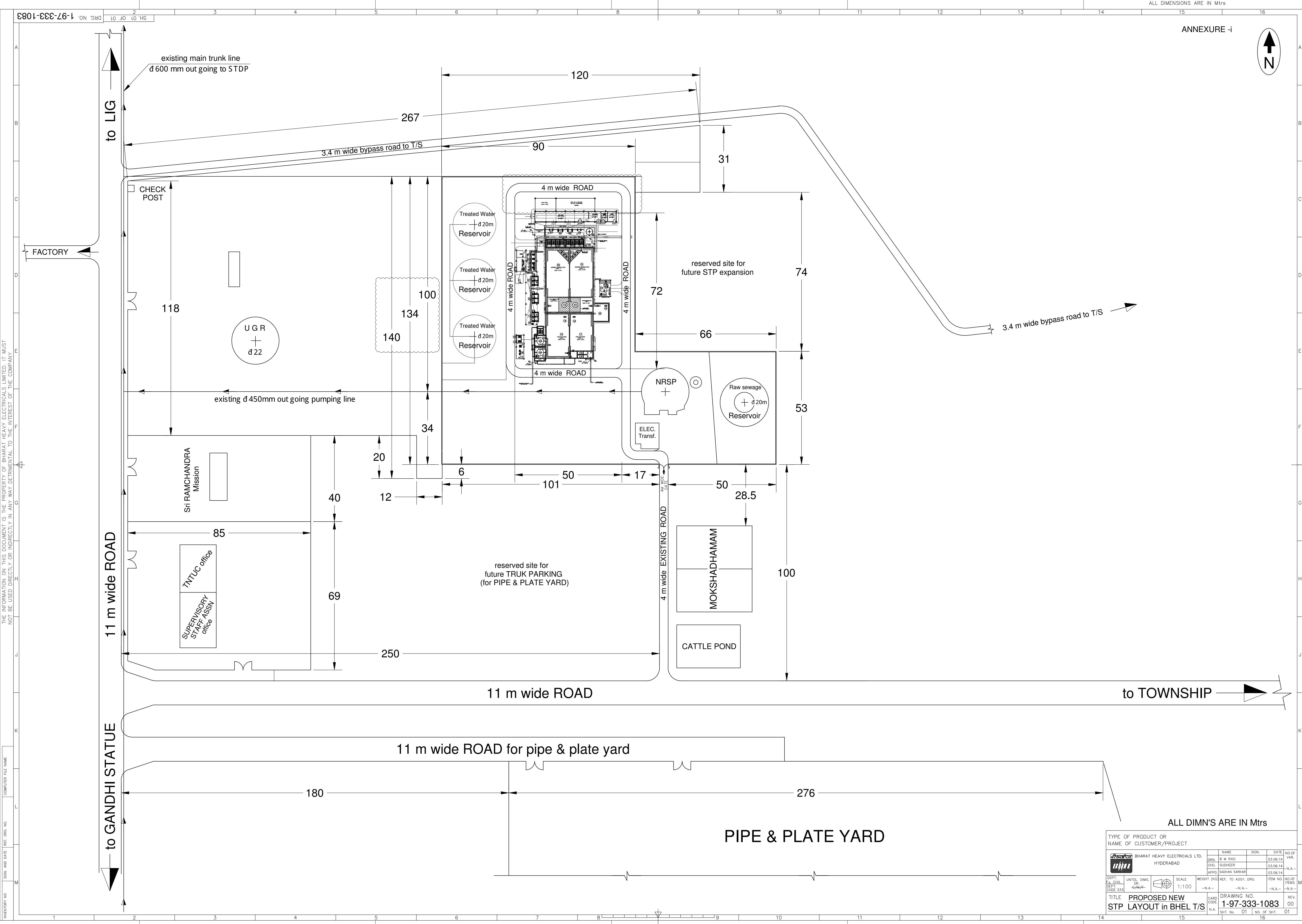
NOTE: The above technical specification is not exhaustive. In case for any item of work, technical specification is not available, such items of works will be carried out in conformance to technical specification of CPWD/manufacturer's recommendations/best engineering practice. In case of any dispute between two specifications or non-availability of specifications, customer's specification will prevail. Decision on applicability of any particular specifications will rest with BHEL engineer and his decision in the matter will be final & binding on the contractor. Contractor has to make himself well conversant with the Customer specification.

TECHNICAL CONDITIONS OF CONTRACT (TCC)
Chapter-VI LIST OF DRAWINGS

LIST OF DRAWINGS(Annexure-II)

S. NO.	TITLE	DRAWING No.	REV. NO.
1	PLOT PLAN *	0-38101-01169	R0
2	SOAK PIT DETAILS	3-38144-00003	R0
3	DETAILS OF ALUMINIUM PARTITIONS	3-38144-00008	R0
4	SEPTICK TANK (25 USERS)	3-38144-00009	R0
5	STANDARD DETAIL OF ANTI TERMITE TREATMENT	4-38144-00004	R0
6	PIPE ELECTRODE	GT 57191(P-10/37)	R0
7	EARTH ELECTRODE IN TEST PIT	GT 57191(P-11/37)	R0
8	ALL RELEVANT BHEL DRAWINGS.		

‘*’ – Plot plan enclosed is not final and likely to change to meet BHEL’s requirements.



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INVENTORY NO	SIGN. AND DATE	REF. DRG. NO.	COMPUTER FILE NAME

ALL DIMN'S ARE IN Mtrs									
TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT									
		BHARAT HEAVY ELECTRICALS LTD. HYDERABAD				NAME	SIGN.	DATE	NO. OF VAR.
		DRN.		B. M. RAO				03.06.14	
		CHD.		SUDHEER				03.06.14	N.A.~
		APPD.		SADHAN SARKAR				03.06.14	
DEPT. P.Y. CIVIL	DRS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.			ITEM NO.	NO. OF ITEMS	
333	UNTOL.	1:100	N.A.~	N.A.~			N.A.~	N.A.~	
TITLE				DRAWING NO.				REV.	
STP LAYOUT IN BHEL T/S				1-97-333-1083				00	
CARD CODE		N.A.		SHT. No		01	NO. OF SHT.	01	



HYDERABAD

STANDARD TECHNICAL SPECIFICATION FOR GENERAL SCOPE

PEDC/STD.SPEC/001
REV 00

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GENERAL SCOPE

REV. NO.	PRAPARED	APPROVED	DATE

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STANDARD TECHNICAL SPECIFICATION FOR GENERAL SCOPE

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- 1) These Specifications establish and define the material and constructional requirements for civil, structural and architectural works.
- 2) Method of measurement are indicated in these specifications. Where not so specified, latest version of IS: 1200 shall be applicable.
- 3) Providing and operating necessary measuring and testing devices and materials including all Consumables are included in the scope of work. No separate measurement or payment for testing the work shall be made but rates quoted for various items shall be deemed to include the cost of such tests which are required.
- 4) All materials shall be standard quality, manufactured by renewed concerns, conforming the Indian standards or equivalent and shall have "IS" mark as far as possible unless other wise approved by engineer in-charge prior to procurement and use. The contractor shall furnish manufacture's certificates, for the materials tested from an approval test house, if asked for by the engineer-in-charge. The costs of all test and the test certificates, shall be borne by the contractor. No separate payment shall be made for the testing. The Engineer –in-charge shall have the right to determine whether all or any of the materials are suitable. Any materials procured or brought to sight and not conforming the specifications and satisfaction of the Engineer-in-charge shall be rejected and the contractor shall have to remove the same immediately from sight at his own expenses and with out any claim for compensation due to such rejection.
- 5) Where ever referred to in third tender document, only the latest revision which shall be enforced in the completion of work of specifications, codes of practice and other publications of the Bureau of Indian Standards shall be applicable.
- 6) Wherever contractor executes civil and structural works involving building and equipment foundations, structural work or building pipe etc the following works are deemed to have been included in the quoted rates for various works.

1. Mark of center lines or foundations

2. Marking of top levels of foundations, floors etc and establishment of reference lines, bench marks on various floors, plat forms etc.

3. Preparation of "as built" scheme of structural foundation and indicating designed and achieved levels, center line and dimensions of pockets, position and level of anchor bolt etc.

- 7) In case of conflict amongst the provisions of schedule of rate specifications and drawings, all of them shall be read in conjunction with other and clarification shall be obtained from the Engineer-in- charge whose decision shall be final and binding.

Following procedure may generally followed

- 7.1 Description of items in schedule of rates shall be followed when provisions therein are different from those in specifications
- 7.2 Where the description of items doesn't call out for some specific requirement but the same are given in specifications, the specifications shall be followed, in addition to the requirements given in description of items
- 7.3 Where drawings call out for requirements different from or additional to those given item description and specifications, the decision of the Engineer-In-Charge shall be obtained as to what to shall be followed.



HYDERABAD

STANDARD TECHNICAL SPECIFICATION PROPERTIES, STORAGE & HANDLING OF COMMON BUILDING MATERIALS

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PROPERTIES, STORAGE & HANDLING OF COMMON BUILDING MATERIALS

REV. NO.	PRAPARED	APPROVED	DATE
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STANDARD TECHNICAL SPECIFICATION PROPERTIES, STORAGE & HANDLING OF COMMON BUILDING MATERIALS

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1.00.0 Scope

The scope for this section is to specify the properties, storage and handling of Common building materials unless otherwise mentioned in drawings or Schedule items.

2.00.0 MATERIALS

a) Bricks

Bricks for general masonry work shall be conform to IS: 10// and for face Bricks work shall conform to the specifications in IS: 2691.

Bricks for general masonry work shall be of first class (Class A) quality, WellBurnt, of uniform size, shape and colour free cracks, flaws or nosules Or free lime and emit clear ringing sound when struck. Fractured surface Shall show uniform texture free from grits, lumps holes etc. Compressive Strength shall be 75kg/cm^2 minimum for common bricks and 150kg/cm^2 Minimum for face bricks. Water for common bricks absorption after 24 Hours Immersion shall not exceed 15% by weight for common bricks and 12%For Face bricks. Dimensional tolerance shall not exceed 8% of the size shown in Drawing for common bricks and 3% for face bricks. All bricks shall haveRectangular faces and shape bricks shall be 6mm at the edges and 10mmFor Corners. The bricks shall show no effluences after socking in water and In shade.

Each bricks shall have manufacturer's identification marks elearly marked on The frog. Representative samples shall be submitted and approved sample shall Be retained by the of face bricks shall be limited to the range of samples Submitted. Any brick not found the specification should be removed Immediately from site at the contractor's own cost.

b) stone

All stones shall be from approved quarries. Hard, tough, durable compact Drained, uniform in texture and colour and free from decay, flaws, veins, Cracks and sand holes. The surface of 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 earthy appearance. Stone showing mottled Colours shall not be used for face works. A stone shall not absorb more than 5 present of its weight of water after 24 hours immersion. The type of stone Shall be as specified on drawings and/or instructed by Engineer. Samples Shall be submitted by the contactor and approved samples shall be retained by By the engineer for comparison of bulk supply.



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c) Lime

Lime shall be stone lime and conform to the specification Building lime IS: 712. Lime putty may be prepared from hydrated lime or quick lime. Hydrated lime shall be mixed with water to form putty and stored with Reasonable care to prevent evaporation for at least 24 hours before use. Quick Lime shall be shacked with enough water to make a cream passed through a No. 10 Sieve and then stored with reasonable care to prevent evaporation for At least 7 days before use.

d) Cement

Cement used shall be ordinary Portland cement conforming to Code for Ordinary cement in IS: 8112 and shall be fresh when delivered. The contractor Shall submit the manufacture's certificate for each consignments of cement Procured to the contractor, the Contractor shall satisfy himself at the time of Taking delivery that the quality, quantity and freshness of cement are up to the Specified standards No. Shall be entertained and all rectification work on Account shall be done by the contractor at his own expense. If at any time, the Engineer feels that 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 else have no claim for this type of Suspension of work.

e) Coarse Aggregates

Coarse aggregates shall be as per IS: 383 latest editions, consisting of hard, Strong and durable pieces of crushed stone and shall and be free organic or clay coatings and other impurities like disintegrated stone. Soft flaky particles etc. and Any other materials 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 produce dense concrete of the specified proportions and strength and of Consistency that will work readily into position without segregation.

f) Sand

Sand shall be hard, durables, clean and free from adherent coating or organic matter and shall not contain clay balls or pellets, the sand shall be free from impurities such as iron pyrites. Alkalise, salts, coal, mica, shale or other laminated materials in such forms or quantities as to affect adversely the Harding, strength, durability or appearance of mortar.



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Plaster or concrete or to cause corrossions to any metal in contact with such mortar, plaster or concrete. All sand shall be properly graded. Unless otherwise directed by the Engineer all sand shall pass through IS Sieve NO< 240 and 15 to 30% of and for masonry mortar and 5 to 50% of sand for plaster shall pass through IS Sieve No 30. Sand for concrete shall conform to IS: 383.

e) Water

Water shall be clean, fresh and free from organise matters, acids or soluble salts And other deleterious substances which may cause corrosion, discolouration, 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: 226. Mild steel and medium tensile steel and medium Tensile steel bars and hard-drawn steel wire for concrete reinforcement shall Conform is IS: 432 Cold twisted steel bars shall conform to IS:1786 Hexagonal Wire netting shall conform toIS: 3150. All steel bars including and above 10mm Diameter shall be of tested quality. All wire netting shall be galvanised.

3.00.0 STORAGE AND HANDLING OF MATERIALS.

a) Bricks

Bricks shall not dumped at sits. They shall be stacked in regular tires. Even as They are unloaded, to minimise breakage and defacement of bricks. Bricks Selected for different situation of use in the work shall be stacked separately.

b) Stones

Stones shall be stored at site in manner approved by the Engineer. Dressed stone For wall facing, paving etc. shall be stored with special care to avoid Defacement of faces and edges or damp and rust stains.

c)Lime

Lime shall be in weatherproof sheds.

d) Cement

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.



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e) Coarse and Fine Aggregates

Aggregates shall be stored on brick soiling or an equivalent platform so that They do not come in contact with dirt. 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.

f) Reinforcement

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.



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REV. NO.	PRAPARED	APPROVED	DATE
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1.0.0 SCOPE

This specification covers excavation in all types of soil, soft and decomposed rock not requiring blasting and rocks requiring blasting, shoring, dewatering, filling around foundations and to grade, compaction of fills and approaches, protective fencing, lighting, etc relevant to structures and locations covered under the scope of this contract.

2.00.0 GENERAL

2.1.0 WORK TO PROVIDED FOR BY THE CONTRACTOR

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

- a) Furnish all labour, supervision, services including facilities as required under statutory labour regulations, materials, equipment, tools and plants, transportation, etc, required by the Engineer
- b) Prepare and submit working drawing showing the approaches, slope, beam, shoring, sumps for dewatering, including drains and outfall for drainage, space for temporary stacking of spoil, disposal area, fencing, etc and all other details as may be required by the Engineer.
- c) To carry out sampling and testing and submit to the Engineer, results of soil compaction tests if required by the Engineer to assess the degree of compaction.
- d) Construction, maintenance and removal after completion of Magazine of proper capacity as well as design for storing of explosives required for blasting work to be carried out scope of this tender.

2.2.0 WORK TO PROVIDED FOR BY OTHERS.

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

2.3.0 CODES AND STANARDS.

All works under this specification, unless specified otherwise shall conform to the Latest revision and /or replacement of the following or any other Indian Standard Specifications and codes of practice. In case any particular aspect of work is no Covered specially by Indian Standard Specification any other standard practice as May be specified by the Engineer shall be followed: -

IS: 3664: Indian Standard for Safety Code for Excavation work.

IS: 1200: Indian standard Method of Measurement of Building and Civil Engineering Work, (Part-I): Earthwork.

IS: 4701: Indian standard Code of Practice for Earthwork on Canals

2.4.0 CONFORMITY WITH DESIGNS.



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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 Engineer's instructions.

2.5.0 MATERIALS TO BE USED

2.5.1 GENERAL

All material required for the work shall be of best commercial variety and approved By the Engineer.

2.5.2 BORROW METERIAL.

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

2.6.0 QUALITY CONTROL

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: -

- a) Lines, Levels and Grades: I) periodic surveys
II) Establishment of markers, boards etc.
- b) Back- filling: I) Checking the quality of fill material
II) Checking moisture content of the backfill
III) Checking the degree of compaction

3.3.0 EXECUTION

3.1.0 SETTING OUT

Within 15 days of award of Contract, the contractor will prepare and submit to the Engineer, detailed drawings of the excavation work as proposed to be executed by The Showing the diminutions as per drawings and specification adding his proposals of Slopes, shoring, approaches, dewatering sumps, beams, etc. On Receiving, approval From the engineer with modifications and corrections, if necessary, the Contractor Will set out the work from the control points furnished by the Engineering and fix Permanent point s furnished by the Engineer and fix permanent point and markers for case of future checking. These permanent points and markers for case of furnished by the engineer and fix permanent points and markers will be fixed at intervals prescribed by the Engineer and checked by the Engineer and certified by him after which the Contractor will proceed with the work. It should be noted that this checking by the Engineer prior to start of the carrying work will in no way



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absolve the Contractor of responsibility of carrying out the work to true lines and levels and grades as per drawing and subsequent corrections. If necessary, free of cost to the Owner in case any errors are noticed in the Contractor's work at any stage.

3.2.0 INITIAL LEVELS

Initial level of the ground either in a definite grid pattern or as directed by the Engineer will be taken by the Contractor jointly with the Engineer over the original Ground prior to starting actual excavation work and after setting out. These initial Level will be used for preparing cross-sections for volume measurement or for Crosschecking the depths obtained from tape measurement.

All records of levels, measurements etc. and also any drawing, cross section etc. Made there from, shall be jointly signed by the authorised representative of the Contractor and the engineer before the commencement of and they shall from the Basis of all payments in future.

3.3.0 CLEARING AND GRUBBING, ETC.

The area to be excavated shall be cleared out of fences, trees, logs, stumps, bush, Vegetation, rubbish, slush, etc. and levelled up. Trees unto 300mm girth shall be Uprooted. Trees above 300mm girth to be cut, shall be approved by the engineer And then Marked. Felling of trees shall include taking out roots up to 600mm below ground level or 150mm below formation level whichever is lower. After the tree is cut and roots taken out the pot-holes formed shall be filled with good earth in 250mm layers and consolidated unless directed by the Engineer otherwise. The trees shall be cut in suitable pieces as instructed by the Engineer.

Before earthwork is started, all the spoil and unserviceable materials and rubbish Shall be burned or removed from the site to approved disposal areas as may be Specified. Ash shall be spread or removed. Useful materials, saleable timber, Firewood, etc, shall be the property of the Owner and shall be stacked properly at the worksite in a manner as directed by the Engineer.

3.4.0 CLASSIFICATION

All earthworks shall be classified under the following categories:

a) ORDINARY SOIL

This shall comprise vegetable or organic soil, turf, sand, loam, clay, mud, peat, black Cotton soil, soft shale or loose moorum, a mixture of these and similar material which Yields to the ordinary application of pick and shovel, rake or other ordinary digging implement. Removal or any other modular material having diameter in any one direction not exceeding 75mm occurring in such strata shall be covered under this category.



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b) HARD SOIL.

This shall include

- i) Stiff heavy clay, hard shale, or compact moorum, requiring grafting tool or pick or both and chovel, closely applied,
- ii) Gravel and cobble stone having maximum diameter in any one direction between 75 and 300mm,
- iii) Soiling of roads, paths, etc, and hard core,
- iv) Macadam surface such as water bound, and bitumen/ tar bound,
- v) Lime concrete, stone masonry in lime mortar and brick work in lime/cement Mortar, below ground level,
- vi) Soft conglomerate, where the stones may be detached from the matrix with Picks, and
- vii) Generally any material, which requires close application of picks, or scarifies to loosen and not affording resistance to digging greater than the hardest of any soil mentioned in (i) And (vi) above.

c) SOFT AND DECOMPOSED ROCK

This shall include:

- i) Limestone, sandstone, late rite, hard conglomerate or other soft or Disintegrated rock which may be quarried or spilt with crowbar,
- ii) Unreinforced cement concrete, which may be broken up with crowbars or picks And stone masonry in cement mortar belowground level.
- iii) Boulders, which do not require blasting having maximum diameter in any Direction of more than 300mm, found laying loose on the surface or embedded In river bed, soil, talus, slope wash and terrace material of dissimilar origin, and
- iv) Any rock which in dry state may be hard, requiring blasting, but which when Wet becomes soft and manageable by means other than blasting.

d) HARD ROCK (requiring blasting)

This shall include:

- i) Any rock or cement concrete for the excavation of which the use of mechanical plant or blasting is requiring.
- ii) Reinforced cement concrete (reinforcement cut trough but separated from the concrete) below ground level, and
- iii) Boulders requiring blasting.



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c) **HARD ROCK (blasting prohibited)**

Hard rock requiring blasting as described under (d) but where blasting is Prohibited for any reason and excavation has to be carried out by chiselling, Wedging or other agreed method.

In case any dispute regarding classification, the decision of the Engineer shall be final.

3.4.0 **EXCAVATION FOR FOUNDATIONS AND TRENCHES**

3.5.1 **GENERAL**

All excavations shall be done to the minimum dimensions as required for safety and Working facility. Prior approval of the Engineer shall be obtained by the Contractor, In each individual case, for the method he proposes to adopt for the Excavations including dimension, side slopes, shoring, dewatering, disposal, etc. This approval, however, shall not in any way make Engineer responsible for any Consequent loss Damage. The excavation must be carried out in the most Expeditious and efficient Manner.

All excavation in open cuts shall made true to line, slopes and grades shown on the Drawing or directed by the Engineer. No material shall project within the dimension Of minimum excavation lines marked. Boulders projecting out of the excavated Surfaces shall be removed, if in the opinion of the Engineer they are likely to be a Hindrance to the workers.

Method of excavation shall be in every case subject to the approval of the Engineer And the Contractor shall ensure that stability and safety of the excavation, adjacent Structures, to be works.

The Contractor shall be in every case subject to the approval of the excavation and Safety of the workmen. If any slip occurs, the Contractor shall remove all slipped Material from the excavated pit.

All loose boulders, semi-detached rocks, not directly in excavation but so close to The Area to be excavated as to be liable, in the opinion of the Engineer, to fall or Otherwise endanger the workmen, equipment of the work, etc, shall be stripped Off Removed away from the areas of excavation. The method used shall be such as Not to Shatter or render unstable or unsafe the portion which was originally sound And safe any materials not requiring removal as contemplated in the work, but Which In the Option of the Engineer, is later to become loose or unstable shall Also be Promptly and satisfactory directed by the Engineer.

Prior starting the excavation, the ground level at the location shall be checked Jointly With the Engineer.

The rough excavation may be carried unto a maximum depth of 150mm above the



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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 and the Contractor shall be paid for the extra excavation and the filling appropriate item Rates.

If the excavation is done to a depth greater than shown on the drawing, or directed By The Engineer, due to the Contractor's fault, the excess shall be filled unto the Required level at the latter's cost (with cement concrete not leaner than 1:4:8 Ordinary Concrete or richer) as directed by the engineer in each individual case.

Information of rock requiring blasting, those over cuts which are unavoidable will be Made unto ordinary cement concrete 1:2:4 which will be paid for under appropriate rate, provided this over cut is not due to negligence of the contractor. The decision of the Engineer as to the admissibility of such over cut for payment will be final. All excavated materials such hard rock, boulders, bricks, dismantled concrete blocks, etc. Shall be stacked separately as directed by the Engineer and shall be the property of the Owner.

3.5.2 EXCAVATION IN ORDINARY SOIL, HARD SOIL AND SOFT AND DECOMPOSED ROCK

The excavation in ordinary soil, soft and decomposed rock will be carried out as per the approved proposal, modified and corrected where necessary by the Engineer. The work will be carried out in a workman like manner without endangering the safety of nearby structure/ services or works and without causing hindrance to other activities in the area. As the excavation reaches the required dimensions, lines, levels and the grades, the work will be carried out carefully to avoid any over- excavation. On completion, the work will be finally checked and approved by the Engineer. In certain cases, where deterioration of the ground, upheaval, slips etc. are expected the engineering may order to suspend the at any stage and instruct the Contractor to carryout the balance work just before the foundation work of the structure can be started. No extra will be paid to the Contractor for such unviable temporary suspension of work.

3.5.3 EXCAVATION IN HARD ROCK

In case where excavation, both in ordinary soil and hard rock, are involved, the Ordinary soil comprising of soft, hard and dense soil (including laterite formation) And rock including weathered rocks, lateritic rocks, etc. Which can be excavated Without blasting, shall be completely stripped off and the levels of the hard rock Wall be taken to be enable measurements. Further work in hard shall be resumed Clearance from the Engineer. Personal deployed for track 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 such that it is not stable Against sliding, necessary from the excavated surfaces is such that it is not stable Against sliding, necessary supports, props, bracing or bulkheads shall be provide and Maintained .

In case where blasting, though otherwise required, is prohibited for any reasons, the



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Excavation shall be carried out by chiselling, wedging or any other approved Method and payment appropriate to blasting shall be made, unless otherwise Mentioned in the Schedule.

3.5.4 BLASTING

3.5.4.1 GENERAL

Storage, handling and use of explosives shall be governed by the current explosive Rules laid down by the state Governments. The Contractor shall ensure that these Rules are strictly adhered to. The following instruction, wherever found in variance With the variance with the above rules, shall be considered as superseded by the Above rules.

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 not they Be allowed to handle the explosives.

3.5.4.2. STORAGE OF EXPLOSIVE:

Storage of explosive shall be governed by the current explosive rules. Explosive shall be stored in aclean, dry, well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400mm of the actual work site or any source of fire. A space surrounding the magazine shall be fenced in. the ground inside the fence shall be kept class and free from tress, bushes etc. the admission ti this fence without permission of the officer-in-charge. The clear space between the fence and the magazine shall. shall not be less than 90m. The magazine shall be perfectly well drained.

Two lightning conductors shall be provided to the magazine, one at each end. The Lightning conductors shall be once in every year.

Fuses and detonators shall be stored in separate magazines. However, detonators can be kept in an annexe adjoining the magazines. However, provided that their number does not exceed 25,000 and that the annexe is so constructed that not less than 60cm masonry and 100cm of air space shall intervene between any detonators in such annexe and not to be opened in a magazine. Cases containing explosives are not to be opened in a magazine. Explosives in open cases are not to be received into a magazine. Explosives which appear to be in damaged or dangerous condition are not to be kept in any magazine, but must be removed without delay to a safe distance and destroyed.

Artificial light is to be allowed in any magazine. No smoking shall be allowed within 100m of a magazine.

Magazine shoes without nails shall be used while entering the magazine.



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The mallets, levers, wedges etc, for opening barrels or cases are to be of wood. Inside a magazine the cases of explosives are to be carried by hand and shall not be rolled or dragged. Explosives, which have been issued and returned to the magazine are to be issued first, otherwise those which have been longest of cases in store are to be issued first.

Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides, special care is to be taken to kept the floor free from grains of powder of portions of explosive matter fallen on the floors due to leakage of cases etc.

The magazine shall not be opened during any duststorm or thunderstorm nor any person shall be allowed in the vicinity of the magazine.

All magazines shall be officially inspected at definite intervals and a record kept of the results of such inspections.

3.5.4.3. Carriage of Explosive

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

No persons except the driver shall be allowed to travel on a vehicle conveying Explosives. No carriage or vessel shall be used for transporting explosives unless all iron or steel therein with which a package containing any explosive is likely to come in contact is free of any other suitable material. No lights shall be carried on the vehicle carrying Explosives.

No operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

3.5.4.4 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 the Responsibilities imposed on him.

Holes for charging explosives shall be drilled with Pneumatic drills, the drilling Pattern being so planned that the rock pieces after blasting will be suitable for Handling.

The hole diameter shall be of such a size that cartridges can easily pass down them And undue force is not required during charging. Charging operations shall be Carried out by or under the personal supervision of the shot firer. Wrappings shall neve be removed from explosive cartridges. Only wooden rods shall be used for



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Loading and steaming shot holes. Only one cartridge at a time shall be inserted and gently passed home with the wooden tamping rod.

Only such quantities of explosives as are required for the particular amount of work To be done shall be brought to the works. Should any surplus remain when all the holes have been charged, it shall be carefully removed to a point at least 300m from the firing point.

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 and to keep the lead wires short circuited until ready to fire. Any kinks in detonator leading wire shall be avoided.

For simultaneous firing of a large number of shot holes, use of cordtex may be done. Cordtex shall be initiated by electric detonator attached to its side with adhesive tape, connecting wire or string.

All connection shall be made by authorised shot firer himself. The shot firing cable shall not be dragged along the ground to avoid possible damage to the insulation. The shot firing cable shall be tested for continuity and possible short circuiting before it is used each time.

The shot firer shall always carry the exploder handle on his person until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits.

Blasting shall be carried out at certain specified times to be agreed jointly by the Contractor and the Engineer.

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 300 meters radius from the firing point, or as required by statutory regulation, at least ten minutes before the time of firing by sounding a warning siren. The area shall be encircled by red flags.

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

When blasting is conducted in the neighbourhood of roads, structures, buildings etc. controlled blasting has to be carried out by drilling shallow shot holes and filling the same with light charge of explosives.



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Adequate safety precautions as per building bye-laws, safety code, statutory regulations etc. shall be taken during blasting operations.

3.5.5 DISPOSAL

The excavated spoil will be disposed of in any or all the following manners.

- a) By using it for backfilling straightway.
- b) By stacking it temporarily for use in back filling at a later date during execution of the Contract.
- c) i) By either spreading, or
ii) Spreading and compacting at designated disposal areas.
- d) By selecting the useful material and stacking it neatly in areas designated by the Engineer for use in backfilling by some other agency.

3.5.6 DISPOSAL OF SURPLUS

All surplus material from excavation shall be carried away from the excavation site to designated disposal area selected by Engineer.

All good and sound rock excavated from the pits and all assorted materials of dismantled structures shall be 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 for the same.

All sound rock and other assorted materials like excavated bricks, etc shall be stacked separately and shall be measured in stacks deducting 50% volumetric Measure for voids.

3.5.7 PROTECTION

The Engineer shall be notified by the contractor as soon as the excavation is Expected to be completed within a day so that it may be inspected by him at the Earliest. Immediately after approval of the engineer, the excavation must be Covered up in the shortest possible time. But, in no case the excavation shall be Covered up or worked On before approval and measurement by the Engineer. Excavated material shall be placed beyond 1.5 metres from the edge of the pit or Trench or half the depth of the pit or trench whichever is more or further away if Directed by the Engineer.

Excavation shall not be carried out below the foundation level of structure close by until required precautions have been taken.

Adequate fencing is to be made enclosing the excavation.

The Contractor shall protect all under- ground services exposed by excavation. The



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Contractor shall also divert all surface drains, etc. affected by the excavation to
Maintain the working area neat and clean.

3.5.8 DEWATERING

All excavations shall be kept free of water and slush. Grading in the vicinity of
Excavations shall be controlled to prevent surface water running into excavated
Areas. The Contractor shall remove by pumping or other means approved by the
Engineer any water inclusive of rainwater and subsoil water accumulated in
Excavation and keep the trench dewatered until the construction of foundation
Structure and backfilling are complete in all respects. (Expect where such separate
Payment will be made.) Sumps made for dewatering must be kept clear of the
Foundations. Method of pumping shall be approved by the Engineer but in any
Case, the pumping arrangement shall be no movement of subsoil or blowing in due
To Differential head of water during pumping.

If necessary, the Engineer may the contractor to Contractor to continue dewatering
Beyond his original or extended contract period in which case will be paid
Separately for dewatering as terms mentioned elsewhere under payment and
Measurement, provided the contractor has completed all the work satisfactorily

3.5.9.TIMBER SHORING

Timber shoring made out of approved quality of timber shall be 'close' or 'open'
Type, depending on the nature of soil and the depth of pit or trench and the type of
The contractor to take all necessary steps to prevent the sides of
Trenches and pits from collapsing.

3.5.9.1 CLOSE TIMBERING

Close timbering shall be done by completely covering the sides of the trenches and
Pits generally with short, upright members called 'polling board'. These shall be of
Minimum 250x40 mm sections as directed by the Engineer. The boards shall
generally be placed in pairs, one board on each side of cutting ,and shall be apart by
Horizontal walers of strong wood at maximum 1.2 metres spacing, cross struts shall
depend 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 the excavation and supported by vertical walers, which shall be
strutted to similar timber piece on the opposite face of the ground. No portion of the
sides shall be taken into the ground. No portion of the vertical side of the trench or
pit shall remain exposed, so that the earth is not libel to slip out.

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



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the pit or trench. It shall be started at 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.

3.5.9.2 OPEN TIMBERING.

In the case of open timbering, the entire surface of the side of trench pit is not required to be covered. The vertical board of minimum 250mm width and minimum 40mm depth shall be spaced sufficiently apart to leave unsupported strips of maximum 500 mm average width. The detailed arrangement, sizes of the timber and the distances apart shall be subject to the approval of the Engineer. In all other respects, specification for close timbering shall apply to open timbering.

3.10.0 TREATMENT OF SLIPS

The Contractor will take all precautions to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides. These precautions along with proper slopes, berms, shorting and control of ground water should cause no slips to occur. If however slips do occur due to causes beyond the control of the contractor, the same shall be removed by him and payment shall be made to him on appropriate item rate of earthwork. Slips caused due to negligence of the Contractor will be cleared and back-filled later by him at his own expenses.

3.7.0 BACK FILLING

3.7.1 GENERAL

The material used for backfilling shall consist of material, approved by the Engineer obtained directly from nearby areas where excavation work by the same agency is in Progress, from temporary stacks of excavated spoils or from borrow pits from Lumps and clods, roots and vegetations, harmful salts and chemicals, organic Materials, etc.

In certain locations, the Engineer may direct sand fillings. The sand should be Cleaned, well graded and be of quality normally acceptable for use in concrete.

3.7.2 FILLING AND COMPACTION IN PITS AND TRENCHES AROUND STRUCTURES

As soon as the work in foundations has been accepted and measured, the spaces Around The foundations structures in pits and trenches shall be cleared of all debris, brick bats, Mortar droppings etc, and filled with earth in layers not exceeding 250mm in loose Thickness each layer being watered, rammed and properly compacted to the Satisfaction of the Engineer. Earth shall be rammed with approved mechanised. Usually, no manual compaction shall be allowed unless specifically permitted by



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the Engineer. The final surface shall be trimmed and levelled to proper profile as Desired by the Engineer.

Since the degree of compaction depends on the moisture content of the soil, a close watch should be kept on it and corrections to optimise the moisture content.

3.7.3 PLINTH FILLING

The plinth shall be filled with earth in layers not exceeding 250mm in loose Thickness, watered and 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 the rammed and Compacted, in order to avoid any settlement at a later stage. The finished level of The following shall be trimmed to the slope intended to be given to the floor.

3.7.4 FILLING IN TRENCHES FOR WATER PIPES AND DRAIN

Earth used for filling shall be free from salts, organic or other foreign matter. All Clods of earth shall be broken or removed. Where excavated material is mostly Rock, the boulders shall be broke into pieces not bigger than 150mm size in any Direction, mixed with fine material consisting of disintegrated rock, moorum or Earth as available, so as to fill up the voids as far as possible and then the mixture Used for filling.

Filling in trenches for pipes and drains 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 excavation of trenches in rock, the filling unto a depth of 300mm or the Diameter of the pipe whichever is more, above the crown of pipe or barrel shall be Done with fine material such as earth, moorum, disintegrated rock or ash according To the availability at site. The remaining filling shall be done with rock filling of Boulders of size not exceeding 150mm mixed with fine material as available to fill Up the voids, watered, rammed and compacted.

3.7.5 FILLING IN DISPOSAL AREA

Surplus material from excavation which is not required for backfilling will be Disposed of in disposal areas. The spoil shall not be dumped haphazardly but Should be spread in layers approximately 250mm thick when loose and compacted With the help of compacting equipment. In wide areas rollers will be employed and Compaction done to the satisfaction of the Engineer as the optimum moisture Content, which shall be checked and controlled by the Contractor.



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In certain cases the Engineer may direct disposal without compaction which can be Done by typing the spoils from a high bench neatly maintaining always a proper Level and grade of the bench.

3.8.0 APPROCHES AND FENCING

The Contractor should provide and maintain approaches for workmen and for Inspection, the roads and approaches around the excavation pits 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 excavation as well as the bottom Of the filling at the surplus disposal area where dumping from a high bench is in Progress.

3.9.0 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.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 EXCAVATION

On completion of the excavation, the dimensions 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 filled back to Required lines, levels and grades by compacted earth, as directed by the Engineer At the Contractor's cost. The choice of grade of concrete will be a matter of unfettered discretion of the Engineer. Over excavation of sides will be made good free of cost by the contractor while carrying out the back filling. The excavation work will be accepted after the above requirements are fulfilled and all temporary Approaches encroaching inside the required dimension of the excavation have been Removed.

4.2.0 BACK FILLING

The degree of compaction required will be as the per the stipulation laid down in IS: 4701, if not otherwise mentioned in the Schedule and the actual method of Measuring the compaction achieved will be as decided by the Engineer. Is Satisfied With the degree of compaction achieved.

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 WITH TENDER



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Detail of equipment proposed to be used for excavation, back filling and Compactions have to be submitted along with the tender.

5.2.0 AFTER AWARD

After award of the Contractor the successful tender shall submit the following for Approved and adoption

- a) Within 30days of award of the Contractor, the Contractor shall submit a detailed Programme of the work as proposed to be executed giving completion dates of Excavation of the various foundations and the time required for back-filling and Compaction after completing the foundation for structure. In case the earthwork Contractor is also the agency for the foundation work, the Earthwork programme is To be contracted with the foundation programme. The programme should also show How the excavation and back-filling quantities will be balanced, minimising Temporary stacking of spoils. It is to be noted that Engineer even after initial Approval of the programme, may instruct to enhance or retard the progress of Foundations without attracting any claims from the Contractor. The initial Programme being submitted by the Contractor should have sufficient flexibility to Take care of such reasonable variations.
- b) Within 15days of award, the Contractor shall submit showing details of slopes, Shorings, approaches, sump pits, dewatering lines, fencing etc, for approval of the Engineer for adoptions.

6.00 RATES

The rates for the items shall include cost of all materials consumed in the works, Hire Charges of materials, tools and plant, cost of labour, insurance, all transport, Taxes, Royalties, security and safety arrangements, supervision, profit etc. The rates of Excavation shall be also include the cost of dewatering and stacking the Excavated Spoils properly within a lead of 30 m unless otherwise mentioned in the Schedule of items.

The Contractor will have to give a rebate if the excavated earth is directly used for Back-filling.

Where back- filling is to be done with sand, it shall be of good quality from quarries Approved by the Engineer. The rate shall include all operations including the cost Of sand.

In cases the Contractor is required to continue dewatering of the excavated pits Beyond of the contract, original or extended, he will be paid separately for it as the Schedule of items only for the period beyond the final terminal date of the contact. The rate will be complete in all respects including the cost all respect including the cost of consumables, if any.



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7.0.0 MEASUREMENTS

7.1.0 CLEARING AND GRUBBING

No separate measurement shall be done for this item for the purpose of payment in General except for cutting of trees having girth more than 30cms and works Connected to this.

7.2.0 EXCAVATION

Actual quantity of excavation required and approved by the Engineer shall be Measured in Cu.M.No extra shall be paid for keeping the excavations dewatered as Required for completion of the structure to come in. Necessary disposal of the spoil As described in the schedule of items shall be included in the quoted rate.

7.3.0 SHORING

The actual efficient area of shoring as approved by the Engineer, shall be measured In Sq.m.All planks, walling, verticals, struts, props and all other materials as Required for the shoring and subsequent safe dismantling and removal shall be Included in the rates quoted.

7.4.0 BACK-FILLING

7.4.1 WITH ASSORTED EARTH FROM EXCAVATIONS, TRENCHES ETC

Actual quantity of consolidated backfill shall be measured in Cu.M. The cost of Lead, Lift, etc. shall be as per schedule of items and included in the rate quoted.

7.4.2 WITH EARTH FROM BORROW PITS AND STACKS

Actual quantity of consolidated back-filling or actual quantity of excavation in the Borrow pits, or the excavated volume of the stack with a deduction of 30% for Voids, in case filling is done by earth from stack, whichever is less, shall be paid in Cu. M. The lead, lift, etc. as mentioned in the Schedule of item shall be included in The rates Quoted.

7.4.3 SAND FILLING

Actual quantity of consolidated sand filling shall be measured in Cu. M. The rate shall include cost of sand and all necessary works for execution of the item.

7.5.0 LEADS AND LIFTS

The leads for excavation and/or back filling will be measured between the centroid of the actual disposal area and that of the plan of pit. The distance between these Two points will two points will be measured along the shortest practicable haulage



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Path as decided by the Engineer.

Lift will be measured vertically between the average ground level from where the Pit Excavation was started and the bottom level of the excavated pit. Level lines Corresponding to the stages where lifts become payable will be drawn on the cross Section of the pit and the volumes of excavation contained between these horizontal Planes will be computed and paid according to the corresponding rates.

7.6.0 DEWATERING

Dewatering for work beyond the contract period original or excavated will be Measured on the basis of horse power –hour which will be obtained by multiplying The estimated requirement of horse power required to run the pumps or actually Employed, whichever is less, by the actual hours run, approximated to the nearest Half hour.

7.7.0 TRANSPORTATION OF SURPLUS EARTH

7.7.1 Payment shall be made only for the lead beyond initial 100M from construction Area. Rate shall include reexcavation, loading, transportation, dumping, stacking or Spreading (as per directions of the engineer-in-charge) the surplus earth and the soil In the area demarcated by the Engineer-in – charge. Payment shall be made on Cubic Meter (M^3) basis on the difference of measurements of the volumes of the Excavated Pits and the measurement of the back filling. Quantity generated due to Voids in back Filled volume of earth, shall also be removed by the Contractor at no Extra cost and This disposal of earth shall not measured and paid under any item.

7.7.2 In exceptional circumstances the Engineer- in-charge may direct the Contractor to Remove surplus earth, concrete or debris or any other material from site to the area Of disposal on the basis of truck measurement. In such cases volume of material Shall be calculated on the basis of truck volume reduce by 30% for voids in case of Soft/hard soil sand 50% for soft/hard rock. All other provisions of disposal such as Spreading, levelling, grading shall apply in this case also.

ANNEXXURE F3.1- VERY BROAD SPECIFICATIONS FOR SOIL TO BE CONSIDERED AS CNS MATERIAL

SL.NO.	PROPERTY	VERY BROAD SPECIFICATION RANGE
1.	Grain size analysis	
	(i) Clay	15-25%
	(ii) Silt	35%-50%



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	(iii) Sand	30-40%
	(iv) Gravel	< 10%
2.	Consistency limits	
	(i) Liquid limits	30-50%
	(ii) Plastic limit	20-25%
	(iii) Plasticity index	10-25%
	(iv) Shrinkage limit	15% and above
3. (a)	Swelling pressure when compacted to Maximum dry density corresponding to Standard proctor compaction with zero Initial compaction moisture constant, for No volume change condition.	Less than 0.1kg/cm ² 10kN/m ²
(b)	Swelling pressure when compacted to Maximum corresponding to standard Proctor compaction and initial compaction Moisture corresponding to optimum moisture Content for no volume change condition	less than 0.05kg/cm ²
4.	Clay minerals	Preferable kaolinite Illite
5.	Shear strength of/ compacted to maximum dry Density correspond to standard proctor compaction And initial moisture content corresponding to Optimum moisture content, but sample test on Saturation.	
	(a) From unconfined compression	Cu0.15- 0.35 Kg/cmsq.
	(b) From consolidated undrained direct Shear test	Cu0.0.1-0.3 kg/cmsq. (10-30 kN/m sq)

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Add under clause 3.70 back filling.

If it is required to use clayey soil exhibiting swelling properties for filling Around foundations and under pavement and floor slabs due to non Availability of suitable filling material nearby, then the back filled clayed Swelling soil should be well compacted and a layer of not less than 250mm Thick cohesive non-swelling (CNS) soil shall be placed on top of the clayey soil and well compacted. Very broad specifications for soil to be Considered as CNS material is given in Annexure F3:1 enclosed at the end of the section.



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REV. NO.	PRAPARED	APPROVED	DATE
00	MARINA	PMISHRA	00

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SCOPE

1.1 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.

1.2 This specification shall also supply to the extent it has been referred to or applicable with the special requirements of structures covered in scope of is: 456.

1.3 IS: 456 shall from a part of these specifications and shall be complied with unless permitted otherwise. for any particular aspect not covered by these code, appropriate is code, specifications and/ or replacement by an international code of practices as may be specified by the engineer shall be followed. all code and standards shall conform to its latest revisions. a list of is codes and standards is enclosed hereinafter for reference.

2.0 General

2.1 Work to 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, mids construction equipment, tools and plants, transportations- etc. required for the work.
- b) Except where it is excluded from the scope of contract, contractor shell prepare progressively and submit for approval detailed drawing and bar bending schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.
- c) Design and prepare working drawing of formworks, scaffolds supports, etc. and submit for approval.



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- d) Submit for approval shop drawing for various inserts, anchors, anchor, bolts, pipe sleeves, embodiments, hangers opening, frames etc.
- e) Submit for approval detailed drawing of supports, templates hangers etc. required for installation of various embedments like inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc.
- f) Submit for approval detailed schemes of all operation required for executing the work, e. g. material handing, 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) Embedment
 - 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, specifications and schedule of items.
- 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, perform for satisfactory performance for a reasonable period as may be specified , binding the manufactures and the contractor, jointly and severally.

2.2 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.

2.3 Information to be submitted by the tenderer

2.3.1 With tendered

The following technical information are required with the tender.



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- a) Source and arrangement of processing of aggregates proposed to be adopted.
- b) Type of plant and equipment proposed to be used.
- 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.

2.3.2 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 and requirement of materials

within 30 days of the award of contract, the contractor will submit a master programme for completion of the work giving month wise requirements of materials, particularly mentioning in details the materials which are to be supplied by the owner, and for the procurement of which the help of the owner is required as per the terms and conditions of the contract. in case the contractor proposes to take on hire any machineries or tools and plants from the owner, the detailed phased out programme of such hire is also to be submitted.

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. Approved samples will be preserved by the engineer for future reference. 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
- ii) admixtures
- iii) Plywood for form work.
- iv) Embedded and anchorage materials as may be desired by the engineer.
- v) Joint sealing strips and other water proofing materials.
- vi) Joints filling compounds
- vii) Foundations quality rubber pads

c) Design mix



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Design mix as per clauses 2.1 (g) & 3.4 of this specification giving proportions of the ingredients. sources of aggregates and cement. along with accompanying test results of trial mixes as per relevant i. s. is to be submitted to the engineer for his approval before it can be used on the works.

d) Detail drawing and bar bending schedules

Detailed working drawings and bar bending schedules in accordance with clause 2.1 (b) and 3.16.1 of this specification.

e) Detailed drawing and designs of formworks to be used

Detailed design data and drawings of standard formworks to be used as per clauses 2.1 (c).

Detailed drawing for templates & temporary supports for embodiments

As per clause 2.1(e).

g) Mill test report for cement & reinforcing steel

mill test report for cement and reinforcing steel in case these Materials are supplied by the contractor.

H) Inspection reports

Inspection reports in respect of form work and reinforcement and any other item of work as may be desired by engineer in accordance with clause 2.4 of this specification.

i) test reports

Reports of tests of various materials and concrete as required under clause 4.0: sampling & testing of this specification.

j) any other data which may be required as this per this specification

2.4 Conformity With Design

The contractor will prepare check 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 specification, the engineer will give written permission on the same poured card allowing the contractor to commence placement of concrete. Details of all instruction issued by the engineer and any other relevant information will be written on accompany sheets,



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termed as progress cards, will be prepared by the contractor on approved Performa. 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 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, of concrete will be as approved or directed by the engineer.

2.5 Materials to be used

2.6 General Requirement

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

2.5.2 Cement

Generally, cement shall be ordinary Portland cement conforming to IS :8112. In special case, rapid hardening Portland cement, low heat cement etc. May be permitted or directed to be used by the engineer.

2.5.3 Coarse Aggregate

Aggregate of size ranging between 4.75 mm and 150mm will be termed as coarse aggregate. only coarse aggregate from approved quarries and conforming to is: 383 will be allowed to be used on the works.

2.5.4 Fine Aggregate

Aggregate smaller than 4.75 mm and within the grading limits and other requirement set in is:383 is 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 on works.

2.5.5 Water

Water for use in concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts or other impurities. Normally potable water is found to be suitable. generally, is:3550 will be followed for routine tests. in



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case of doubt, the acceptance test for water shall be as per is: 3025, and table-i of is: 456.

2.5.6 Admixture

Only admixture of a quality will be used when directed or permitted by the engineer. the admixture shall conform to is: 9103.

2.5.7 Reinforcement

Reinforcement shall be as per relevant specification as mentioned in the contract/drawing/instruction. all bars above 10mm dia. shall be tested quality.

2.6.0 Storage of materials

2.6.1 General

All materials shall be so 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 from site immediately, failing which, the engineer shall be at

Liberty to get the materials removed and the cost incurred there of shall be realised from the contractors dues. The contractor shall maintain up to- date

2.6.2 Cement:

- 1) Sufficient space for storage, with open passages between stacks, shall arranged by the contractor to the satisfaction of the engineer.
- 2) Cement shall be stored off the ground in dry, leak proof, well-ventilated ware-houses at the works in such in such a manner as to prevent deterioration due to the moisture or intrusion of foreign matter. Cement shall be stored in easily countable stacks with consignment identification marks.
- 3) Consignment shall be used in the order of their receipts at site. Sub – standards or partly set cement shall be removed from the site, with the knowledge of the engineer, as soon as it is detected

2.6.3 Aggregate:

Aggregate shall be stored on planks or steel plates or on concrete or masonry surface. Each size shall be kept separated with wooden or steel or concrete or masonry bulk-heads 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.



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2.6.4 Reinforcement:

Reinforcement 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 be removed from storage.

2.7 Quality Control:

Contractor shall establish and maintain quality control for different items of work and materials as may be directly by the engineer to assure compliance with contract requirement and maintain and submit to the engineer records of the same. The quality control operation shall include.

- a) Admixture : Type, quantity, physical and properties that affect 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 : Test of satisfy relevant IS specification (only association With Owner s tests, if the supply is made by Owner).
- e) formwork : material , shapes dimensions, lines elevation , surface Finish, adequacy of form , ties, bracing and shoring and Coating.
- f) Reinforcement : shapes, dimensions, length of splices, clearances, items and supports . Quality and requirement of welded splices.
- 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.



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- i) joints : Location 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 proper bond, prevention of cold joint, types of chutes or conveyors.
- l) Compaction : numbers of vibration, 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 & Beaming plates : Lines, elevations and bedding mortar.
- n) Concrete finishes : Repairs of surface defects, screening, floating, steel troweling and Booming, special finishes.
- o) Curing : Methods and length of time.

Copies or 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.

3.0 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 requirement Mentioned in this section of the specification do not cover all the aspects to the full Satisfaction of the Engineer.

3.1 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.

3.2 Admixture



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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 may be permitted to be used 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 other 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.

3.3 Grades of Concrete

Concrete shall be in any 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 or as per the Engineer's instruction. In case of liquid retaining structures, IS: 3370 will be followed.

3.4 Proportioning and Works Control

3.4.1 General

Proportioning of ingredients of concrete shall be made by any of the two following Methods as directed by the Engineer.

- a) With preliminary tests by designing the concrete mix. Such concrete shall be called "Design Mix Concrete"
- b) 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. Ordinary concrete, in grades permitted in accordance with IS: 456 may be used if shown on drawing or approved by the Engineer. In all cases the proportioning of ingredient 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.

3.4.2 Mix Design Criteria

Concrete mixing 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 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.



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- c) 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.
- d) The finished concrete should have adequate durability in all conditions to withstand satisfactorily the weather and other destruction agencies which it is expected to be subjected to in actual services.

The requirement of adequate structural strength is catered for by the choice of proper grade of concrete by the Engineer. The Contractor will strictly abide by the same in his design of concrete mix installation.

Notwithstanding anything mentioned in various tables given in IS:456 giving specific values and degrees of workability for different condition of concrete placing, minimum cement content and maximum water cement ratio for concrete exposed to sulphate attack and for concrete to ensure durability under different condition of exposure, strength requirement for different grades of concrete, proportion for nominal mix concrete, the following tables in the specification are included. For identical condition is values given in the tables shown herein below are different from those mentioned in IS:456, the values as indicated in the table shown herein below shall prevail.

TABLE – 1

STRENGTH REQUIREMENT OF CONCRETE

Grade of Concrete	Specific Characteristic Compressive Strength of 15cm cubes at 28 days conducted in accordance with IS: 516(All values in N/Sq.mm)
M – 10	10
M – 15	15
M – 20	20
M – 25	25
M – 30	30
M – 35	35
M – 40	40



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Note: 1. Notwithstanding anything mentioned above, the cement/total aggregate ratio is not to be increased beyond 1:9.0 without specific permission of the Engineer

Note: 2. It should be noted that such high aggregate cement ratio will be required for concretes of very low slump and high water – cement ratio which may be required to be used in mass concrete work only.

Note: 3. The above figures are guidance only, the actual cement /aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used and from trial mixes.

3.5 Strength Requirements

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.

3.6 Minimum Cement Content

The minimum cement content for each grade of concrete shall be as shown below unless specified in schedule of items: -

TABLE –III

Minimum Cement CONTENT, Maximum Water Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm nominal maximum Size

SI No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum Cement Concrete Kg/m ³	Maximum Free Water Cement Ratio	Minimum Grade of Concrete	Minimum Cement Concrete Kg/m ³	Maximum Free Water Cement Ratio	Minimum Grade of Concrete
1	2	3	4	5	6	7	8
i)	Mild	220	0.60		300	0.55	M20
ii)	Moderate	240	0.60	M15	300	0.50	M25
iii)	Severe	250	0.50	M20	320	0.45	M30
iv)	Very severe	260	0.45	M20	340	0.45	M35
v)	Extreme	280	0.40	M25	360	0.40	M40



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Note: 1.Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in 5.2. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water – cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (part I) and IS 455 respectively.

2. Minimum grade of plain concrete under mild exposure condition is not specified.

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 WEIGHT OF CEMENT TO CRUSHED STONE AGGREGATE	
		20mm size	30mm size	20mm size	38mm size
Very low slump 0-25 mm	0.4	1:4.8	1: 5.3	1: 4.5	1: 5.0
	0.5	1:7.2	1: 7.7	1: 6.5	1: 7.4
	0.6	1:9.4	1: 10	1: 7.8	1: 9.6
	0.7	1:10	1: 12	1: 8.7	1: 10.6
Low slump 25-50 mm	0.4	1:3.9	1: 4.5	1: 3.5	1: 4.0
	0.5	1:5.5	1: 6.7	1: 5.0	1: 5.5
	0.6	1:6.8	1: 7.4	1: 6.3	1: 7.0
	0.7	1:8.0	1: 8.5	1: 7.4	1: 8.0
Medium slump 50-100 mm	0.4	1:3.5	1: 3.8	1: 3.1	1: 3.6
	0.5	1:4.8	1: 5.7	1: 4.2	1: 5.0
	0.6	1:6.0	1:7.3	1: 5.2	1: 6.2



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High slump 100-175 mm	0.4 0.5 0.6 0.7	1:3.2 1:4.4 1:5.4 1:6.2	1: 3.5 1: 5.2 1: 6.7 1: 7.4	1: 2.9 1: 3.9 1: 4.7 1: 5.5	1: 3.3 1: 4.6 1: 5.7 1: 6.5

Note: 1- notwithstanding anything mentioned above, the cement/ Total aggregate ratio is not be increased beyond 1; 9.0 without specific permission of the Engineer

Favourable conditions, on of better quality of cement control, then the Engineer may instruct lower cement content, and Contractor shall abide by the stipulations laid down hereunder:

- The contractor shall design the mixes for 10% (ten percent) higher strength over and above those specified in table-I under Clause 3.4, for the various grades of concrete and different slump requirement.
- 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.
- 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.
- 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.

In case there is a downward revision of the minimum cement content from that specified in the contract, the particular unit rate of concrete will be reduced by an amount equal to the cost of cement saved, calculated at the issue rate. The relevant cost of wastage and handling on the cement saved, which is inherent in the total cost of structure, will not be deducted from the unit rate and will thus pass on the Contractor.

3.7 Water Cement Ratio

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

- The requirement of strength
- The requirement of durability.

3.7.1 Strength Requirement



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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 ratio for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary test laboratory to the satisfaction of Engineer. Frequent checks on test will have to be carried out and the water – cement ratio will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above all the consequences in case of default remains unaltered.

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

3.7.2 Durability Requirement

Tables 19 & 20 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 chemical. Impermeability may also be an important consideration.

Whenever the water – cement ratio dictated by Durability consideration is lower than that required from strength criterion, the former shall be adopted.

However, water – cement ratio, from the point of durability as well as from strength consideration, should meet the requirement given in Table No.IV.

TABLE IV

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

	Exposure Conditions					
	Severe wide range of Temperature. Frequent alterations of freezing and thawing (use Air Entrained concrete only)			Mild Temperature rarely below Freezing or rainy or arid		
Type of structure	At the water line or within the range of fluctuating water level or spray.			At the water line or within the range of fluctuating water level or spray.		
	In air			In air		



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		In Fresh water	In sea water or in contact with sulphate (concentrati on more then 0. 2p.c)		In fresh water	In sea water or in contact with sulphate (concentration more then 0. 2p.c)

Thin sections such as railing kerbs, sills ledges, ornamental or Architectural concrete reinforced concrete piles, pipes and all sections with less then I” concrete cover to reinforcement	0.49	0.44	0. 40	0.53	0.49	0.40
Moderate sections such as Retaining Walls, abutments, piers, girders, beams	0.53	0.49	0.40	*	0.53	0.44
Exterior portions of heavy mass sections	0.58	0.49	0.44	*	0.53	0.44
Concrete deposited by Tremie under water	-	0.44	0.44	-	0.44	0.44
Concrete slabs laid on ground	0.53	-	-	*	-	-
Concrete which will later be protected by enclosure or backfill but which may be exposed to freezing & thawing for several years before such protection is offered	0.53	-	-	*	-	-



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Concrete protected from the water, interiors of building concrete below ground which is free from sulphate attacks	*	-	-	*	-	-

Note: * Water/Cement ratios be selected on basis of strength and workability requirements.

3.8 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 embodiments 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 and like
Low	25	50	Uncontested wide and shallow R.C.C. Structures
Medium	50	100	Deep but wide R.C.C. Structures with congestion or 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 professes shall be as per direction of the engineer)



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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.

Workability of concrete shall be checked at frequent intervals by slump tests. Alternative where facilities exist or if required by the engineer, the compacting factor test in accordance with IS: 1199 and Clause 6 of IS: 456 shall be carried out.

3.9 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	-	12mm
Reinforced concrete except foundation	-	20mm
Ordinary plain concrete and Reinforced	-	40mm
Mass concrete	-	80mm
Mass concrete very large structure	-	150mm

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 of the specified proportion, strength and consistency that will work readily into position without segregation.

Coarse aggregate will normally be separated into the following size and stacked separately in properly designed stockpiles ; 150mm to 80mm, 80mm to 40mm, 40mm to 20mm and 20mm to 5mm. In certain it may be necessary to further split the 20mm to 5mm fraction into 20mm to 10mm and 10mm to 5mm fractions.

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

3.10 Mixing of Concrete

Concrete shall always be mixed in mechanical mixer unless specifically approved by the Engineer for concrete to be used in unimportant out of the way locations in small quantities. Water shall not normally be charged into the drum of the mixer until all the cement and aggregates consisting 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 color and consistency, but in no case shall mixing be done for less than 2



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(two) minutes and at least 40 (forty) revolutions after all the material 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 mixes, 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 where used shall conform to IS: 4925.

When hand mixing is permitted by engineer, 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

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 settings of the cement starts. Concrete should be conveyed in such a way as will prevent segregation of loss of any of the ingredients. For long distance haulage, agitator cars of approved design will be used. If in spite of all precautions, segregation does occur during transport, the concrete shall be properly remixed before placement. During 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 evaporation or loss of heat. If equipments for concrete shall be well maintained and thoroughly cleaned before commencement of concrete mixing. Such equipments shall be kept free from set concrete.

A layer of mortar of thickness 12mm of the same or less w/c ratio and the same proportion as that of the concrete being placed and cement slurry will be spread thoroughly on the rock foundation or construction joint just prior to placement of concrete. The cost of application of such cement slurry and mortar will be deemed to be included in the unit rate of concrete.

After concrete has been placed, it shall be spread, if necessary and 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



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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 vibration 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 and 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. Moulding, 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, anchor's 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.

3.12

Placing and Compacting Concrete

Where specifically covered the relevant IS 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 the relevant IS Code for any particular aspect or 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:-

- a) Earth foundations
- b) Rock foundations
- c) Formwork



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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 cutting's dirt, oil, foreign and deleterious material, laitance, etc., are to be removed by the air water jetting or water at high pressure. Earth foundation on which direct placement of concrete is allowed, will be crumble and 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, embodiments, 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 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.

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 Construction Joints and Cold Joint

3.13.1 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 at 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 embodiments and fixtures that may be shown. For water retaining structures and leak proof buildings suitable and approved water stops may be installed at the construction joints as per clause 12.4 of IS: 456.



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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 soft 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 in 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 with which no construction joint will be allowed.

3.13.2 Cold joint

An advancing face or 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 rise in spite of extensive vibration,



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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 Repairs, Finishes and Treatment of Concrete surfaces

3.14.1 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 and 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 and shape.
- c) Cleaning or reinforcement and embedments.
- d) Roughening by sand blasting or chipping
- e) Installing additional reinforcement/welded mesh fabric
- f) Dry packing with stiff mortar
- g) Plastering, guniting, shotcreting etc
- h) Placing and compacting concrete in the void left by cutting out defective concrete.

Grouting with cement sand slurry of 1:1 mix.

3.14.1.1 Finishing Unformed Surfaces

The requirements of finishes of formed surfaces are given separately under clause 3.20.7 of this specification. The Contractor is to include in his quoted rate for concrete, the provision of normal finishes in unformed surfaces which can be achieved by screening, floating, troweling etc., as and where required by the Engineer without any extra cost to the Owner. A few typical and common cases of treatment of concrete surface are cited below:-

- a) Floor

Wherever a non-integral floor finish is indicated, the surface of reinforcement 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 troweling, to obtain a very smooth surface, shall be done as it will prevent adequate bond with the subsequent finish.



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If desired by the Engineer, the surface shall be scored and marked without any extra cost to the Owner 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 aberration Steel trowel ling properly done will flatten and smoothen sandy surface left by wooden floats and procedure a dense surface free from blemishes, ripples and trowel mark. A fine textured surface that is not slick and can be obtained by trowel ling the surface lightly with a circular motion after initial towelling 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 trowel ling.

b) Beams, Columns & Walls

If on such or any other concretes structure it is intended to apply plaster or such concrete surfaces against which brick work or other allied works are to be built. The Concrete shall hack the surface adequately as soon as the from it stripped off so that proper bond can develop pattern adequacy and details of such hacking shall meet with the approval of the Engineering who shall be informed to inspect such surfaces before they are covered up.

3.15 Protection and curing of concrete

- i) Newly placed concrete shall be protected approved means from rain sun and wind. Concrete placed below the ground level shall be protected aghast 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 of flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage b 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, hession, 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.



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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 any lapse on the part of the Contractor is noticed by the Engineer, 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 pay for the part where adequate curing was noticed at a reduced rate, entirely at the discretion of the Engineer.

3.16 Reinforcement

Mild steel round bars, cold twisted and 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.

3.16.1 Bar Bending Schedules

The Contractor shall submit the Engineer for approval Bar Bending Schedules with working drawing in triplicate, showing clearly the arrangements proposed by the Contractor to match available stock of reinforcing steel, within one month of receipt of the Letter of Intent or of the receipt of the relevant design drawings whichever is later. Upon receipt of the Engineer's final approval of the Bar Bending Schedule and drawings, the Contractor shall submit 6 (six) prints of the final drawings with one reproducible print after incorporating necessary modifications or corrections, for final record and distribution. 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.

3.16.2 Cleaning

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

3.16.3 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 to the approved Bar Bending Schedules. Bar Bending Schedules shall be rechecked by the Contractor before any 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. Bars shall not be



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straightened in a manner that will injure the material. Rebinding 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 Deg. 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.

3.16.4 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 irrespective of whether such supports are payable or not. 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 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.

3.16.5 Welding

Normal bond laps in reinforcement may be placed by lap or butt welding reinforcement bars, if asked by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant India 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 Schedule of Items and Drawings.

3.16.6 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 in a lap are not of the same diameter, the smaller will guide the lap length. The laps shall be staggered as far as practicable and as that reinforcement in position do not have to bear extra load and get disturbed.

The cover for concrete over the reinforcement 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

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	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 Cold Weather Concreting When conditions are such that the ambient temperature may be expected to be 4.5 Deg. C or below during the placing and curing period, the work shall conform to the requirement of Clause 13 of IS:456 and IS:7861. 3.18 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 Deg. C while placing. Positive temperature control by precooling, post cooling or any other method, if required, will be specified and paid for separately. 3.19 Concreting under water When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of clause 13 of IS:456. 3.20 FORM WORK 3.20.1 General If it is so desired by the Engineer, the contractor shall prepare, before commencement of actual work, designs and working drawings for form work and cantering 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 cantering 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 cantering shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Reckers 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 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 form work 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.	



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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 or 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 free of charge 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 plumb and true thoroughly cross-braced to keep them so. All floor and beam centering shall be crowned not less than 8 mm in all directions for every 5 meters span. Unless specifically described on the drawings or elsewhere to the contrary, bevelled forms 25 mm by 25 mm shall be fixed in the form-work at all corners to provide chamfering of the finished concrete edges without any extra charge. 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 of 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.

3.20.2 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, saw dust 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.

3.20.3 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



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

30.20.4.1 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.

3.20.4 Removal of Forms

Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if he 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 of the Owner. The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

Form for various types of structural components shall not be removed before the minimum periods specified herein and the removal after the minimum periods shall also be subject to the approval of the Engineer in each case.



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TABLE – VI
SCHEDULE OF REMOVAL OF FORM

part of Structure	Ordinary Portland Cement Concrete				Rapid Hardening Portland Cement Concrete			
	Temperature °C				Temperature °C			
	Above 40°C	40 ⁰ 20 ⁰	20 ⁰ 5 ⁰	Below 5 ⁰	Above 40°C	40 ⁰ 20 ⁰	20 ⁰ 5 ⁰	Below 5 ⁰
	Days	Days	Days	Days	Days	Days	Days	Days
a) Columns & Walls	2	1	1	Do not remove forms until site cured test specimen develop at least 50% of the specified 28 days 12 strength	1	1	1	Do not remove forms until site cured test specimen develop at least 50% of the specified 28 days strength
b) Beam sides	3	2	3		2	1	1	
c) Slabs, 125 mm	10	7	8		7	4	5	
d) Slabs over 125 mm thick and soffit of minor beams	18	14	16		12	8	9	
e) Soffit of main beams	24	21	22		14	10	12	

Wherever exposed surfaces of concrete can be effectively sealed to prevent loss of water, the periods specified for temperature above 40 Deg. C can be reduced to those of the temperature range of 20 Deg. C to 40 Deg. C subject to approval of the Engineer.

Construction joints in beams, if required to be provided, will be located at the middle of span according to clauses 3.13.1 (b) of this specification. In such cases, however, entire span of beam shall have to be kept supported by form work till its removal for the portion of beam, cast at a later date, is due and so approved by the Engineer.

3.20.5

Tolerance

The from work shall be so made as to produce a finished concrete true to shape, lines, levels, plump and dimensions as shown on the drawings subject to the following to lerances otherwise specified in this Specification or drawings or directed by the Engineer:

For a) Sectional dimension - $\pm 5\text{mm}$

b) Plumb - 1 in 1000 of height



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c) Levels

- $\pm$ 3mm before any deflection has
Taken place

The tolerance given above are specified for local aberration in the finished concrete surface and 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.

3.20.6 Re-use of Forms

Before re-use, all forms shall thoroughly scraped, cleaned, joints and planes examined and when necessary required, and inside surface treated as specified here in before. From work shall not be used/re-used if declared unfit or unserviceable by the Engineer.

3.20.7 Classification

Generally, the 'ordinary' class from work shall be used unless otherwise directed by the Engineer:

- 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 a 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 specification and approval by the Engineer. He may also permit utilisation 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 Opening, Chases, Grooves, Rebates, blackouts etc.

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

3.22 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and Other Miscellaneous Embedded Fixtures



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The Contractor shall build into concrete work all the items noted below and shall embed them partly or fully as directed and secure the same as may be required. The materials, if required to be supplied by the Contractor, 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 be painted 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, fixtures, supports etc. shall be used as may be required or directed by the Engineer, free of cost to the Owner.

Items to be embedded

- a) Inserts, hangers, anchors, frames 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 structural to be left embedded for future extension. Special connection etc.
- d) Dowel bars, etc. for concrete work falling under the scope of the contractors.
- e) Lugs or plugs for door and window frames occurring in concrete work.
- f) Flashing and jointing in concrete work.
- g) Any misc. embodiments 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 Expansion and Isolation Joints

3.23.1 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 herein after. 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



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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.

3.23.1 Bitumen Board/Expanded Polystyrene Board

3.23.2.1 Bitumen Board

Bitumen impregnated fibre board 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 piece, 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.

3.23.2.2 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.

3.23.2 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. Aluminium 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 joint. 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.

3.23.3.1 Metal Sealing Strips



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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 and schedule of items and/or as instructed by the Engineer.

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, longer lap lengths and different method of brazing which will tender it leak proof, will be adopted by the Contractor without any additional cost to the Owner. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

a) **G.I. Strips**

G.I. Strips shall be minimum 1.5 mm thick and 150 mm in width unless specified otherwise. The Standard of Galvanising 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.

b) **Aluminium Strips**

Aluminium strips shall be minimum 10 SWG thick and 300 mm wide unless specified otherwise and shall conform to IS:737 of 19000 grade or 31000 grade (Designation as per IS: 6051. A minimum lap of 50 mm length is required at the joints.

c) **Copper Strips**

The Copper strips shall be minimum 18 SWG in thickness and 300 mm wide unless specified other wise 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.

3.23.3.2 Non-metallic Sealing Strips

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

- a) Plain
- b) Central bulb
- c) Dumb-bell or flattened ends.
- d) Ribbed and Corrugated Wings
- e) V shaped



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As these types of seals be easily handled in very lengths unlike metal strips, transverse joints will be only under unavoidable circumstances and with the specific approval of the Engineer.

The method of forming these joint, laps etc. shall be specified by the manufacturer and /or as approved by the Engineer taking particular care to match the central bulbs and the edges accurately

a) **Rubber Sealing Strips**

The minimum thickness of Rubber sealing strips shall be 3mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings/schedule of items and/or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion and tear and also 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	:	65 A to 75 A
Tensile Strength	:	25-30 N/Sq.mm
Maximum Safe Continuous Temperature	:	75 Deg.C
Ultimate Elongation	:	Not less then 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 / Schedule of items and / 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, which will be directed by the Engineer, may very slightly:-

Specific Gravity	:	1.3 to .1. 35
Shore Hardness	:	60 A to 80 A
Tensile Strength	:	10 – 15 N/Sq.mm
Maximum Safe Continuous Temperature	:	70 Deg.C
Ultimate Elongation	:	Not less then 275 %

3.23.4 Bitumen Compound

When 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.

3.23.5 Isolation Joints



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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.

3.23.6 Rubber Pad

Hard Foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings or as directed by the Engineer. The rubber shall have a unit weight of 1,500Kg/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 earth or any earth or any other deleterious material expected under normal conditions.

3.24 Grouting under Machinery or Structural Steel Bases

If required, grouting under base plates of machines or structural steel etc., shall be carried out by 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, 6mm 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 desired by the Engineer, admixtures like Aluminium powder, 'Ironite' etc. may have to be added with the grout in proportions to be decided by the Engineer. Admixture, if directly to be added, will be measured and paid sep[separately].

3.25 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 have 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 proportions) 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 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.



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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, levelling 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 directed by the Engineer. 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 Water Proofing of Concrete Structure

3.26.1 General

Waterproofing of concrete structures shall be by either suitable extraneous treatments like applying paints, fixing bitumen felts etc. or 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.

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.

3.26.2 Water Bar/Seal

Water bearing structures and under ground structures may have water bar/seals installed at the joints. They may be either metallic rubber or P.V.C. The materials and installation will be as described under Clause 3.23.3.

3.26.3 Waterproofing Admixtures

- 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 the Owner 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 water



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proofing 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 manufacturer's supervisor at no extra cost to the Owner. On completion, the plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

3.26.4 Bituminous of Tar Coating

The surface to be waterproofed shall be rendered absolutely dry, clean and dust free. The surface shall be sand papered, cleaned and completely coated with hot coal tar pitch of approved manufacture and quality as per IS: 216 (not heated above 375 Deg.F) using not less than 2 kg per Sq. M or with hot asphalt i.e., bitumen according to IS: 73 (not heated above 400 Deg.F) using not less than 1.5 kg. Per Sq. m when the first coat has completely dried up and approved by the Engineer, the second coat shall be applied in the same manner using not less than 1.25 kg. per sq. M in case of coal tar and 1 kg per Sq. M. in case of asphalt. Immediately after application of the second coat and before it is dried up, sand shall be spread on the surface to cover it completely. Sufficient time shall be allowed after spreading of before back filling is done in order to allow the final coat to dry up completely.

3.26.5 Bitumen Felt: Application for Tanking

This specification shall cover laying the waterproof coarse 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 shall be Hessian base and/or fibre base as specified in Drawing/Schedule of Items. If required by the Contractor without charging any extra to the Owner.

Cleaning the surface, keeping it dry, providing necessary corner fillets and cement rendering and cutting chases, etc., shall be included in the rate for this item. If any protective brickwork on/against concrete sub-bases or walls are required, this will be paid extra under suitable items in the contract. A 20 years guarantee for satisfactory performances shall be given by the Contractor as well as his specialist sub-contractor jointly and severally, for this item of 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.

3.26.6 Polyethylene films: Application in Walls or base of Structures

Waterproof treatment shall be applied as outlined and as per sequence given here under.

- 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 back poly ethylene film 250 micro (IS 2508- 1977) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed,



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taking care not puncture the film.

Alternatively, the overlaps shall be 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 spread a cushion for better welding of 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 join 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 80/200 grade (IS: 73-1961) at 1.0 Kg/Sq.m minimum.
- vi) Lay 250-micron polyethylene film as second layer similar to (iii) above.
- vii) Lay second layer of 100 gm brown craft paper laminated similar to (iv) above.
- viii) Apply hot bitumen (straight run grade) to IS: 73-1961 at 1.0 Kg/Sq.m. dusted with fine sand.
- ix) Protecting with a layer of 75 mm plain cement concrete M-100, 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.

4.0 SAMPLING AND TESTING

4.1 General

The Contractor shall carry out all sampling and testing in accordance with the relevant India Standards and as supplemented here in 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 test results in triplicate within 3 (three) days after completion of the test.

4.2 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 IS:269. Soundness Tests may also be required to be carried out if required by the Engineer. The test shall be carried out free of charge by the Owner, if Cement is supplied by him or by the Contractor is directed to arrange for the supply as per the terms and conditions of the Contract. In case due to any circumstances, the agency of supply is changed in the middle of the Contract, the party who bore the original contractual obligation will carry on with the test, free of charge to the other, till the end of the works unless satisfactory 3(three) days and 7 days test results for compressive strength are known. The Owner, Engineer and Contractor will jointly associate themselves with the tests irrespective of whether they are carried out by the Owner or the Contractor. These tests are of great importance as



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their results will have a bearing on the acceptance of concrete or otherwise as per the terms and conditions of the Contract.

4.3.1 Aggregates

The Contractor shall carry out any or all the tests aggregates as may be required by the Engineer in accordance with IS2300 (PARTS-I to VIII). The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant Indian Standards.

4.4 Water

Sampling and Testing of water being used for concrete works per IS:3550 will be carried out by the Contractor at regular intervals and whenever directed by the Engineer. The final acceptance criteria in case of doubt will be as per IS: 3025 & IS: 456.

4.5 Admixture

4.5.1 Air Entraining Agents

Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cylinder cube crushing strength via-a via quantity of A.E.A. used for all types of concrete will be established by the Contractor free of charge by carrying out sufficiently large number of tests. Contractor will check up free of charge, the actual presented by the Engineer, the Contractor with earlier test results.

4.5.2 Other Admixtures

Tests for establishing the various of any other admixtures which may be Required to be added shall be carried out by the Contractor free of charge to Owner.

4.6 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 Clause 14 of IS: 456.

To control the consistency of concrete from every mixing plant, slump tests and/or compacting factor tests in accordance with IS:1199 and as mentioned in Clause 3:6 of this Specification shall be carried out by the Contractor every two hours or as directed



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by the Engineer. Slump corresponding to the test specimens shall be recorded for reference.

The acceptance criteria of concrete shall be in accordance with Clause 15 of IS:456. However, in exceptional circumstances, the Engineer may, at his discretion, accept a concrete of lower strength than specified and which is otherwise unacceptable according to IS:456.

Payment for concrete which is normally unacceptable as per the criteria laid down in IS: 456, but which has been accepted by the Engineer shall be made at a reduced rate prorated to the strength obtained.

Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the Contractor. No payment for the dismantled concrete, the relevant formwork and reinforcement, embedded fixtures etc. wasted in the dismantled portion shall be made. In the course of dismantling, if any damage is done to free of charge by the Contractor, to the satisfaction of the Engineer.

5.0 ACCEPTANCE CRITERIA

5.1 Standard Deviation

Standard deviation shall be based on test results and determination of Standard deviation shall conform to clause 14.5 of IS: 456.

5.2 Acceptance Criteria

The strength requirements and acceptance criteria shall conform to Clause 15 of IS:456.

5.3 Inspection and Core Tests

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to Clause 16 of IS: 456.

5.4 Load Test

Load tests of structural members may be required by the Engineer, when the strength of test specimen results fall below the required strength as per "Load Test on parts of structures", Clause 16.5 of IS:456. If load testing is decided by the Engineer, the member under consideration shall be subjected to a test load equal to 1:25 (one and a quarter) times the specified live load user for design and this load shall be maintained for a period of 24 (twenty-four) hours before removal. The detailed procedure of the test is to be decided by the Engineer. Load tests shall not be made until the structure is at least 56 days old.

If the member shows evident failure, such changes as are necessary to make the structure adequately strong shall be made by the Contractor free of cost to the Owner.



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Alternatively, if permitted under Statutory Regulations and at the discretion of the Engineer, the structure under test or a portion thereof may be retained as such without any modification by de-rating its load bearing capacity, provided the design criteria allows such de-rating.

A reinforced concrete beam, floor or roof shall be deemed to have passed the test if the maximum deflection at the end of 24 hours does not exceed the deflection given in Clause 16.5 of IS: 456.

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 damages done to the embedded items and or other adjacent to the satisfaction of the Engineer.

6.0 RATES

The rate for any item in the schedule, unless specifically excluded in the contract, shall be deemed to include the cost of all materials consumed or used in the work or incidental to it a labour, tools, plants, equipment, templates, supports, scaffolds approaches, security, and safety measures, power, fuel, lubricants, storage, handling transport, testing, insurances, taxes overheads, profits etc., the various items of work which are to be provided are mentioned under Clause 2.1 and elsewhere in this specification. If no separate item is provided for any such work in the schedule of items. It is implied that the contractor shall not claim for any of the connected items of the schedule viz., detailed drawings and drawings of formwork in the item of formwork of concrete etc., rate for R.C.C. items shall include for carrying out specimen tests as per specifications.

7.0 METHOD OF MEASUREMENT

7.1 Concrete

- a) Actual volume of work as executed or as per drawings issued, whichever is less shall be measured in Cu.M. Deductions for openings, conduits, pipes, ducts pockets, chases etc. shall be made, provided they are larger than 0.1 sq. M. in area each.

No deduction shall be made for embedded fixtures including reinforcements, sleeves, anchor bolts and similar items.

- b) Precast concrete work shall be measured in the same way as specified in foregoing paragraph. No separate payment shall be made for formwork. Lifting hook where required in the design, shall be treated as reinforcement steel and paid accordingly. Payment shall be due only after erection, grouting and curing of the precast units in proper position unless otherwise provide for



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in the contract. All breakages and damages of the precast units will be to the Contractor's account and shall be replaced free of charge to the Owner.

7.2 Admixture

Admixture will be measured on the basis of theoretical requirement or actual consumption, whichever is less.

7.3 Reinforcement

- a) Bar or any other type of reinforcement used like Hard drawn steel Wire fabric etc. for reinforced shall be measured by weight in tonnes. The weight will be arrived at by multiplying the actual or theoretical length; whichever is less, by the sectional weights. In case the Owner issues the reinforcing steel, the section weights will be the same as were applied at the time of issue. In case the steel is to be supplied by the contractor, the sectional weight to be adopted will be the I.S. Sectional Weight or as per actual which will be arrived at by accurately measuring representative samples as directed by the Engineer, whichever is less.
- b) Standard hooks; cranks, bonds, authorised laps etc. shall be measured.
- c) Lap welding or butt welding if permitted will be, measured diameter wise per Joint. The actual length of steel in lap will be measured separately in case of lap welding. The rate quoted for the smaller size bar will be applied in case of joint between two bars of different diameters.
- d) Separator pieces between two or more layers of steel shall be measured.
- e) No payment shall be made for binding wires, spacer block, supports, chairs, hangers, etc. of height 300 mm and less, required of keeping the steel in position unless otherwise specified in the contract. For supporting horizontal reinforcement at heights larger than 300 mm support drawings will be prepared by the Engineer, or as actually placed, whichever is less, at the same rate as for Reinforcement.
- f) No extra will be paid for modification of already embedded reinforcement, if required due to faulty fabrication or placement.
- g) Dowels neither shown on the drawings not instructed by the Engineer, but required for construction facilities and/or sequence, shall not be measured.

7.4 Form work

- a) Formwork shall be measured as the actual surface in contact with the concrete and paid in Sq.M unless included in the rate for concrete.



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- b) Formwork shall not be measured separately for precast concrete work which shall be included in the concrete rates.
- c) No payment for form work or any other requirement in construction joints shall be made.
- d) Openings upto 0.1 Sq.M shall be neglected as if non-existent for the purpose of form work measurement.
- e) No extra measurement or payment shall be made for making the form work waterproof or for supports, scaffolding, canting approaches, etc.
- f) No measurement shall be taken for the form work in pockets, openings, chases etc. in concrete if the cross-sectional area is less than or equal to 0.1 Sq.M. in each case if the cross-sectional area of any opening exceeds 0.1 Sq.M the form work shall be measured under appropriate classification.
- g) Fixing and removing pockets and openings of sectional area less than 0.1 Sq.M. shall be measured on number basis and paid separately.

7.5 Anchor Bolts, Anchor Sleeves, Inserts, Hangers, Conduit Pipes and Other Miscellaneous Embedded Fixtures

- a) These will be measured on theoretical weight basis of the complete insert handled by the Contractor irrespective of the amount of insertion. Where theoretical weight cannot be assessed satisfactorily, the actual weight shall be allowed under certification of the Engineer.
- b) No extra shall be to be paid for templates and other arrangements required to secure these in position. The protection of these materials with proper anticorrosive paints/grease and covering with gunny bags against any damages till the structure is handed over, shall be the responsibility of the Contractor at no extra cost.
- c) Any 'boxing' left for inserts, etc. during construction, for facility of the Contractor's work, and later on filled in by the same Contractor after placing the inserts shall be considered for measurement purpose, as if the inserts, etc. were placed before concreting.
- d) No extra payment shall be made for cleaning of the inserts, etc. required for bond with the concrete.

7.6 Expansion and Isolation Joints

- a) Expansion and isolation joints will be measured and paid on area basis. The drawings and or schedule of items will describe the thickness. Painting, filling material, sealing, strips, metal fixtures, inserts, etc. to be used in the joint.



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- b) Formwork for the 'leading side' of the joint will be measured and paid under the relevant item. No payment for the formwork for the 'following side' will be made even if the Contractor is required to use from work for constructional facilities.
- c) Joints sealing strips made out of Copper, Aluminium or G.I. or P.V.C. or rubber, will be measured and paid on area basis under relevant items. Rubber pads below foundation will be measured on area basis under the relevant item.
- d) Any other fixtures and inserts like dowels, installed as per drawing, riding plates etc., will be measured and paid if under the respective items of the schedule of Items.
- e) All other work like installing Bitumen coating, Bitumen boards, Expanded polystyrene Boards, Alkathene sheets, Bitumen filler etc. and trimming the top, repair, finishes and other connected items will be deemed to be included in the unit rate for expansion/Isolation joints.

7.7 Joints Seals: G.I. Copper, Aluminium, Rubber or P.V.C.

All seals, whether used as water bars or in expansion or Isolation Joints shall be measured as joint seals and on area basis. In case of Metallic seals like G.I. copper or Aluminium the developed area will be measured. In case of Rubber and P.V.C. seals also, developed area will be measured but the central bulb, corrugation ribs etc. will be neglected. In all cases laps will not be measured.

7.8 Rubber pad

Rubber pads will be measured on area basis. The theoretical or actual area, whichever is less, will be recorded.

7.9 Grouting under Base Plates etc.

Grouting shall be measured on theoretical volume basis neglecting the volume of embedded items. The cost shall include the cost of backing the old concrete Plus necessary from work if any Edges of the groutting shall be measured equal even if chamfered. Necessary curing shall also be included Admixtures. If added, Will be measured and paid separately under the relevant items.

7.10 Water proof Plaster

The measurement will be no finished square area basis. The thickness, method of applications, waterproofing additive to be used etc. will be specified in the specification/drawings/schedule of items.

The waterproofing additive will be measured and paid separately under admixtures (Clause 7.2) .No deduction will be made for opening less than 0.1 Sq .m in area each.



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7.11 Bitumen Coating/Tar Coating

These shall be measured on next useful area, neglecting openings up to 0.1 Sq.M in area each.

7.12 Bitumen Felt

Bitumen felt waterproofing shall be measured nett on area of structure cover, neglecting openings up to 0.1 Sq.M . in area each, measuring only once for the completed work and once for each layer.

7.13 Polyethylene Film

Polyethylene Film waterproofing shall be measured nett on area of structure covered, neglecting openings up to 0.1 Sq.M. in area each, measuring only once for the completed work and not once for each layer.

7.14 Tests

- a) Tests on concrete specimens shall not be paid for separately. The specimen shall be either in the form of 15 cubes or 15 cm dia. 30 cm long cylinders. No separate measurement shall be made for column of concrete used in the specimen or for the mould.
- b) No payment shall be made for tests carried out for approval of samples or different materials in accordance with the specification.
- c) Load Test, if required to be made as per terms and conditions of the contract, shall not be paid.

8.0 LIST OF IS: CODES AND STANDARDS FOR REFERENCE

All work under this specification shall, unless specified other wise, 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 paying Bitumen.
- IS : 216 - Indian Standard Specification for Coal Tar Pitch.
- IS : 226 - Indian Standard Specification for Structural Steel (Standard quality).
- IS : 269 - Indian Standard Specification for Ordinary, and Low Heat Portland Cement.

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	IS:8112 - 43 grade ordinary portland cement. 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 :1139 - Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and High yield Strength Steel; Deformed Bars for concrete Reinforcement. IS : 1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete. IS : 1200 - Indian Standard Specification for Method of measurement (part-II) Cement Concrete work. IS : 1200 - Indian Standard Specification for Method of measurement (part-V) Form work. IS : 1322 - Indian Standard Specification for Bitumen Felts for waterproofing and Damp-proofing. IS : 1489 - Indian Standard Specification for Portland – Pozzolana Cement. IS : 1566 - Indian Standard Specification for Methods for sampling and Analysis of Concrete. IS : 1609 - Code of practice for laying Damp-Proof Treatment using Bitumen Felts. IS : 1786 - Indian Standard Specification for Cold-twisted Steel Bars for Concrete Reinforcement. IS : 1791 - Indian Standard Specification for Batch Type Concrete Mixers.	



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IS : 2185	-	Indian Standard Specification for Hollow Cement Concrete Blocks.
IS : 2210	-	Indian Standard Specification for Design of Reinforced Concrete shall 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 : 2722	-	Indian Standard Specification for portable Swing Weigh Batches for Concrete (Single and Double Bucket type).
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 Construction.
IS : 3025	-	Indian Standard Specification for methods of sampling and Test (physical and Chemical) for Water used in Industry.
IS : 3201	-	Indian Standard Specification for Design and construction of precast Concrete Trusses.
IS : 3370	-	Indian Standard Specification for Code of practise for Concrete structures for Storage of Liquids.
IS ; 3550	-	Indian Standard Specification for Method of Test for Routine Control for water used in Industry.
IS : 3558	-	Code practice for use of Imersion Vibrator for Consolidating Concrete.
IS : 3590	-	Indian Standard Specification for Load Baring Light Weight Concrete Blocks.
IS : 3696	-	Safety code for Scaffolding and Ladders.

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	IS : 3812 - Indian Standard Specification for fly Ash for use as Admixture for Concrete. IS : 4031 - Indian Standard Specification for Method of Tests for Hydraulic Cement. IS : 4031 - Indian Standard Specification for Method of Test 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 Archs. IS : 4634 - Indian Standard Specification Method of Testing performance of batch- type Concrete Mixes. IS : 4656 - Indian Standard Specification for From Vibrators for Concrete. IS : 4925 - Indian Standard Specification for Concrete Batching and mixing Plant. IS : 4926 - Indian Standard Specification for read 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 Part I & II - Indian Standard Specification for Design of reinforced Concrete Bins for the Storage of granular and powdery Materials. IS : 4998 - Indian Standard Specification for Design of reinforced Concrete Chimneys. IS : 5512 - Indian Standard Specification for Flow table for use in Testes of Hydraulic Cement and Pozzolanic Materials. IS : 5513 - Indian Standard Specification for Vie at Apparatus IS : 5515 - Indian Standard Specification for Compaction factor Apparatus. IS : 5751 - Indian Standard Specification for precast concrete Copying Blocks.	



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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 : 6452	-	Indian Standard Specification for High Aluminium 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 : 5891	-	Indian Standard Specification for Hand Operated Concrete Mixers.
IS : 6452	-	Indian Standard Specification for High Aluminium Cement for Structural Use.
IS : 6909	-	Indian Standard Specification for super-sulphated Cement.



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1.0.0 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.

2.00.0 GENERAL

2.1.0 WORK TO PROVIDED FOR BY THE CONTRACTOR

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

- a) Furnish all labour, supervision, services including facilities as required under statutory labour regulations, materials, equipment, tools and plants, transportation, etc, required by the Engineer
- b) Prepare and submit working drawing showing the approaches, slope, beam, shoring, sumps for dewatering, including drains and outfall for drainage, space for temporary stacking of spoil, disposal area, fencing, etc and all other details as may be required by the Engineer.
- c) To carry out sampling and testing and submit to the Engineer, results of soil compaction tests if required by the Engineer to assess the degree of compaction.
- d) Construction, maintenance and removal after completion of Magazine of proper capacity as well as design for storing of explosives required for blasting work to be carried out scope of this tender.

2.2.0 WORK TO PROVIDED FOR BY OTHERS.

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

2.3.0 CODES AND STANARDS.

All works under this specification, unless specified otherwise shall conform to the Latest revision and /or replacement of the following or any other Indian Standard Specifications and codes of practice. In case any particular aspect of work is no Covered specially by 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 use of steel in general building construction

IS:806: Code of practice for use of steel tubes in general building construction

IS:808: Rolled steel beams channels and angle sections



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IS:813: Scheme of symbols for welding

IS:814: Covered electrodes for metal are welding of structural steel

IS:815: Classification and coding of covered electrodes for metal are welding mild steel and low ally high tensile steel.

IS:816: Code of practice for use of metal are welding for general construction in mild steel

IS:817 : Code of practice for training and testing metal are 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:9595: Recommendations for metal are welding of carbon and carbon manganese steel:

IS:919: Recommendations for limits and fits for Engineer.

IS:961:Structural Steel (High tensile)

IS:1148: Rivets bars for structural purposes.

IS:1149:High tensile rivets bars for structural purposes

IS:1161: Steel Tubes for structural purposes

IS:1200: Method of measurement of steelwork and ironwork (Part-B)

IS:1239: Mild Steel Tubes

IS:1363: Black hexagon bolts, nuts and lock nuts (dia. 6 to 30mm) and black hexagon screws (dia 6 to 24mm)

IS:1363: Black hexagon bolts, nuts and lock nuts (dia. 6 to 30mm) and black hexagon screws (dia 6 to 24mm)

IS 1346: Precision and semi-precision hexagon bolts, screws, nuts and locknuts.(dia 6 to 24 mm

IS:1367: Technical supply conditions for threaded fasteners

IS:1442: Covered electrodes for the metal are welding of high tensile structural steel.



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IS:1600: Method for tensile testing of steel products other than sheet strip, wire and tube

IS1730: Dimensions for steel plates, sheet and strip for structural and general engineer purposes.

IS: 1731: Dimensions for steel flats for structural and general engineering Purposes.

IS: 1852: Rolling and cutting tolerance for hot-rolled steel products

IS:1977: Structural steel (Ordinary quality) St-42-0

IS:2062: Structural steel (fusion welding quality)

IS:2074: Ready mixed paint red oxide Zinc chromate painting

IS:2629: Recommended practice for Hot – Dip Galvanising of Iron and Steel

IS:2633: Method for testing uniformly of coating on Zinc Coated Articles

IS:3757: High Tensile Fraction Grip bolts

IS:4759: Specifications for Hot – Dip Zinc coatings on structural Steel and other Allied products

IS 7215: Tolerance for fabrication of steel structures

2.4.0 CONFORMITY WITH DESIGNS.

Except where the standard connection details are furnished, the contractor shall design all connection, 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

2.5.0 MATERIALS TO BE USED

2.5.1 GENERAL

All steel material 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, pitting, rusts etc. that may



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impair their strength, durability and appearance all materials shall be of tested quality only unless otherwise permitted by the Engineer and/ of 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 tonnes or less of any particular section.

The arc welding electrodes shall conform 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 be uniform and concentric with each container of electrodes, the manufacturer shall furnish instructions giving recommended voltages and amperage (polarity in case of D.C supply) for which the electrodes are suitable.

2.5.2 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.

- 1) IS 226 - Structural steel (Standard quality)
- 2) IS 961 - Structural steel (high Tensile)
- 3) IS 1977 - Structural steel (Ordinary quality) St-42-0
- 4) IS 2062 - Structural steel (Fusion Welding Quality)

In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable.

2.5.3 Rivet Steel

All rivets steel used in construction within the purview of this Specification shall comply with one of the following Indian Standard Specifications as may be applicable

- 1) IS 1148 – Rivet Bars for Structural purpose

IS 1149- High tensile rivet bars for structural for purposes where high tensile steel is specified for rivets, steps shall be taken on ensure that the rivets are so anufactured that they can be driven and heads formed satisfactorily without the physical properties of steel being impaired.

2.5.4 ELECRODES

All electrodes to be used the Contract shall comply with any of the following Indian Standard Specifications as may be applicable:-



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IS:814: Covered electrodes for metal arc welding of structural steel

IS:815: Classification and coding of covered electrodes for metal arc welding mild steel and low alloy high tensile steel.

IS:1442: Covered electrodes for the metal arc welding of high tensile structural steel.

2.5.5 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 44kg/mm^2 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:-
 - 1) IS:1367: Technical supply conditions for threaded fasteners.
 - 2) IS:1600: Method for tensile testing of steel products other than sheet strip, wire and tube.
- b) High Tensile Steel (Structural Quality) The material used for the manufacture of high tensile steel bolts and nuts shall have a minimum tensile strength 58kg/mm^2 . Other mechanical properties shall conform to grade HT of IS 961.
- c) High Tensile Steel (Special Quality). The material used for the manufacture of special quality 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.

2.5.6 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:-

- 1) IS: 226: Structural steel (Standard Quality)
- 2) IS:961: Structural Steel (High tensile)
- 3) IS:1977: Structural steel (Ordinary quality) St-42-0

2.5.7 PAINTS



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Paints to be used for shop coat of fabricated steel under the purview of this contract shall conform to the Indian to Standard Specifications IS:2074: Ready mixed paint red oxide Zinc chromate painting.

2.6.0 STORAGE OF MATERIAL

2.6.1 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 up to 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.

2.6.2 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.

2.6.3 ELCTRODES

The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrode shall be kept in dry and warm condition if necessary by resorting to heating.

2.6.4 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.

2.6.4 PAINTS

Paints shall be stored under cover in air tight containers paints supplied in sealed containers shall be used up as possible once the container is opened.

2.7.0 QUALITY CONTROL

The Contractor shall establish and minimum quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed



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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 shall co-operative 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 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 limited to the following items of works:-

- 1) Steel - Quality. manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used.
- 2) Rivets, Bolts, Nuts & Washers - Manufacturer's certificate, dimension checks, material testing.
- 3) Electrodes - Manufacturer's certificate, thickness and quality of plus coating.
- 4) Welders - Quality Tests.
- 5) Welding sets - Performance Tests.
- 6) welds - Inspection, x-ray. Ultrasonic tests.
- 7) Paints - Manufacturer's certificate, physical inspection reports.
- 8) Galvanizing - Tests in accordance with IS: 263 Method for testing uniformity of coating of Zinc Coated Articles and IS 4759: Specifications for Hot – Dip Zinc coatings on structural Steel and other Allied products

2.8.0 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.

2.9.0 SHOP DRAWINGS



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The contractor shall within 15 days after the award of the Contract submit to the Engineer the Schedule of Fabrication and erection of structural steel work for approval. He shall, within 15 days after the award of the contract start to for approval. The shop drawings based on the Design Drawings furnished to him and, before proceeding with in fabrication work, shall get the said shop drawings approved in accordance with the contract.

The sequence of submission of shop drawings for approval shall match with the approved fabrication and erection schedule. The approval for the shop drawings will be accordance only towards general conformity with the design requirements as well as specifications and will ensure the correctness of general arrangement for centreline dimensions and level, Section sizes, and adequacy of connections including splice joints as to the no. of bolts, welds length, size of gusset/ end plated. The correctness of all other details like cutting lengths, matching of holes, notch dimensions, match markings, bill of materials, bolt list etc. will be entirely the contractor's responsibility. The approval of the 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 shop drawings shall include but not be 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 bolt location etc.
- c) Comparison sheet to show that the proposed alternative section, if any, are 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

The preparation of shop drawings shall not be submitted without prior approval of Engineer. 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 shop drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Shop drawings shall give complete information necessary for fabrication of two various components of the steelwork, including the location. Type, sizes 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 covey all the necessary information adequately. Notes on the shop drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding symbols used shall be in accordance with the requirements of the Indian Standard Specification.

IS:813: Scheme of symbols for welding 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 pay for 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



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duly approved or not in accordance with the Contact, provided that such particulars on the Design furnished to the Contractor. In the Contractor. In the latter case, the Contractor will be paid for any alteration that has to be made after materials have been fabricated by the Contactor.

3.0.0 WORKMANSHIP

3.1.0 FABRICATION

3.1.1 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 user of steel tubes in general building construction and other relevant Indian Standards or Equivalent.

3.1.2 STRAIGHTENING MTERIAL

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 IS: 1852: Specification Rolling and cutting tolerance for hot-rolled steel products. If straightening it necessary, it may be done by mechanical means or by the application of limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600sq.c

3.1.3 CUTTING

Cutting shall be effected by shearing. Cropping or sawing use of mechanically controlled gas cutting torch 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 meal 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, 3mm 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 gauges not more than 4mm deep will be permitted Gouges greater than 4mm, that remain from cutting, shall be removed by girding. All re-entrant corners shall be shaped notch-free to a radius of at least 12mm. Shearing, cropping and gas cutting shall be clean, reasonably squire and free from any distortion.

3.1.4 PLANNING OF EDGES

Planning of 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



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cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer.

3.1.5 CLEARNCES

The erection clearance for cheated ends of members connecting steel to steel shall preferably be not greater than 2mm at each end. The erection clearance at ends of beams without web cleats shall be not more than 3mm at each end, but where, for particular reasons, greater clearance is necessary, suitably designed clearings shall be provided.

3.2.0 RIVETED AND BOLTED CONSTRUCYION

3.2.1 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 materials is not greater than the nominal diameter of river or bolts plus 3mm subject to a maximum thickness of 16mm provided that the holes are punched 3mm less in diameter than the required size and rammed after assembly to the full diameter.

Holes for rivets or black bolts shall be not more than 1.5mm or 2.0mm (depending on whether the diameter of the rivet or bolt is less or more than or equal to 25mm) Larger in diameter than the nominal diameter of the rivet or black bolt passing through them.

Holes for turned bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of HB 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 thickness 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.

3.2.2 ASSEMBLY

All parts of riveted member shall be well pinned or bolted and rigidly held together while riveting drafting to enlarge unmatching holes shall not generally be permitted. In case drafting is permitted to a slight extent during assembly it shall not distort the metal on enlarge the holes. Holes that must be enlarged to admit the rivets or bolts shall be to 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 the holes. Rivets shall be heated uniformly to a temperature not exceeding the holes. Rivets shall be heated uniformly



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to a temperature not exceeding 1065⁰C. They shall not be driven after their temperature has fallen below 540⁰C.

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 specially 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 rivets any proud ness of the countersunk head being dressed off flush, if required.

Rivets member 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 bolts 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 to the extent of ten sound rivet per five hundred done Riveting work, for any particular section or group, will be considered satisfactory when at least 90% of the corresponding cut rivets are found to be sound. If the ratio is below 75%, all the rivets in the particulars 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 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 out through 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 bolts 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 forces or otherwise as many by specified on the Drawings.

3.3.0 WELDED CONSTRUCTION

3.3.1 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.



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3.3.2 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 surface shall be free from fine and tears. Preparation of edges by gas-cutting shall, wherever practicable, be done by a mechanically guided torch.

3.3.3 ASSEMBLING

Parts to be fillet welded shall be brought in close contact as practicable and in no event shall be separated by more than 4mm. If the separation is 1.5mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit at 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 3mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2^0).

The work shall be positioned for that welding whenever practicable.

3.3.4 WELDING SEQUENCE

In assembling and jointing parts of a structure of built-up members, the procedure and sequence of welding shall be as will avoid needless distortion and minimize shrinkage stresses. Where it is impossible to avoid high residual 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 shop 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.

3.5.5 WELDING TECHNIQUE

All complete penetration groove welds made by manual welding, except when produced with the aid of backing materials not more than 8mm thick with root opening not less than 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



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material. Backing strips need not removed. If required, they maybe 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, that should be done by use of extension bars or run-off plates. Extension bars of 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 relevant Indian Standards.

3.3.6 TEMPERATURE

No welding shall normally be done on parent material at temperature below $(-) 5^{\circ}\text{C}$. However, if welding is to be undertaken at low temperature, adequate precautions as recommended in relevant Indian Standard shall be taken. When the parent material is less than 40mm thick and the temperature is between $(-) 5^{\circ}\text{C}$ and 0°C , the surface around the joint to a distance of 100mm 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 40mm 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.

3.3.7 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 welds has cooled to a temperature warm to the hand Care shall be exercised to prevent sealing or flaking of weld and base metal from over peening.

3.3.8 EQUIPMENT

There shall be capable of producing proper current so that the operator produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufactures of electrodes or as may be approved by the Engineer.

3.4.0 FINISH

Column splices and butt joint compression members deepening on contact for stress transmission shall be accurately machined and close-butt 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 connects butt over the entire surface of contact, Care should be taken that those connecting angles on channels are fixed with such accuracy that they are reduced in thickness by machining by more than 1.0mm.



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3.5.0 SLAB BASES AND CAPS

Bases and caps fabricated out of steel slabs, except when cut from 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 be machined if such face is true and parallel to the upper face.

3.6.0 LACING BARS

The ends of lacing bars shall be neat and free from burns.

3.7.0 SEPARATORS

Rolled section or built-up steel separated or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used.

3.8.0 BEARING PLATES

Provision shall be made for all necessary, steel bearing plates to taken up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings.

3.9.0 ARCHITECTURAL CLEARANCES

Bearing plates and stiffener connections shall not be permitted to encroach the designed architectural clearances.

3.10.0 SHOP COMMUNICATIONS

- a) All shop connections shall be either riveted or welded at specified on the Drawings
- b) Heads of rivets on surfaces carrying brick walls shall be flattened 10mm 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 Contractor will have to make the desired changes at no extra cost to the Owner.

3.11.0 CASTINGS

Steel castings shall be annealed

3.12.0 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 despatch. The parts shall be shop-erected with a sufficient member of parallel drifts to bring and keep the parts in place in case of parts



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drilled or punched using steel jigs to make all interchangeable, the steelwork shall be shop erected in will facilitate the check of interchange ability

3.13.0 SHOP PAINTING

3.13.1 GENERAL

Unless otherwise specified, steelwork which will be concealed by interior building finish need not be painted, steelwork to be uncared 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 substances which have been cleaned, in accordance with the following paragraph, by brush, spotty, roller coating, flow-coating or dripping as may be approved by the Engineer.

After inspection and approved and before leaving the shop, all steel work specified to be painted shall be cleaned by hand-wire brushing or by other method of loose mill scale loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil of grease by solvent cleaners and be cleaned of dirt and other foreign material by through sweeping with a fibre brush.

3.13.2 INACCESSIBLE PARTS

Surface 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.

3.13.3 CONTACT SURFACES

Contact surface shall be cleaned in accordance with Sub-clause 3.13.1 before assembly.

3.13.4 FINISHED SURFACES

Machine finished surface 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.

3.13.5 SURFACES ADJACENT TO FIELD WELDS:

Unless otherwise provided for surfaces within 50 mm of any field weld location shall be Free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

3.14.0 GALVANIZING

3.14.1 GENERAL



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Structural steelwork for switchyard or other structures as may be specified in the Contract shall be not dip galvanized in accordance with the American Society for Testing and Materials Specification ASTH-A 123 or IS:2629: Recommended practice for Hot – Dip Galvanising 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.

3.14.2 SURFACE PREPARATION

All members to be galvanized shall be cleaned, by the process of picking of rust, loose scale, dirt, 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.

3.14.3 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: Specifications for Hot – Dip Zinc coatings on structural Steel and 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 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 having been dipped twice, it shall be rejected. Special care shall be taken not to injure the skin on galvanized surface during transport, handling and erection. Damages, if occur, shall be made good in accordance with the provision or as directed by the Engineer.

4.0.0 INSPECTION TESTING, ACCEPTANCE CRITERIA

4.1.0 Inspection



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Unless specified otherwise, inspection to all work shall be made by the Engineer or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all responsible times to those parts of the manufacturer's works which are concerned with the fabrication of the steel work under this contract and he shall be afforded all responsible 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 paint, 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.

4.2.0 TESTING AND ACCEPTANCE CRITERIA

4.2.1 General

The contractor shall carry out sampling and testing in accordance with the relevant Indian standards and as supplemented here in for the following items at his own cost, unless otherwise specified in the contract. 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.

4.2.2 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 MT or less of any particular section for tests to confirm to relevant Indian standards. Cost of all tests shall be borne by the contractor.

All materials shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. That may impair their strength, durability and appearance.

4.2.3 Welding

All electrodes shall be procured from reliable 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 tonnes 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 in the event of further tests as may be desired by the engineer, the cost of such tests shall be borne by the contractor if the results are found to be unsatisfactory; and if the test shows no defect, the cost shall be borne by the owner. In cases of the test results showing deficiency,



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the engineer shall have option to reject or instruct any remedial measures to be taken free of charge to the owner.

4.2.4 RIVETS, BOLTS, NUTS AND WASHERS

All rivets, bolts, nuts and washers shall be produced from M/s Guest Keen Williams Ltd, or equivalent and shall conform to the 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 percent) of the rivets done shall be cut off by chisels to ascertain the fit. Quality of material and workmanship. The removal of the cut rivets and reinstallation new rivets shall be done by the Contractor at his own cost.

4.2.5 SHOP PAINTING

All paints and primers shall be of standard quality and produced from approved manufactures and shall conform to the provisions of the relevant Indian Standards.

4.2.6 GALVANIZING

All galvanizing shall be uniform and of standard quality when tested in accordance with IS:2633: Method for testing uniformly of coating on Zinc Coated Articles and IS:4759: Specifications for Hot – Dip Zinc coatings on structural Steel and other Allied products.

4.3.0 TOLERANCE

The tolerance on the dimensions of individual rolled steel components shall be as specified in IS: 1852: Rolling and cutting tolerance for hot-rolled steel products. The tolerance 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 7215: Tolerance for fabrication of steel structures.

4.4.0 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 the test results obtained at the Contractor's works by independent tests at an approved laboratory and should the items, so tested, be found to be unsatisfactory, the costs shall be borne by the Contractor, and if satisfactory, the costs shall be borne by the Owner.

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 accepted forthwith and the Engineer will issue an acceptance certificate, upon receipt of which, the



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items will be shop painted, picked and despatched. 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.

4.5.0 DELIVERY OF MATERIALS

4.5.1 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.

4.5.2 MARKING

Each separate piece of fabricated steel work shall be distinctly marked on all surface 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.

4.5.3 SHIPPING

Shipping shall be strictly in accordance with the sequence stipulated in the agreed programme. Payment may held up for items sent in advance of the sequence till they could be erected. The contractor shall include and provide for in his rates, the Freight and other charges for despatching the materials to avoid loss or damage during transport by rail, road or water. All packing shall allow for easy removal and checking at site. Special precautions shall be taken against rusting, corrosion, breakage or damage otherwise of the materials. 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 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.



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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 inside of the cover in water-proof envelope, quoting especially:-

- a) Name of the Contractor
- b) Number and date of the Contract
- c) Name of the office placing the contact
- d) Nomenclature of stores
- e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawing and the quantity of each

The shipping dimensions of each package 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 without any extra payment.

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 transits 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, wharf age, demurrage and other charges.

If, however, the Owner has to make payment of any of above mentioned charges, the amount paid will be deducted from the progressive bills of the Contractor.

Necessary advise regarding the shipment with relevant details shall reach the Engineer at least a week in advance.

5.0.0 WITH TENDER

The following information are required to be submitted with the Tender.

- a) Progress Schedule.



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The Contractor shall quote in his tender a detailed schedule of progress of work and total time of completion, itemising the time required for each of the following aspects of work.

- 1) Preparation and approval of shop drawings
- 2) Procurement of materials
- 3) Fabrication and shipping of all anchor bolts
- 4) Fabrication and shipping of main steel work
- 5) Fabrication and shipping of main steel work for bunkers Tanks and / or silos as applicable.
- 6) Fabrication and shipping of all other remaining steelwork including miscellaneous steelwork.
- 7) Final date of completion of all shipments

Time required for completion being one of the main criteria for selecting the successful bidder, it is desired that the bidder quotes the minimum time required by him for completing the work

b) **Shop**

Location of the Tender's fabrication workshop giving details of equipment, manpower, the total capacity that will be available exclusively for this contract shall be submitted.

c) **MATCHING STEEL**

A rough indication for the quantities and details of matching steel section required to start the work shall be furnished.

d) **TRANSPORT OF STEEL**

In case the tendered is to draw steel materials from the Owner's stores at site as per terms and conditions of the Contract, the mode of transport proposed by the Tender shall be stated.

5.1.0 **AFTER AWARD**

After award of the Contract the successful Tender is to submit the following:-

- a) Complete fabrication drawings, material lists, cutting lists, rivet and bolt lists, field welding schedules based on the design drawings furnished to him in accordance with the approved schedule.



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- b) List of phase wise requirement of matching steel section in six (6) copies in accordance with the approved schedule shall be submitted within 2(two) weeks after the award of the contract, and/or receipt of the design drawings
- c) Monthly progress Report with necessary, photographs in six (5) copies to reach the Engineer on or before the 7th day of 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.
- d) Detailed monthly material reconciliation statements relevant to the work done and reported in the progress report, giving the stock at the hand of raw steel, work in progress, finished materials and scrap.
- e) Results of any test and when conducted and as required by the Engineer.
- f) Manufacturer's mill test report in respect of steel materials, rivets, bolts, nuts and electrodes as may be applicable.

6.0.0 ADDITIONAL CODES AND STANDARD

IS:823	Code of Procedure for manual Metal ARC welding of Mild Steel
IS:1024	Code of practice for the use of welding in Bridges and Structures subjected to Dynamic loading
IS:1365	Slotted counter sunk Head and slotted Raised counter sunk Head Screw (dia 1.6 to 20mm)
IS:1447	Code of practice for Finishing of Ferrous Metals in Buildings Painting and Allied finisher
IS:2016	Plain Washers
IS:3664	Code of practice for Ultrasonic Testing by Pulse Echo Method
IS:5334	Code of practice for Magnetic particle Flow detection of Welds.
IS:7318	Approval Test for Welds when welding procedure Approval is not Required
IS:7318	Fusion welding of Steel (part I)



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METHOD AND BASIS FOR PAYMENT FOR FABRICATION & ERECTION OF STRUCTURAL STEEL.

- 1) Payment for structural steel works shall be made on the basis of admissible weight in tons (determined as described in clause between of structure accepted by the Engineer-in-charge. The rate shall include supplying, fabrication, erecting in position (at al level & location), testing/examining (excluding radiography only) of bolted and/or welded structural steel works of all types(including all built up/compound sections made out of rolled sections and/or plates) including all handling, transporting, storing, straightening if required, cutting, edge preparation, preheating, bolting and welding),of joints (including sealing the joints of ox sections with continuous welding), finishing edges by grinding, fixing in line & level with temporary staging & bracing and removal of the same erection, grouting with ordinary/non-shrink grout as specified, including preparation of fabrication & erection drawings, erection schedule and getting them reviewed, preparing the surfaces for painting, surface cleaning, wire brushing, removal or mill scale, dust, rust, oil or grease and applying one coat of red oxide zinc chromate primer after fabrication etc. all complete as specified.
- 2) The weight for payment shall be determined from the fabrication drawings and respective Bill of materials prepared by the contractor wherever applicable. In case sections used are different from IS sections, then Manufactures Hand Book shall be adopted No allowance in weight shall be made for rolling tolerances.
- 3) Welds, bolts, nuts, washers, shims, pack plates, wedges and grout shall not be measured. The quoted rate shall be deemed to include the same.

IS:816: Code of practice for use of metal are welding for general construction in mild steel

IS:817 : Code of practice for training and testing metal are 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:9595: Recommendations for metal are welding of carbon and carbon manganese steel:

IS:919: Recommendations for limits and fits for Engineer.

IS:961:Structural Steel (High tensile)

IS:1148: Rivets bars for structural purposes.

IS:1149:High tensile rivets bars for structural purposes

IS:1161: Steel Tubes for structural purposes



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IS:1200: Method of measurement of steelwork and ironwork (Part-B)

IS:1239: Mild Steel Tubes

IS:1363: Black hexagon bolts, nuts and lock nuts (dia. 6 to 30mm) and black hexagon screws (dia 6 to 24mm)

IS:1367: Technical supply conditions for threaded fasteners

IS:1442: Covered electrodes for the metal are welding of high tensile structural steel.

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ERECTION OF STRUCTURAL STEEL WORK

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1.0.0 SCOPE

This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at Site, and/or from Owner's Site stores and store Yard. Installing the same in position, painting and grouting the stanchion bases all-complete as per drawings, this Specification and provision of the Contract.

2.0.0 GENERAL

2.1.0 Work to be provided for by the Contractor

The 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 the erection of the structural steelwork.
- b) Receiving, unloading, checking and moving to storage yard at site including prompt attendance to all insurance matter as necessary, for all fabricated steel materials arriving at site. The Contractor shall pay all demurrage and/ at Wharf age charges etc. on account of default on his part.
- c) Transportation of all fabricated structural steel materials 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 transportation of fabricated steel structures.
- d) Checking centre 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 brought to the notice of the Engineer. 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, levelling, riveting, bolting, welding and securely fixing the fabricated steel structures in accordance with the Drawings or as directed by the Engineer.
- f) Painting of erected steel structures if required by the Contract.
- g) All minor modifications of the fabrications of the fabricated steel structures as directed by the Engineer including but not limited to the following:-
 - 1) Removal of bends, kinks, twists etc. for parts damaged during transport and Handling.
 - 2) Cutting, chipping, filling, grinding etc. if required for preparation and Finishing of site connections.
 - 3) Reaming of holes for use of higher size rivet or built if required.
 - 4) Welding of connections in place of riveting or bolting for which holes are



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Either not drilled at all or wrongly drilled during fabrication. Welding in place of riveting or bolting will be permitted only the discretion of the Engineer.

- 5) Refabrication of parts damaged beyond repair during transport and Handling of Refabrication of parts, which are incorrectly fabricated.
- 6) Fabrication of parts omitted during fabrication by error, or subsequently Found necessary.
- 7) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.
- 8) Carry out tests in accordance with this Specification if directed.

2.2.0 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

2.3.0. CODES AND STANDARDS:

All work this specification 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 use of structural steel in general building construction.

IS - 456: Code of practice for plain or reinforced concrete.

2.4.0 CONFORMITY WITH DESIGNS

The Contractor will erect the entire fabricated steel fabricated steel structure, align the all members, complete all field connections and group the foundations all as per the provisions of this specification and sequence and the design criteria laid down by the Engineer. All work shall conform to the provisions of the relevant Indian Standard Specifications and/ or the instructions the engineer. The testing and acceptance of the erected structures shall be in accordance. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specification and / or the Instruction of the Engineer.

2.5.0 MATERIAL

2.5.1 GENERAL

All fabricated steel structures and connection materials shall be supplied by the Contractor for fabrication work through the Owner. The Contractor for erection work will take delivery of all the materials from the Owner's Stores or storage yard at site. The Contractor may also have to take delivery directly from railway wagons or trucks at Site, in which case he shall



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have to unload the materials and perform all formalities like checking of materials and attend to insurance matters in accordance with Sub-Clause 2.1.0 and as specified hereinbefore.

While taking delivery, the Contractor will check the quantity, quality and the sizes of the materials and verify the adequacy of the same in accordance with the Drawings and Specifications. In case the Contractor finds any materials inadequate, he shall inform the Engineer immediately prior to taking delivery of the same. No claim whatsoever, in respect of bad quality, shortage or difference in size will be entertained once the delivery is taken and the Contractor shall make good any such deficiency, if detected later, either by repair or with fresh material as be directed, by the Engineer at the Contractor's Own cost.

Excepting all field connection materials like rivets, bolts, nuts, washers and electrodes, which will be supplied by the fabrication Contractor to the extent of 10% in excess of the estimated requirements as per Drawings, all other consumables like Oxygen and acetylene gas, paints, fuels, lubricants, oil, grease, cement, sand, aggregates and any other materials that may be required for the execution of the works in accordance with the contract will be supplied by the contractor for erection work and will be deemed to have been including in this rates.

2.5.2 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.

2.6.0 STORAGE OF MATERIALS

2.6.1 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 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.

2.6.2 YARD

The Contractor will have to be establishing a suitable yard in the approved location at site for storing the fabricated steel structures and other materials will be delivered to him by the Owner recording to the Contract. The yard shall have proper facilities like, drainage, lighting, suitable access for large cranes, trailers and other heavy equipment 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 Tender 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 by the Engineer.

2.6.3 COVERED STORE



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

2.2.0 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 record of the same to the Engineer. The quality control operation shall include but not be limited to the following items of work:-

- 1) Erection: Lines, levels, grades, plumbs, joint characteristics including
Tightness of bolts.
- 2) Grouting: Cleaning and roughness of foundation, quality of materials used for
grouting, administers, consistency and strength of grout.
- 3) Painting: Preparation of surface for painting, quality of primers and paints,
thinners, application and uniformity of coats.

2.2.0 TAKING DELIVERY

The erection Contractor shall take delivery of fabricated structural steel and necessary connection materials supplied by the Fabrication Contractor from railhead, trucks and/or the Owner's stores at site 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 erection Contractor shall submit claims to insurance or other authorities and pursue the same in case of loss or damaged during transit and handling and all loss there of shall 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. The Contractor shall salvage, collect and deliver all the packing materials to the Owner free of charge.

3.0.0 WORKMANSHIP

3.1.0 ERECTION

3.1.1 PLANT AND EQUIPMENT

The suitability and adequacy of all erection tool s and equipment proposed to used shall be efficient, dependable, in good working condition and shall have the approval of Engineer.

3.1.2 METHOD AND SEQUENCE OF ERECTION

The method and sequence of erection shall have the prior approval of the Engineer. The Erection shall arrange for most economical method and sequence available to him consistent with the Drawings and Specifications and such information as may be furnished to him prior to the execution of the contract.



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3.1.3 TEMPORARY BRACING

Unless adequate bracing is included as a part of the permanent framing, the erector during erection 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 loads due to erection equipment and erection operations.

If additional temporary guys are required to resist 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 responsibility of the contractor in respect 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 maybe removed immediately upon completion of the steel erection unless other agreed arrangements are made. The Owner shall remove and return the same in good condition to the Contractor without any charge if they have been left in place under such other agreed arrangements.

3.1.4 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 by laws of state, Municipal or other local authorities.

3.1.5 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. Concrete foundations, where required, shall be made by other agencies. The Contractor shall check the positions and levels of the anchor bolts, etc. before concreting and get them properly secured against disturbance during pouring operations. He shall remain responsible for correct positioning. For heavy columns, etc. the Contractor shall set proper screed bars if desired by the Engineer, to maintain proper level. No extra payment shall be made for this. Each tire of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance allowable under this Specification.

No permanent field connections by riveting bolting or welding shall be carried out until proper alignment and plumbing has been attained.

3.1.6 Filed riveting

All riveting 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



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point must be approved by the engineer. No cold rivets shall be driven. All other requirements of reverting including quality and acceptance criteria shall be in accordance with the relevant portions of the Specification for Fabrication of Structural Steel work of the project.

3.1.7 Field bolting

All relevant portions in respect of bolted construction of the Specification for Fabrication of structural Steelwork applicable the Project shall also be applicable for filed 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 scale except tight mill scale. 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 man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the applicable amount of nut rotation specified in table-1 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 part not turned by the wrench.

TABLE-1

Bolts length not	Bolts length	Remarks
Exceeding 8 dia. Or 200mm ½ turn	Exceeding 8 dia. or 200mm 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.



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Bolts tightened by the turn- of – nut method may have the outer face of the nut Match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual not 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 produce the bolt tensions, the bolts shall be tightened to the torques specified in TABLE-II. Nuts shall be in tightening motion when torque wrenches to install several bolts in a single joints, 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	Torque to be
Diameter (mm)	applied (kg's) for bolts Class 8.8 of IS: 1367
20	59.94
22	81. 63
24	103. 73

In either of the above two methods, if required, 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 clause.

3.1.8 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 herein which manifestly apply to shop conditions only. Where the fabrication structural steel members have been delivered paints, the paint shall be removed before field welding for a distance of at least 50 mm on either side of joints.

3.1.9 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.



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The erector shall not cut, drill or otherwise alter the work of other trades, or his own work to accommodate other trades, unless such work is clearly specified in the Contractor or directed by the Engineer. Wherever such work is 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.

3.2.0 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 connection. 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 which prevents the 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.

3.2.0 GROUTING OF STANCHION BASES AND BEARINGS OF BEAMS AND GRIDERS ON STONE, BRICKS OR CONCRETE (PLAIN OR REINFORCE)

Grouting shall be carried out with Ordinary Cement grout as described bellow:-

The mix shall be one (1) part cement and one (1) part sand just enough water to Make it workable. The positions to be grouted shall be cleaned thoroughly with Compressed air jet and placed under expert supervision, taking care to avoid air-Looks. 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, levelled 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 thoroughly cleaned.

If required by the Engineer, certain admixtures like aluminium powder, “ironies” or equipment, may be required to the grout. The Contractor will, when so directed by the Engineer, take delivery of the material from the Owner’s site stores and use it in the grout in proportions to be decided by the Engineer and carry out the allowance of 5% (five percent) for wastage shall be allowed over the above theoretical requirement of the admixtures. Cost of any wastage beyond the above limits shall be paid for by the Contractor or will be realised from his dues at the rates prescribed by the owner.



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3.3.0 PAINTING AFTER ERECTION

Field painting, if required to be done by the Contract, shall only be done after the structure is erected, levelled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. 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 erection 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 Steel work applicable for the project.

Painting shall not be done in frosty or foggy, weather or 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. Where specified, 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 assembly. Bolts and fabrication steel members which are galvanized or otherwise treated and steel members to be encased in concrete shall not be painted.

The specification for paint and workmanship shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable to the project. The number of coats and the shades to be used shall be as specified or as directed by the Engineer.

3.4.0 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.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 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 on 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 of either fabrication or erection of steelwork whoever is responsible for it and no payment towards the cost of the dismantled portion and any connected work shall be made to the Contractor, unless it is proved that the deficiency is due to reasons beyond the Contractor's scope. On the basis of the tests, the Engineer will decide



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whether the fabricator or the erector is responsible for the unacceptable member or structure and his decision will be final. In case it is established that the unacceptability of the member or structure is due to design deficiency, the cost of replacement and/or modifications will borne by the Owner. In course of dismantling, if any damage is done to any other parts of the Contractor responsible, to the satisfaction of the Engineer, The cost of the tests specified hereinafter shall be borne by the Owner. 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 as long a time as possible before testing and the tests shall be conducted as indicated in the following. Sub-clauses 4.1.1, 4.1.2 and 4.1.3. The method of testing and application of loading shall be as approved by the Engineer.

4.1.1 STIFFNESS TEST

In this test, the structure or member shall be subjected, in 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 limits. If after removal of the tests load, the member or structure dose not show are recovery of at least 80 % of the maximum strain or deflection shown during 24 hours under to have 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 not less than 90% of the maximum increase in stain or deflection recorded during the second test.

4.1.2 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 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 falls and if on removal of the test load, the structure shows a recovery of at least 20% of the maximum deflection or strain recorded during the 24 hours under load.

4.1.3 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 basis of comparison in any check test carried out on sample of structure.



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When a structure of the same type is selected 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, 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 should be recorded.

The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded at similar load in test on the prototype.

4.1.4 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 herein before 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 4.1.1 hereinbefore.

4.2.0 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 tolerance for the profile dimensions permitted under the Specifications for fabrications of structural steel work applicable to this project and as specified Below:

1 For Building Containing Cranes

Component 1.	Description 2.	Variation Allowed 3.
Main column	a) Shifting of column axis at foundation Level with respect to building line i) In longitudinal direction ii) In lateral direction b) Deviation of both major or column axis From vertical between foundation and Other member connection levels: i) For a column up to and including IOM height true vertical ii) For a column greater than IOM but less	 i) ± 3.0 mm ii) ± 3.0 mm i) ± 3.5 mm from ii) ± 3.5 mm from vertical



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	than 40M height	for any 10M length measured between connection levels, but
	not more than ± 7.0 mm per	3.0mm length
	c) For adjacent pairs of columns across the width of the building prior to placing shown on drawings	± 9.0 mm on true span
	d) For any individual column deviation of Any bearing from levels shown on drawings	± 3.0 mm
	e) For adjacent pairs of column either across The width of building or longitudinally level difference allowed between bearing or seating Level supposed to be at the same level	3 mm.
Trusses	a) Deviation at centre of span of upper chord Member from vertical plane running through Center of bottom chord.	1/1500 of the span or not greater than 10mm Whichever is the least.
Trusses	b) Lateral displacement of top chord At centre of span from vertical plane running through centre of support.	1/250 of depth of truss or 20mm which Ever is the least
Crane Girders& Tracks	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 thermit welding	1.0mm
	d) Deviation to 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 ⁰ C. The coefficient of expansion or contraction shall be as 0.000012 per ⁰ C per unit length.	taken

iv) For Building without Cranes

The maximum tolerances for line and level of the steel works shall be ± 3.0 mm on
Any part of the structure. The structure shall not be out plumb more than 3.5mm
On each 10M section of height and not more than 7.0 mm 30 M section.

These tolerances shall apply to all parts of the structure unless the drawings issued
for erection purposes state otherwise.

4.3.0 ACCEPTANCE



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Structures and members which have passed the tests and conform to all requirements specified in the foregoing sub-clause 4.1, 4.1.1, 4.1.2, 4.3.1 and 4.1.4 and other applicable provisions of this Specification and are within the limits of tolerances specified in Sub-clause 4.2.0 and / or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfilment of the provisions of this Contract.

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 Before tender

Along with the tenders the Tenderers will be required to submit the following Information:

5.1.1 TENTATIVE PROGRAMME

The Tender 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 accordance with the Contract.

5.1.2 CONSTRUCTIONAL PLANT AND EQUIPMENT, TOOLS, TEMPORARY WORKS & MANPOWER.

A detailed list of all Constructional Plant & Equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the Tender 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.

5.1.3 ERECTION YARD

A site showing the layout and location of the erection yard proposed to be established by the Tender shall 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.

5.2 AFTER AWARD OF THE CONTRACT

After award of the contract, the Contractor shall submit the following:-

5.2.1 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 a accordance with in



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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 perform a approved by the Engineer.

5.2.2 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 5.2.1 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 furnished details of fabricated materials in hand at site and the strength of his workers.



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1. ANCHOR BOLTS

All materials supplied by the Contractor shall be of tested quality as per specification below and test certifications of raw materials shall be provided by the Contractor.

- a) Bolts shall be turned from M.S. conforming to IS: 226 and IS: 422 Grade I.
- b) Nuts shall be hexagonal type conforming to IS: 1363 and IS: 3138.
- c) Plain washers shall be of mild conforming to IS: 226.
- d) Sleeves shall be M.S Tubes (Medium) conforming to IS: 1239.

1.1 FABRICATION

Fabrication of anchor bolts shall be in compliance with the specification
Complete anchor bolts assembly shall be as per drawings, and will include the
Cost of sleeve pipes, fine gussets, bottom plate, and other fixtures including all welding work if
involved.

- a) Threads shall be of coarse type conforming to IS: 1367 and IS: 4218
- a) Plain washers shall be of mild steel conforming IS: 2016.
- c) Bolt shall conform to IS: 1367.

- 1.2 The anchor bolt assembly to be anchored or embedded in concretes shall be placed and securely held in position strictly as per drawings before and during pouring of concrete, with necessary wooden or steel templates and other devices.

- 1.3 Tolerances allowed for anchor bolts positioning shall be:

- For sleeved bolts, and one tenth of bolt nominal diameter.
- For bolts without sleeves one twentieth of the bolt nominal dia.

- 1.4 The surface not to covered with concrete shall be greased and protected from damage by wrapping and typing just cloth/polythene.

1.5 Payment

- 1.5.1 Payment for supply and fabrication of anchor bolts including sleeves and nuts
Shall be on weight basis of the finished product and shall include greasing etc.
A sample bolt shall be got approved from Engineer –in-Charge.

- 1.5.2 Payment for fixing where separately specified shall be on weight basis and rate



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shall including carting, fixing, providing and tying Hessian cloth, welding, if required etc. complete.

2 M.S Metal Inserts

- 2.1 All metal inserts its fabrication, bolting, riveting welding, etc. shall conform to the requirement specified under Specification of structural “ Steel “. The metal inserts shall be fabricated as per – drawing and direction of the Engineer- in-Charge.
- 2.2 The placement of the metal inserts shall be securely placed in brick masonry, plain or reinforced concrete members. It shall be so securely placed in member that its position is not disturbed while concreting. Suitable templates, spacer blocks, dummy structures and staging shall be provided. Necessary cutting in the shuttering and adjustment for the placement of metal inserts if situation so desires. Where indicated, it shall be welded to the reinforcement.
- 2.3 The exposed surfaces shall be given one coat of red oxide primer and where directed, protected by jute cloth wrapping and tying.

2.4 PAYMENT

Payment shall be made on the basis of actual weight of metal inserts shall include supply, fabrication tying, turning, tack welding, welding on other embedded items such as pipe (for puddle flanges) cutting and adjusting the shuttering and reinforcement and dry packing, if required with cement mortar 1:3 painting, protecting with jute cloth etc. complete.

3 M.S. Chequered Plates

- 3.1 Chequered plates shall be 6mm thick (7mm, over chequers and shall conform To IS: 3502). Steel for Chequered plate shall conform to IS: 226. It shall be rolled, and free from harmful surface defects such as cracks, surface flaws etc. The plates shall be cut to shape and fixed to bearing members as shown in the relevant drawing and as directed by Engineer-in-Charge. The edges shall be made smooth and no burs or jagged end shall be left. The plates may be spliced with prior consent of Engineer –in-Charge but in that case care should be taken so that there is continuity in the pattern of the plates between the two portions.

3.2 Payment

Payments shall be made on the basis of weight of Chequered plate actually laid. The rate shall include cost of cutting to size, making holes to required shape, smoothing ends, transporting and welding, bolting, fixing, in positions etc. complete. No deductions will be made for openings up to size of 300mm square.

4. M.S. Grating



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- 4.1 Material: Both the types of Gratings shall be fabricated, out of M.S. Flats. The steel shall conform to IS: 236 and shall be of weld able quality. It shall be clearly rolled and shall be free from harmful surfaces defects.
- 4.3 Fabrication Drawings: Based on the arrangement of supporting beams of design Drawings, the Contractor shall prepare shop fabrication drawings and get the Same approved as per the procedure outlined for shop fabrication drawings for structural steel work.
- 4.2 Type I Gratings
- 4.5.1 These shall be of ready made bought out type and designed to carry specified loads with limits.
- 4.5.2 Unless other wise mentioned in schedule of rates these shall be capable of carrying a uniformly distributed load of 500 kg. per square metre or a concentrated loads of 1000 kg. at mid span , whichever is governing . The maximum span for the above loading condition shall be 1200 millimetres. The deflection shall not exceed span /200 or 6mm whichever is less. The design shall be done as per IS: 800. Before fabrication or procurement the contractor shall submit the design calculations, drawings and manufacturer's Literature and gets the same approved from Engineer –in-Charge.
- 4.5.2 The gratings for stair treads shall be provided with nosing of Chequered plate of approved size and thickness.
- 4.6 Payment
- 4.6.1 Gratings shall be paid on the basis of weight of the area of M.S. Grating and frame actually laid.
- 4.6.3.1 The rate shall include cost of preparation of fabrication drawings, calculations, cost of cutting to size fabricating, welding, bolting, smoothing ends if necessary shop coat of red oxide zinc chromate primer, transporting and fixing in positions by welding or clips as per the design drawings.
- Loading, unloading, strong, safe custody, watch and ward, returning back of surplus materials to go down of issue where applicable.
- 5 M.S. Tube Hand Rails.**
- 5.1 All mild steel tubes and fittings shall conform IS: 1239 and shall be of medium grade. All screwed pipes shall have threads as per IS: 554. All fittings shall be malleable iron fittings as approved by Engineer-in-Charge.
- 5.2 All pipes shall either be directly welded or jointed with screwed couplings. Care shall be taken to remove burrs from the ends of the pipe and if required the vertical members should be grouted with cement mortar as specified. The pipe shall be fixed to pipe or angle uprights by means of suitable



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clamps or by means of welding. After fixing, the pipe shall be painted with two coats of white paint over a coat of primer as directed by Engineer-in-Charge.

5.3 Payment

The payment shall be made on running metre basis of the actual of handrails fixed and shall include the cost of pipes. Clamps and fittings, if any, transportation, cutting of pipes as required, threading or welding, fixing painting etc .all complete as per direction of the Engineer-in-Charge.

6 M.S. Rungs

6.1 M.S.bars used for rungs shall conform IS: 432 and shall be fixed in positions as per detailed drawings and directions of Engineer-in-Charge.

6.2 Payment

Payment shall be made of the basis of actual weight in kilogram (kg) of M.S. rungs.

7 EXPANSION FASTENERS

7.1 SCOPE

The specification deals with the use of expansion fasteners for providing fixture to concrete surfaces.

7.5 Installation Procedure

The Contractor shall install the expansion at the specified places according to the approved manufactures specification with the help of necessary tools specified by the manufactures with the prior approval of Engineer –in-Charge for the approval of Engineer-in-Charge for every installation of expansion fasteners in regard to its correct location and strength.

7.6 Payment

Payment shall be made on number basis. The rate shall include cost of fasteners, nuts, washers and bolts of required sizes necessary scaffolding, drilling with electric drill, labour, materials, complete.



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0.0 SCOPE

This shall include supply, fabricators and erection of miscellaneous metal items of light nature in gates, grills balcony and steps handrails particulars structural mullions and transoms, ladders hangers masonry anchors, shell angles, anchor bolts fasters etc. as shown or drawing or as instructed by the Engineer. The above items shall be of fabricated or cast M.S./Aluminium Brass. Cast iron .M.S. and galvanised M.S sheets aluminium sheets expanded metal with mesh etc. as shown on drawings and/or described in the Schedule of items.

1.0 INSTALLATION

2.1 Fabrication/Casting

2.1.1 General

All work shall be done according to approved shop drawings. All workmanship shall be equal to the best practice in modern structural foundry shop.

2.1.2 Shop Connections

- a) All shop connections shall be riveted or welded except when noted otherwise on drawings.
- b) Welding of steel shall be done on accordance with the IS: 816. Use of metal are welding for general construction in Mild Steel.
- c) Welding of Aluminium shall be done in accordance with IS : 2912. Are 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.

2.1.3 Shop Coat

Before leaving the shop, all metal work shall be thoroughly cleaned by effective means of all loose mill/scale, rust and foreign matter. Except where encased in concrete all steel work shall be given one coat of approved metal protective paint, applied by ; brush thoroughly evenly, well worked in to joints and other open spaces. All paint shall be applied to dry surfaces. When specified on Schedule, steel work shall be galvanised or galvanised and 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

2.2 Erection

2.2.1 Bracing



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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.

2.2.2 Temporary Bolting- Up

As erection proceeds the Contractor shall plumb up and level all members and shall securely bolt up to take care of all dead load. Wind load and erection stresses. Wherever piles of materials erection equipment or other loads are carried during erection . proper provision shall be made to take care of the stresses resulting from the same.

2.2.3 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.

2.2.4 Welding

Where specified on drawings, welding shall be done in accordance with IS:816 for steel and IS:2812 for Aluminium and Alloys.

2.2.5 Cutting and Fitting

No cutting of sectors, flanges, webs of angles should be done without the approval of the Engineer. Where indicated on the drawings, holes cuttings etc. shall be provided as regulated for installation, to the work by the other Contractors. No additional holes or cuttings their those shown on drawings, shall be made without the approval of the Engineer.

2.2.6 Drifting

Correction of 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 first the holes properly or to adjust accurately after ream one shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of draft pans of 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 confection obtained. The sue of cutting torches to enlarge or alter rivet holes shall not be permitted.

2.2.7 Grouting



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All beaming plates, loose, 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 1/2:3 concrete with 5mm down stone chips.

2.2.8 Anchor Bolting

When shown on drawings, the miscellaneous metal items shall be fixed to crete by case hardened and drawn carburizing steel expander nut and bolt. The contractor shall submit the manufacturer's literature shown the average pull out and average shear values for bolts of various sizes. The bolts shall be fixed strictly as per the manufacturer's instructions.

2.2.9 Pipe Joints

M.S. Pipes shall be joined by threaded sockets or by welding Cast iron pipes shall be socket and spigot jointed and caulked with hemp and molten head.

2.2.10 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.

2.2.11 Making Good

All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer.

3.0 ACCEPTANCE CRITERIA

- a) All items shall be of correct shape, size, weight etc., shown on drawings and schedule of items.
- b) For installed items, the tolerances shall be 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 blow holes, cracks and other blemishes.

4.0 RATES

The Contractor shall quote unit rate for supply of materials fabrication, shop paint and erection. This shall also include transporting the fabricated materials to the site, unloading storing and erection, including furnishing necessary temporary bracings guys, staging and planking. This shall also include cutting and drilling to steel, concrete or masonry and welding, bolting, grouting and making good damages after erection and removing all rubbish and clearing the site upon completion of erection.



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Where only erection of materials supplied by the Owner at site to actual erection site, erection including free of cost is involved, the rate shall include handling, transportation from the Owner's stores at site to actual erection site, erection including furnishing necessary temporary bracing, guys, staging and planking etc., complete with all cutting drilling welding grouting bolting etc., making good damages removing all debris on completion of the job.

5.0 METHOD OF MEASUREMENT

- a) For supply and/installation generally, cast items except pipes shall be measured for actual numbers used or for weight as mentioned in the Schedule.
- b) Cast Iron rain water down corners or drain pipes shall be measured for length along the center line of piping including all bends, joints shoes and specials.
- c) Fabricated items shall be measured for weight.
- d) Ornamental metal grills, gates etc., shall be measured either for weight or area or such grills, gates etc.

6.0 I.S CODES

IS:226	-	Structural Steel (Standard Quality)	
IS:800	-	Code of Practice for use of structural steel in general construction.	building
IS:816	-	Use of metal arc welding for general construction	
IS:2812	-	Arc Welding of Aluminium and Alloys	
IS:3150	-	Hexagonal Wire Netting	
IS:4948	-	Welded steel wire fabric for general use.	



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PAINTING ON STRUCTURAL STEEL

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1.0 SCOPE

- 1.1 This specification covers the general requirements for painting structural steel work. It covers the supply and delivery of all necessary materials, labour, scaffolding, tools, equipment and everything that for the job completion on schedule.
- 1.2 The scope of painting work could be one or more of the following.
- a) Shop painting after fabrication.
 - b) Painting after erection.
 - c) Painting after fabrication and painting after erection.
 - d) Routing maintenance painting or repainting of erected structural steel.
- 1.3 Shop painting shall be understood to mean painting prior to erection whether such Materials are fabricated in shop or at site. In case the contract covers shop painting only, the contractor shall ensure that the painted surfaces are not abraded/scratched etc, as they leave his works/shops. In case of ex-works delivery contract and in case of FOR site contracts, the materials as received at site should be good condition. Otherwise all damaged, abraded and scratched surfaces shall be touched up on receipt of materials at site as specified. If the contract covers both shop painting and painting after erection, the responsibility would be total. In Case of routine maintenance painting of erected steel work, the surface preparation, primer application and painting shall be as per the instructions of the Engineer.

2.0 APPLICABLE CODES

The following Specifications, Standards and Codes are made a part of this Specification. All standards, tentative specifications, Specifications and Codes of Practice referred to here in shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy between this Specification and those referred to herein, this Specification shall govern, In case as discrepancy between tender drawings and this Specification of the tender drawings shall govern.

In case of discrepancy between this Specification and those referred to herein, this Specification shall govern, In case as discrepancy between tender drawings and This Specification of the tender drawings shall govern.

- a) IS : 800 Code of practice for Use of Structural Steel in General Building Construction.
- b) IS: 012 Ready Mixed paints, Brushing, Red Lead, Non setting, Priming.
- c) IS : 129 Ready Mixed Paint, Brushing, Finishing, Interior, Oil glass, for General purposes, to Indian Standard colours.



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- d) IS : 157 Ready Mixed Paints, Brushing, Acid and Alkali Resisting, Lead Free, for General Purposes, to Indian Standard Colours No.446 Red Oxide, NO.632 Dark Admiralty Grey and other colours as required.
- e) IS : 159 Ready Mixed paint, Spraying, Acid Resisting, for protection against Acid Fumes, Colour as required.
- f) IS : 160 Ready Mixed paint, Spraying, Acid Resisting, for protecting against Acid Fumes, Colour as required.
- g) IS : 341 Black Japan, Types A,B,c
- h) IS : 1236 Ready Mixed Paint, Brushing, Oil Gloss, Heat Resisting, to Indian Standard Colour No630 Deep Buff.
- i) IS : 1477 code of practice for painting of Ferrous Metals in Buildings.
(part-I) - pre-treatment
(part-I) – painting.
- j) IS : 2074 Ready Mixed paints, Red Oxide – Zinc chrome, priming.
- k) IS : 2330 Aluminium paint for General purposes, in Dual Container.
- l) IS : 5905 Sprayed Aluminium and Zinc Coatings on Iron and Steel.

2.0 PAINT

- 3.1 All paints delivered to the fabrication shop/site shall be ready mixed, in original Sealed containers, as packed by the paint manufactures and no thinners shall be Permitted.
- 3.2 Paint shall be stirred frequently to keep the pigment in suspension.

3.0 WORKMANSHIP

- 4.1 The surface of steel works to be painted in the shop shall be thoroughly cleaned for All loose mill scale, rust, grease, dirt and foreign matter by hand tool cleaning, Power tool cleaning, flame cleaning or sand / shot blasting as specified in Data Sheet A. In power tool brushing, sufficient care shall be exercised no to burnish mill scale to a slick finish to which paint may not adhere property.
- 4.2 All fabricated steel martial, except those to be galvanised shall receive protective Paint coating of red Oxide Zinc chromate or as specified in schedule of items.
- 4.3 The paint treatment shall be applied either by brushing or spraying on the



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thoroughly cleaned and dry surface, Airless spraying shall be done if so specified.
The number or coats of paint shall be one or as specified in schedule of items.

- 4.4 Surface inaccessible after assembly shall receive an additional coat for the specified paint prior to assembly.
- 4.5 Steel delivered at the erection site be touched up with the specified paint on surface which are scratched.
- 4.6 After steel has been erected, all bare and abraded spots, rivet heads, field welds, Bolt heads and nuts shall be painted with primer specified in Data Sheet A. Before paint is applied, the surface shall be dry and free from dust, dirt, scale, oil and grease.
- 4.7 Surface inaccessible after erection, including top surface of floor beams shall Receive treatment with one additional coat of red oxide zinc chromate primer.
- 4.8 No painting shall be done in frosty/foggy weather or when the humidity is high Enough to cause condensation on the surface to be painted. Paint shall not be applied when the temperature of surface to be painted in 5⁰C or lower.
- 4.9 In addition, colour code marking as specified shall be clearly painted in the Fabrication shop on the member in the manner specified.
- 4.10 Separate colours code of identification mark shall be adopted in the fabrication Shop for member fabricated from steel supplied by the OWNER and the VENDOR/CONTRACTOR
- 4.11 Surfaces coming in contact with concrete, and such other areas should not be painted, if so specified or directed by Engineer.
- 4.12 All machine finished surface shall be provided with a coat of white lead tallow Before despatch to site to prevent rust formation.

4.0 METHOD OF PAYMENT

- 5.1 Payment for painting of structural steel works shall be made on the basis of weight in metric tons of the painted structures accepted by the Engineer-in- charge. The rate shall include supplying and applying two coats of synthetic enamel paint of approved quality and shade over a coat of red oxide zinc chromate primer besides one coat of shop primer already applied to structure steel works of all types/ shapes at all locations & positions including storage, surface preparation, degreasing, cleaning, drying, touching up of shop primer coat, providing temporary staging, testing etc, all complete as specified.



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1.0 SCOPE

This specification source the general the requirement for providing insert and cut out concrete work as indicated in the drawings supplied to the contractor.

2.0 GENERAL

Numerous insert are requirement to be fixed/embedded in concrete as indicated In construction drawing/as directed by the Engineer. These insert comprise plates, angle, pipe sleeves, anchor bolts assemblies, owner, etc to be supplied by owner free of coat at his stores, for incorporation in the works, other inserts are required to be supplied and fabricated, by the Contractor These would be indicated clearly on the construction drawings.

3.0 MATERIALS AND INSTALLATION

3.1 Steel templates shall be used by the CONTRACTOR to locate and very accurately position bolts, group of inserts, inserts, embedded parts, etc, at his cost. Such templates shall be got previously approved by the Engineer. Templates shall invariably be supported such that the same is not disturbed due to vibration, movement of labours, materials, shuttering work, reinforcement, etc, while concreting. The CONTRACTOR will have to suitably bend, cut or otherwise adjust the reinforcement in concrete at the location of inserts, as directed by the Engineer. If the Engineer so directs, the insert will have to be welded to reinforcement to keep these in place. The contractor shall be responsible for the accuracy of dimensions, levels, alignments and canter lines of the insert in accordance with the drawings and for maintenance of the same until the erection of equipment structure or final acceptance by the Owner.

3.2 The Contractor shall ensure proper protection of all bolts, inserts, etc, from weather by greasing or other approved means such as applying white lead putty and wrapping them in gunny bags or canvas or other means as directed by the Engineer to avoid damage due to movement of his labourers, materials, equipment etc. No extra claim from the Contractor on this account shall be entertained. The contractor shall be solely responsible for all the damage caused to bolts inserts, etc, due to his negligence and in case damage does occur, they shall be rectified to the satisfaction of the Engineer at the Contractor's cost.

4.0 RATE

4.1 The rate quoted by the Bidder for embedment works shall hold good for accurately fixing the inserts at the correct-levels/alignment and shall include the cost of templates and any temporary supports/anchors etc, including cutting, bending , welding, etc as requirement.

5.0 MEASUREMENT:

All embedment will be measured by weight including lugs.



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Templates and temporary supports, if any will not be measured.

Permanent supports such as road, structural sections etc, used exclusively for supporting the embodiments shall be paid for under ordinary embodiments (not under Foundation hardware).



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1.00.0 GROUTING OF BASE PLATES

1.01.0 GENERAL

Grouting under base plates constitute a special kind of work requiring judicious selection of materials and careful execution of work. Grouting should ensure complete filling of the space and perfect bond. The grouting shall be done under Expert supervision. Care must be taken to ensure that there is no locked air in the grouting.

1.02.0 MATERIALS

1.02.01 CEMENT : Only fresh Portland conforming to IS:8112

1.02.02 SAND : Fine aggregate shall comply in general with requirement of concrete aggregate (IS:383) and shall have a fineness modules of 2.5 to 3.0

1.02.03 ANTI-SHRINKAGE MATERIAL : Aluminium powder or anti-shrinkage admixture like Groutex CRS-NS grout (by Cement Research Institute of India) or conbextra GP2 its equivalent shall be of standard brand from reputed manufactures And shall be approved by the Engineer prior to use in work.

1.02.03 MORTAR

Water cement ratio should not exceed 0.5 Mortar shall be made up of cement and sand in the proportion 1:1 by weight and blended with Aluminium powder (about 0.005 by weight of cement or with anti –shrinkage admixture) in a suitable proportion to cement mortar in accordance with the recommendation of the manufacturer and subject to the approval of the Engineer.

1.04.0 SCOPE

The work covers all operation connected with grouting including all labour and materials. Any damage to the concrete foundation works caused during such operations due to the carelessness, or negligence shall be made good by the Contractor in a manner to be decided by the Engineer, whose decision shall be final and binding.

1.05.00 SURFACE PREPARATION: CONCRETE

Concrete surface receiving the grout shall be properly roughened removing latency and exposing good concrete. The preparation of the surface may be accomplished through the use of a chipping hammer or hand bush hammer and wire brush. The surface shall be thoroughly cleaned removing all the free water from the surface but keeping it wet before the grouting begins.



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1.06.0 SURFACE PREPARATION:STEEL

The steel surface coming in contact with the grout should be cleaned or rust, mill scales, paints, oil or grease and be wet before setting into place for grouting.

1.07.0 WORKMANSHIP

Grouting arrangements should ensure mortar to fill all the voids completely. Provisions of grout holes and rod ding arrangements should be checked before commencement of grouting. If necessary, pressure grouting with grout pump shall be restored to. Edges shall be finished properly.

1.08.0 METHODS OF GROUTING

1.08.01 USE OF DRY PACK CONCRETE

The widely used method of obtaining satisfactory grout is based on the principle of using lowest water cement ratio reducing the shrinkage to a minimum. Pozzolana cement having less shrinkage than ordinary Portland cement is preferred for this grouting. Only enough water shall be added to produce a grout. The proper amount of mixing water and proper consistency are those which will produce a grout which is at the point of becoming rubbery when the material is solidly packed. Any mortar which has been mixed for period longer than an hour shall not be used.

1.08.0 USE OF DRY PACK CONCRETE

To reduce the shrinkage anti-shrinkage materials as specified earlier to be added.

1.08.02 LEVELLING & PLUMBING

No grouting shall be carried out until the steel-works shall been finally levelled and plumbed and sufficient number of floor beams are tied in position. The stanchions, meanwhile, are to be supported by steel wedges, and immediately Before grouting, the space under steel base plate shall be thoroughly cleaned. The steel wedges must not be welded to the underside of base places.

2.00.0 DISMANTLING, ALTERATION AND RE-ERECTION OF STEEL WORK

In case it is found that alteration are to be done for certain portions of steel work already erected for any reasons what so ever, this shall be done only on the written orders of the Engineer. Complete scheme of alterations shall be detailed and got approved by Engineer before work is taken up at site.

The sections requiring modifications which cannot be done in the erected position shall be dismantled carefully without damaging other structure, lowered dismantling, cutting, re-welding or supporting, re-aligning of other adjacent connected member as well.

3.00.0 MEASUREMENT

3.00.01 Grouting under base plates of structures erected by the Contractor will not be



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measured. The rate for erection is expected to include cost of grouting. However, Volume of grout will be considered for the purpose of theoretical consumption of cement.

3.00.02 Grouting under base plates and machine bases erected by other will be measured for actual volume of grout. The volume of embedded base plate/machine basis will be deducted from the overall volume of grout.

3.00.03 Grouting in pocket for erection done by other will be measured for the volume of Of pockets. No deduction will be done for volume of bolts etc.



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1.0.0 SCOPE

This specification covers furnishing, installation, repairing, finishing, cutting, protection, maintenance and handing over of masonry and allied works of use in structures and locations covered under the scope of the Contract.

2.0.0 INSTALATION

2.1.0 SOLING

2.1.1 BRICK SOLING

The ground shall be dressed, consolidated by ramming or by light rolling and a 12mm 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 wooded 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 designed by the Engineer. After laying of each layer of brick sand shall be spread over and worked into the joints to pack the bricks tight.

2.1.2 STONE SOILING

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.

2.2.0 BRICKS EDGING

Excavation shall be done closed to the brick dimensions 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.

2.3.0 MASONRY

2.3.1 GENERAL

All masonry work shall be true to lines and levels and as shown on drawings. All Masonry shall be tightly built against structural members and bonded with dowels, inserts etc, as shown on drawings.

2.3.2 MORTAR

Mix for mortar shall be specified in the Schedule of Items.

When lime is used hydrated lime shall be mixed with water to from a putty and stored with care to prevent evaporation for at least 24 hours before use, Quick lime shall be slaked with enough water to make a cream, passed through a No.10



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sieve and stored avoiding evaporation for seven days before use.

Lime putty and sand in proper proportion shall be mixed on a water-light platform with necessary addition of water and thoroughly ground in a mortar mill. This mix shall be transferred to a mechanical mix, required quantity of cement added and the content mixed for at least 3 minutes. Mixtures of lime putty and sand may be stored avoiding drying out. For cement sand mortar cement and sand in requisite proportions shall be mixed dry in a mechanical mixer and then water added and mixed further. Minimum quantity of water shall be added to achieve working consistency. Surplus mortar droppings from masonry, if received on surface free from dirt may be mixed with rest 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.

2.3.3 BRICK MASONRY

Bricks shall be soaked by submergence in clean water for at 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 closures. 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 passed against it. Thus, all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept uniformly 10mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provided 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.

2.3.4 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 truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformly of brick courses. Masons must check workmanship frequently with plumb, spirit level, rule and strings. All brickwork shall be cleaned at the end of dry work. If face bricks are specified in the Schedule of item, the brickwork shall be in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed brickwork on completion of work shall be rubbed down, washed clean and pointed as specified. Where face bricks are used carborundum stone shall be used for rubbing down.



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2.3.5 REINFOCED BRICKWORKS

Reinforcements shall be as specified in the Schedule of Items. All reinforcements shall be thoroughly cleaned and fully embedded in mortar. Where M.S. bars are used as reinforcement, these shall be laced with dowels if left in R.C. columns or welded to steel stanchions.

2.3.6 REINFORCED BRICKWORKS

Reinforcements shall be as specified in the Schedule of Items. All reinforcements shall be thoroughly cleaned and fully embedded in mortar. Where M.S bars are used as reinforcement, these shall be laced with dowels if left in R.C. columns or welded to steel stanchions.

2.3.7 STONE MASONRY

Stones shall be thoroughly soaked before laying. Stones shall laid on their natural quarry beds. Individual stones 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 the Schedule of Items or Instructions. A sample wall, 10 sq.m. In area shall be build and approved by the Engineer and all works shall match with this sample.

2.3.8 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.

2.3.9 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 in the Schedule of Items. Expansion joint filler boards and sealing strip shall have minimum traverse joints. Transverse joints shall meet the approval of the Engineer.

Separation joints shall be with standard water proof paper or with alkathene sheets about 1mm in thickness. Length and sealing of laps shall be to the satisfaction of the engineer.

2.3.10 MOULDINGS, CORNICES, DRIP COURSE



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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.

2.3.11 CURING

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry whether at the end of days work top surface of masonry shall be kept wet by ponding.

2.3.12 EMBEDDING OF FIXTURES

All fixtures shall generally be embedded in mortar and masonry units shall cut as required.

2.3.13 ENCASING OF STRUCTURE STEEL

This shall be done by masonry work round flanges, webs etc. and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be warped with checked wire mesh shown on drawings of instructed by the Engineer. The minimum lap is checked wire mesh shall be 50mm

2.4.0 DAMP PROOF COURSE

Unless otherwise specified Damp-proof course shall be 40 mm Thick 'artificial stone' proportion 1:1-2/3 cement sand stone-chips (10mm down) with admixture of a waterproof compound as approved by the Engineer. The percentage of admixture shall be as manufacture's specifications but not less than 2% weight of cement. The top surface shall be double chequered cured by ponding for seven days.

2.5.0. DAMP PROOF MEMBRANE

Damp proof treatment using fibre or hessian base bitumen felt shall be 6,8 or 10 course treatment is specified in IS:1609. The number of courses shall be as mentioned in the schedule of items. Sequence or work shall be as directed by the Engineer. Extreme sequential care shall be taken to prevent damage to felt during and after laying. The contractor shall be obliged at the own expense, if to rectify and leakage appearing within 5 years of installation by removing and renewing the coats at the point of leakage.

Where shown on drawing damp proof measurance with one layer bitumen paper or one land alkathene sheet shall be laid with minimum 150 mm lap under sides on grade.

3.0.0 RATES



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Rates shall be units rates for the complete work as detailed out in the Specification unless any particular portion is specifically in the Schedule of Item.

4.0.0 METHOD OF MEASUREMENT

4.1.0 SOLING

Soling of different types as enumerated in the Schedule of Items shall be measured on actual area basis.

Deductions shall not be made for areas less than 0.1 Sq.M.

4.2.0 BRICK EDGING

Edging shall be measured on running length unless included in other relevant items.

4.3.0 MASONRY

4.3.1 Thickness of brick walls shall be measured in normal brick sizes.

4.3.2 For masonry work exceeding 150mm in thickness, actual volume of work shall be measured and deductions for opening, lintels, sills, conduit ducts, pipes etc., shall be made. No opening less than 0.1 Sq.M Min area shall however be deducted.

4.3.3 No deductions shall be made for embedded fixtures nor any extra by paid for the mortar used for fixing or for necessary cutting of bricks.

4.3.4 For encasing of steel beams, columns etc. the sizes as shown on drawings shall be measured and deductions made for the volume of encased steel.

4.3.5 No extra payment shall be for cutting of masonry units.

4.3.6 Walls 150mm in thickness or less shall be measured for actual area of works and deductions made as in Clause 4.3.2.

4.3.7 Exposed brickwork using selected ordinary brick or free bricks for the exposed face shall be measured in area as an extra over the ordinary brickwork if no provided in the Schedule of Items. It shall be measured by volume including the composite backing if so provided in the Schedule. Deductions shall be as described in Clause 4.3.2

4.3.8 Reinforcements shall be measured and paid separately under relevant items in the schedule unless included in the items for masonry work.

Laps in wire mesh reinforcements shall not be measured. Reinforcing mesh shall be measured on actual area basis. Reinforcing bare shall be measured by weight.



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The weight shall be arrived at on the basis sectional weights as per I.S. No extra shall be paid for necessary modifications of existing dowels, if any, to tie up with the Contractor's work.

4.3.9 EXPOSED STONE WORK

Exposed stone work using selected stone for exposed face shall be measured in area as an extra over ordinary stone work if as provided in the Schedule of Items. Deductions shall be made as described in Clause 4.3.2.

4.3.10 COMPOSITE MASONRY

Composite masonry shall be measured for value including backing if so provided in the Schedule of taxes. If not, brickwork and stone-work shall be measured separately and paid under relevant items.

4.3.11 EXPANSION AND SEPARATION JOINTS

Joints shall be measured for length or area for the complete work as shown on drawings including filler boards, sealant strips, sealing compounds, painting, cover etc. If so provided in the Schedule of items unless any particular work is specifically excluded from the item.

4.3.12 MOULDING, CORNICE, DRIP COURSE:

Mouldings, cornice, drip course unless indicated specifically under separate items shall be considered in masonry items. However, cut in bricks or stone shall be neglected in measurements.

4.3.13 EMBEDDED FIXTURES

Inserts etc shall be measured by weight or by number and paid separately under relevant item in the Schedule of Items.

4.4.0 DAMP PROOFING:

Damp proofing shall be measured and paid in net area. No deductions shall however be made for opening less than 0.1sq.m in area. No separated payment shall be made for preparation of base, formworks and additive for cast-in-situ damp proofing unless specified otherwise.

5.0.0 I.S.CODES

Some of the important relevant codes these sections are:-



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- IS:1127 : Recommendations for dimensions and workman ship 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.



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1.0.0 SCOPE

The Specification covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over or 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 minimise damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

2.0.0 INSTALATION

2.1.0 PREPARATION OF SURFACE

All joints masonry walls shall be racked out to a depth of 10mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be brushed down with stiff wire brush to remove all loose dust from joints and thoroughly washed with water. All latency 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 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.

2.2.0 PLASTERING

2.2.1 MORTAR

Mortar for plastering shall be as specified in the Schedule of Items.

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.



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For lime gauged plaster, lime putty or hydrated lime and sand in the required proportion shall be mixed platform with necessary addition of the water and thoroughly ground in mortar mill. This mix shall then be transferred to a mechanical mixer to which the required quantity of cement is added and mixed for at least 3 minutes.

No plaster which has stood for more than half an hour shall be used; plaster than shows tendency to become dry before this time, shall have become dry before this time, shall have water added to it.

2.2.2 APPLICATION OF PLASTER

Plaster, when more than 12mm 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 12mm in thickness. The lower coat shall be thicker than the upper coat, the over all 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 at plaster. The undercoat shall be scratched or roughened before Applying the second coat at plaster. The undercoat shall be scratched or roughened before it is fully hardened to from 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 10 mm to 150mm square or wooden screen 75mm wide and of the thickness of the plaster, shall be fixed vertically about 2000mm to 3000mm 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, moldings 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.

2.2.3 FINISH

Generally, the standard finish shall be used unless otherwise shown on drawing or directed by the Engineer. Where ever, 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, colour and finish.

a) Standard Finish

Where 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.



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b) Neat cement finish

Immediately after achieving a true plastered surface with the help of a wooden straight edges, 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 2:2:2 but using coloured cement in place of ordinary cement. When coloured plastering is specified in more one coat, the top coat shall be made with coloured cement. Colored 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 edition

Samples of colouring material shall be submitted to the Engineer for approval and material produced, 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 on 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 2.2.2. While the mortar is still plastic small pebbles or crushed stone of size generally from 10mm to 20 mm 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 end of 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 6mm to 12mm 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 2.2.2 after being levelled and allowed to stiffen for a few hours, shall be scraped with a steel straight edges to remove the surface skin. The Patten 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 requirements 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.

2.2.4 CURING



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All plastered surface after laying, shall be watered, for all 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.

2.3.0 POINTING TO MASONRY

All joints of brick shall be raked out to a depth of 10mm 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 remove all loose 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 scraped off the wall face lagging the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.4.0 PLASTER WITH METAL LATH

The supports, hangers, brackets, cleats etc., shall be as shown on drawings and/or 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 12mm x 38mm mesh, 16 BC thick and 3 mm wide strands. Side laps shall be minimum 12mm and end laps 25mm minimum. The plastering shall be minimum 20mm thick measured from the back of lath and applied in two layers. The mortar for plastering shall consist of 1 part cement, ½ part lime and 4 parts sand by volume mixed as specified in plastering, Clause 2.2.1. The application, finish etc., shall be as specified under relevant clause above. Where called for in the Schedule of Items, a 2mm Plaster of Pair punning shall be applied over plaster as a finishing coat to give perfectly smooth and even finish

2.5.0 LIME PUNNING

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slacked, strained and aged, mixed with 1 part clean, washed, sleeved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2mm and more than 3mm. The plastered surface shall be saturated with water before application of the lime punning. The punning shall be applied by skilled workman and given a smooth and even finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

2.6.0 PLASTER OF PAIRS PUNNING

Plastered surfaces, where specified shall be finished with plaster of parts punning. The material shall be from approved manufactures and approved by



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The Engineer. The thickness of the punning shall be 2mm 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 Esq. area and approval of the span Engineer taken. The work shall then be taken in hand as per approved sample.

2.7.0 STONE FANCING

Stone facing where specified shall be done as shown on design drawings and approved shop drawings. The stone shall be as specified on drawings and/or schedule of items. Samples of stone shall be submitted to the Engineer for approval and then bulk purchase made. The Contractor shall submit three copies of shop drawing for the Engineer's approval before commencing the work.

The thickness of facing stone shall be not less than 25mm 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 700gms per square meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12mm 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 to 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 and/or Schedule of items.

3.0.0 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 specifications or as shown on drawings.

4.0.0 RATES

Rates shall be for the complete work as detailed out in the specification unless any particular portion is specifically excluded in the Schedule of Items. Rate shall include for rounding of corners.

5.0.0 METHOD OF MEASUREMENT



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- a) All surface finish shall be measured on actual area laid. No deductions shall be made for openings, pipes, sleeves etc. upto 0.1 Sq.m in area.
- b) Unless separate item is provided for special corner or edges finish, drip course, grooves, mouldings, curbs etc., these shall not be measured separately. Where separate item is provided in the Schedule of Items, such work shall be measured for length.
- c) No separate payment shall be made for finishing round openings, sleeves, pipes, etc. No separate payment shall be made for form work, templates etc., required for achieving true lines and profiles as shown on drawing.
- d) Finishes applied integrally with walls, floors, steps and ceilings shall be measured separately and paid under relevant items.
- e) Any reinforcement incorporated in the finish shall be measured and paid separately under relevant items.
- f) Unless otherwise mentioned in the Schedule of Items, hangers, supports and lath plastering shall be measured and paid separately under relevant items.

6.0.0 I.S. CODE

Important relevant code for this Section:-

- a) IS:1661 : Code of practice for cement and Cement-lime plaster finish on walls & ceilings.
- b) IS:4101 : Code of practice for external facings and veneers.



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1.0.0 SCOPE

This specification covers painting, white washing, varnishing polishing etc. of both interior and exterior surface of wood work, masonry, concrete plastering, plaster of paris., false ceiling, structural and other miscellaneous steel items, rainwater down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items as shown on drawings, schedule or as directed by the Engineer.

Copper, bronze, chromium plate, nickel, stainless steel, aluminium and monel metal shall generally not be painted or finished except if otherwise specified.

The painting Contractor shall inspect the work of other prior to the application of paint. If surface to be finished can not be put in suitable condition for painting by customary preparatory methods, the painting contractor shall notify the Engineer in writing or assume responsibility for and rectify unsatisfactory finishing that results.

Before commencing painting, the painting Contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage, disfiguration or staining by other trades. He shall also undertake normal precautions to prevent damage, disfiguration or staining to work of other or other installations.

2.0.0 INSTALLATION

2.0.1 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 or one shade is obtained from the same manufacturing batch. 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 finishing coats to be applied.

All unspecified materials such as shellac, 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 recognised manufactures 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



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required, they shall be executed in advance with the specified materials for the approval of the Engineer.

a) **White Washing**

Shall be done from pure shell lime or fat lime, or fat lime, or a mixture of both as instructed by the Engineer, and shall conform to IS : 712 latest edition. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unlaced condition. After slaking, it shall be allowed to remain in a tank of water for two days and then stirred up with a pole. Until it attains the consistency of thin cream. 100 grams of gum to 6 liters of white wash water and a little quantity of indite of synthetic ultramarine blue shall be added to the lime.

b) **Dry distemper**

Shall be made from suitable pigments, extenders, lime proof tinters, water soluble binders etc., and shall conform to IS:427.

c) **Oil Bound Washable Distemper**

Shall be of oil emulsion type, containing suitable preservatives and shall conform to IS:428.

d) **Waterproof Cement Paint**

Shall be made from best quality white cement and lime resistant colours with accelerators, waterproofing agent and fungicides. The paint shall conform to IS:5410.

e) **Acrylic Emulsion on Paint**

Shall be water-bases acrylic copolymer emulsion with rutile titanium dioxide and other selected pigments and fungicide. 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 be able to withstand washing with mild and water without any deterioration in colour, or without showing flaking, blistering or pooling.

f) **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 interior surfaces. White and pastel shades shall resist yellowing and darkening with aging. The painting shall conform to IS:2932 and IS:2933

g) **Aluminium paint**

Shall be in two pack containers and shall resist weathering. The paint shall conform to IS: 2339.

h) Shall be best quilt alkyd varnish suitable for brushing over the tint of paint or



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Light natural wood and shall not darken or yellow with age.

i) **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 wood is pre-treated with a liquid wood filler conforming to IS : 345 is applied and rubbed out.

2.0.2 **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 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.

2.1.1 **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.

2.1.1 **WOOD**

All surface 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 shellacs applied thinly & extended 25mm 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.

2.1.2 **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 resurfaced area shall be treated from the original surfaces, the resurfaced area shall be treated with minimum one coat of cement primer which should be continued to the surrounding area for a distance of minimum 100mm.

Surface with mildew or efflorescence shall be treated as below.



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a) Mildew

All mildew surface shall be treated with an approved fungicide such as ammonia cal wash consisting of 7g of copper carbonate dissolved in 80ml liquor ammonia and diluted to 1 litre with water, or 2,5 percent magnesium silica fluoride solution and allowed to dry thoroughly before paint is applied.

2.1.3 METAL

All metal surface shall be absolutely clean, dry and free from wax, grease or dried soap films. In addition, all steel and iron surface shall be free from rust, surface shall be cleaned by mechanical power tools to remove mill scales unless otherwise approved by the Engineer for epoxy chemical resistant paints, surface shall be blast cleaned to near white metal. All galvanised iron surfaces shall be pre-treated 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 cost.

2.1.0 APPLICATION

2.2.1 GENERAL

The method of application shall be as recommended by the manufacturer. In case of selection of special shade 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 to application of finishing paints.

Proper tools and implements shall be used. Scaffolding if used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor holes.

Painting shall be done by skilled labours in a workman like manner. All materials shall be evenly applied so as to be 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 undercoats for painting shall be applied by brush only, and rollers spray equipments etc., shall not be used.

No work shall be done under condition that are unsuitable for production of good results. No painting shall be done when plastering is in progress or is drying. Application of paint which seals the surface to moisture shall only be done after the moisture on the below the surface has dried out.



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All coats shall be thoroughly dry before succeeding is applied. Coats of painting as specified are intended to cover surface perfectly. In case the surface is not covered properly by applying the specified number of coats, further cats shall be applied by the Contractor when so desired by the Engineer.

sample 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 1&2). The total dry thickness of the film should not be less than 120 micron.

2.2.2 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 application of the lime solution.

One coat of white wash 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 in case the Engineer feels that one more coals are required the Contractor shall do so without any extra coat to the owner. No brush marks shall show on the finished surface.

2.2.3 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 of 1:50 sulphuric acid solution and 24hours after which the wall shall be thoroughly washed with clean water. For cement plastered surface, the surface shall be washed with a solution of 100gms of zinc sulphate to 1 litre of water then allowed to dry.

Dry distemping shall be done as per manufacture's instruction. In applying the distempers the brush should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long, as otherwise brush marks may result.

2.2.4 OIL HOUND WASHBLE DISTEMPER

The distemper shall be applied after surface is printed with an alkali resistant primer, and followed by minimum two coats of oil bound washable distemper all as per manufacture's instruction.

2.2.5 WATERPROOF CEMENT'S PAINT



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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 dose 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.

2.2.6 ACRYLIC EMMISION PAINT

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 strictly as per manufactures specification.

2.2.7 SYNTHETIC ENAMEL PAINT

Shall be applied on properly prime red surface. Sub sequential coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coat.

2.2.8 ALUMINIUM PAINT

The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacture's direction. When more one coat of paint is required or indicated, the next coat shall only be applied after the previous coat become hard dry.

2.2.9 CLEAR SYNTHETIC VARNISH

The varnish shall be applied on wood surface after (a) 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 rubbed down lightly, wiped off and allowed to dry, Careful attention cleanliness is required for varnishing. All dust and dirt shall be removed form 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 while 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 began to set, shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started a fresh.



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The varnish shall be minimum of two coats, with the first coat being a flattening varnish. This shall be allowed to dry hard and be flattened 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.

2.2.10 FRESH 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 wood shall be filled up with a paste of whitening in water or methylated spirit with a suitable pigment like burnt sienna 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 ease of application. A trace of linseed oil may be used on pad for ease 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 cloths, slightly dampened with methylated spirit and rubbed lightly and quickly with circular motions to leave the finished surface with a uniform texture and high gloss.

2.2.11 CHEMICAL RESISTANT PAINT

For chemical resistant paints, epoxy, chlorinated rubber or vinyl butryl paint system shall be used manufacture's recommendation regarding the paint system Exposed to moderately severe corrosive condition and subject to acid/alkali spillage and fumes, shall be followed.

2.2.0 PROTECTION

Furniture and other movable objects, equipments, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipments 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 instructions of the Engineer.

2.3.0 CLEANING UP

In addition to provisions in general conditions the Contractor shall, upon completion of painting etc., remove all marks and make good surface, where paint has been spilled, splashed or spattered, including all equipments, fixtures, glass, furniture, fittings etc., to the satisfaction of the Engineer.



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2.4.0 ACCEPTANCE CRITERIA

- a) All painted surfaces shall be uniform and pleasing in appearance.
- b) All varnished surface 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 surround surfaces.

4.0 RATES

Rates shall be unit rates for complete items described in the Schedule of Items. No extra payment will be made for preparation of surface before be made for preparation of surface before painting or for cleaning up after the work is complete.

5.0 METHOD OF MEASUREMENT

- a) Structural steel work shall not be measured separately and the cost shall be included in this rates for the fabrication and erection.
- b) Painting or whitewashing to concrete or masonry shall be measured and on the area painted. For measurement of openings whose jambs, sills, soffits etc., are to be painted the following procedure shall be followed.
 - I) For openings up to 0.5 Sq.M no deductions shall be made and no additions shall be made for lambs, sills, etc.,
 - ii) For opening exceeding 0.5 Sq.m. but not exceeding 3.0 Sq.m. each deductions shall be made for half the area of openings, and no additions shall be made for jambs sills etc.
 - iii) For opening exceeding 3.0Sq.m. each deductions shall be made for the jambs, sills, soffits, reveals etc.
- c) For opening, pipes, sleeves etc., whose sides are not finished no deductions shall be made openings etc., up to 0.1 Sq.m. in area each, and full deductions shall be made for all openings above 0.1 Sq.m. in area each.



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- d) No extra shall be paid for painting etc. done around openings, sleeves, pipes ducts, inserts etc.
- e) No extra payment shall be made for painting, etc., on wall features such as grooves, ducts, beads, protections, cornices, etc., unless give different finish or otherwise specified in the "Schedule of Items". The actual area of the features shall be gritted and included in the wall measurements.
- f) For painting of uneven surface in doors, windows, ventilators, louvers, guard bars, balustrades, gratis, railings, gates, etc., equivalent plain areas shall be measured as given in Clause 17.2 (Table 11) of IS:1200 unless mentioned otherwise.
- g) Corrugated surface shall be measured flat as fixed as not gritted. The quantities as measured shall be multiplied by the following factors to get equivalent plain area:
 - i) Corrugated steel sheets-shall be multiplied by 1.14
 - ii) Corrugated asbestos sheet with large corrugations shall be multiplied by 1.20.
 - iii) Semi-corrugated asbestos cement sheets shall be multiplied by 1.10
 - iv) Any other non-standard for sanitary and plumbing work, no separate Measurement shall be made and the cost shall be included in the Installation of pipes.
- h) For painting pipes for sanitary and plumbing work, no separate measurement Shall be made and the cost shall be included in the installation of pipes.
- i) Unless specifically started on the schedule of items, all painting, varnishing or Polishing of wood shall be measured and paid on the area treated. For Measurement of uneven surfaces, equivalent Main area shall be measured as Per Clause 17.2 (Table ii) of IS: 1200 unless specified otherwise.

6.0.0 I.S. CODE

Important relevant IS Codes for this Sections are listed below:

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.



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IS:1477(I&II) : Code of practice for painting of ferrous metal in buildings.

IS:2328(I&II) : Code of practice for finishing of wood and wood based materials.

IS:2329 : Specification for Aluminium paints for general purposes in dual containers.

IS:2395 : Code of practice for painting concrete masonry and plaster.

IS:2932 : Specification for enamel, synthetic, exterior, type-1.

IS:5410 : Specification for cement paint, colour as required.



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REV. NO.	PRAPARED	APPROVED	DATE
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1.0 SCOPE

This specification covers furnishing, installation, finishing curing, testing, protection, maintenance till hanging over various type of floor finishes and allied item of work as listed below:

a) In Situ Finishes

- i) Integral Finish to concrete base
- ii) Red Oxide of Iron finish
- iii) Terrazzo finish
- iv) Granolithic finish
- v) Patent stone
- vi) Metallic Hardener like “Ironite” finish
- vii) Mastic Asphalt finish
- viii) Chemical Resistant finish

b) Tiled finishes

- i) Terrazzo tile
- ii) Chequered tile
- iii) Glazed tile
- iv) Tesserae (Mosaic etc.)
- v) Chemical Resistant
- vi) Rubber, Vinyl etc.
- vii) Stone Slab

1.0.1 BASE

The base to receive the finish is covered under other relevant specification.

1.0.2 SEQUENCE



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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 the area. However, the Contractor for the finishing items shall remain fully responsible for all normal precautions and vigilance to prevent any damage what so ever till handing over.

2.0 INSTALLATION

2.0.1 SPECIAL MATERIALS

Basic materials are covered under Specification “properties Storage and Handling of Common Building Materials” Special materials required for individual finishing items are specified under respective items. In general, all such materials shall be as per relevant I.S. Codes where available. In all cases these materials Shall be of the best quality available indigenously, construction schedule.

The materials for finishing items must be procured from well reputed specialised 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 maintaining in the construction schedule.

2.0.2 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 manufacture shall be engaged in particular cases where the Engineer so desires the Contractor shall get the finishing items install by the manufacture.

2.0.3 PREPARATION OF THE BASE SURFACE

The surface to the treated shall be thoroughly examined by the contractor. Any rectification necessary shall be brought in 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 adequately roughened by chipping, taking out joints and cleaning thoroughly all dirt’s, 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 under individual item.

To prevent soakage of water from the finishing treatment the base shall be thoroughly soaked with water and all excess water mopped up. The surface shall be done dry where adhesives are used for fixing the finishes.

Prior to Contractor Commencement of actual finishing work the approval of the Engineer shall be taken as per the acceptability of the surface.



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2.1 IN SITU FINISHES

2.1.1 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' a thick slurry made with neat cement shall be applied evenly and worked in with iron float. When the slurry starts to set it shall be pressed with iron floats to have a firm compact smooth surface without trowel mark of undulations. This finish shall be as thin as possible by using 2.2kg, of Cement per Sq.M.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 laying.

As desired by the Engineer the surface, while still 'green' shall be indicated by pressing strings, the marking shall be of even depth, in straight lines and the panels shall be of uniform and symmetrical patterns.

2.1.2 RED OXIDE OF IRON FINISH

It shall consist of an under bed and a topping over already laid and matured concrete base.

a) Thickness

Unless otherwise specified the total thickness of the finish shall be minimum 50 mm for horizontal and 25mm for vertical surface of which the topping shall (not less than 10mm) while the topping shall be of uniform thickness the under bed may vary in thickness to provide necessary slope. The vertical surface shall project out 6mm from the adjacent plaster or other finishes. Necessary cutting into the surface receiving the finish shall be done to accommodate the specified thickness.

All junctions of vertical with horizontals shall be rounded neatly to uniform radius of 25mm.

b) Mix

i) Underbed

The underbeds for floors and similar horizontal surface shall consist of a mix of 1 part cement, 2 parts coarse and 4 parts 10 mm down graded stone chips by volume. For vertical sand similar surface the mix shall consist of 1 part cement to 3 parts coarse sand by volume.



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ii) Topping

For the topping cement, screened through a fine mesh and red oxide of iron pigment powder similarly screened shall be dry mixed thoroughly in right proportions to produce the desired colour when laid. The mix shall then be prepared with 1 part cement (mixed with pigment) and 3 parts coarse volume. The whole quantity required for each visible area shall be prepared in one batch to ensure uniform colour.

c) Laying

The under bed shall be laid in panels of mixing area 5 Sq.M. each and no side shall be more than 2.5m long. For outdoor locations the maximum area shall be 2.0 Sq.M. The forms for the panels shall have perfectly aligned edges to the full depth of the total thickness of finish. If specified aluminium or glass dividing strips shall be used.

The panels shall be laid in alternate bays or in chequered board pattern. No panel shall be cast in contact with another already laid, until the contraction of the latter has taken place. The under bed shall be laid, compacted, levelled and brought to proper grade with a screed or float. The topping shall be placed after about 24 hours while the under bed is still somewhat 'green' but firm enough to receive the topping. The surface of the under bed shall be roughened for better bonding. The topping shall be rolled for horizontal stress and thrown and pressed for vertical areas to extract all superfluous cement And water to achieve a compact dense mass fully boned with the under bed.

The topping shall then be levelled up by trowel ling and finished smooth with a slurry made with already prepared cement and pigment mixture. About 2.0kg of the mixture shall be consumed/per Sq.M. for horizontal surface and 1.0 kg, for vertical surface. The surface shall be cured for seven days by keeping it moist.

d) Polishing

About 16 hours after laying when the surface has hardened sufficiently it shall be polished with polishing stone till a smooth shiny surface to the satisfaction of the Engineer, is achieved. The finish shall washed and cleaned just before handing over.

2.1.3 TERRAZO FINISH: IN SITE

It shall consist of an underbeds and a topping laid over an already laid and matured concrete base.

a) Thickness



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Unless, otherwise specified the total thickness of the finish be minimum 550mm for horizontal and 25mm for vertical surface of which the topping shall be not less than 10mm. While, the topping shall be of uniform thickness the under bed may vary in thickness to provide necessary slopes. The vertical surface shall project cut 6mm from the adjacent plaster or other finish. Necessary cutting into the surface receiving the finish shall be done to accommodate the specified thickness.

All

b) Mix

i) Under bed

The under bed for floors and similar horizontal surface shall consist of mix of 1 part cement, 1 ½ parts sand and 3 parts stone chips by volume. For vertical surface the mix shall consist of 1 part cement to 3 parts sand by volume. The sand shall be coarse. The stone chips shall be 10mm down well graded. Only sufficient water to be added to give a workable consistency.

ii) Tapping

The mix for the tapping shall be composed of cement colour pigment, 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 grey or a mixture of 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 1 1/2 parts of marble chips by volume shall be added and thoroughly mixed dry again.

The pigment must be stable and non fading. It must be very finely ground. The marble powder shall be from white marble and shall be finer than IS Sieve No.:30. The size of marble chips may be between 1 mm to 20mm.

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 quantity that can be used up immediately before it starts to set.

c) Laying

The under bed 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 location the maximum area of panel shall be 2.0 Sq.M. The panel shall be laid



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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 under bed plus topping.

After laying, the under bed 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 under bed 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 horizontal areas and thrown and pressed for vertical area to extract all superfluous cement and water and to achieve a compact dense mass fully bonded with the under bed. The surface of the topping shall be trowel led over, pressed and brought to a smooth dense surface showing a minimum 75% area covered by marble chips in an 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 polishing

When the surface has sufficiently hardened it shall be watered and ground evenly with rapid cutting coarse grade (no. 40) 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 in 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 pinhole. The grinding shall be done by a suitable machine. 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:80) and final rubbing and polishing with fine grade (no:120). The surface shall be cleaned with water, dried and covered with solid free, clean sawdust if directed by the Engineer. The final polishing shall be positioned till 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 if and the surface to be left glossy but not slippery.

2.1.4 GRANOLITHIC FINISH



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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 6mm and 12mm. 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 up to 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 be roughened by the Engineer, mechanical vibrators of suitable design shall be used to press the topping firmly and work vigorously and quickly to secure full bond with concrete base.

The latency brought to the surface during compression shall be removed carefully without disturbing the stone chips. The surface shall then be 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 16 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 2.0.3 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 monolithic topping.

e) **Curing**

Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface has hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or pouring of water on the surface. The floor shall not be exposed to heavy traffic during this period.



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f) **Grinding**

If grinding is specified, it shall start only after the finish has fully set, Clause 2.1.3 © shall be followed. However, the ultimate polish required shall be decided upon by the Engineer.

g) **Finishing**

Where specified, sodium silicate or magnesium or zinc silica fluoride treatment shall be done. The number of coats to be applied shall be as specified in the Schedule of items. The concentration and method of application of the solutions shall be as specified in IS:5481.

2.1.5 **PATENT STONE**

It shall consist of an under bed 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 2.1.2(a) except that the topping shall be 6mm thick.

b) **Mix**

i) **Under bed**

The mix shall be as stipulated under clause 2.1.3 (b)

ii) **Topping**

The mix for the topping shall consist of 1 part cement and 1 part fine sand by volume.

c) **Laying**

The Patent Stone finish, including the under bed shall be laid in alternate bays or in chequered board pattern. No panel shall be as in contact with another already laid till the concentration 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.

Unless otherwise specified the total thickness of the finish shall be minimum 50 mm horizontal and 25mm for vertical surface of which the topping shall (not less



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than 10mm) while the topping shall be of uniform thickness the under bed may vary in thickness to provide necessary slope. The vertical surface shall project out 6mm from the adjacent plaster or other finishes. Necessary cutting into the surface receiving the finish shall be done to accommodate the specified thickness.

All junctions of vertical with horizontals shall be rounded neatly to uniform radius of 25mm.

e) **Mix**

- i) The underbids for floors and similar horizontal surface shall consist of a mix of 1 part cement, 2 parts coarse and 4 parts 10 mm down graded stone chips by volume. For vertical sand similar surface the mix shall consist of 1 part cement to 3 parts coarse sand by volume.
- ii) For the topping cement, screened through a fine mesh and red oxide of iron pigment powder similarly screened shall be dry mixed thoroughly in right proportions to produce the desired colour when laid. The mix shall then be prepared with 1 part cement (mixed with pigment) and 3 parts coarse volume. The whole quantity required for each visible area shall be prepared in one batch to ensure uniform colour.

f) **Laying**

The under bed shall be laid in panels of mixing area 5 Sq.M. each and no side shall be more than 2.5m long. For outdoor locations the maximum area shall be 2.0 Sq.M. The forms for the panels shall have perfectly aligned edges to the full depth of the total thickness of finish. If specified aluminium or glass dividing strips shall be used.

The panels shall be laid in alternate bays or in chequered board pattern. No panel shall be cast in contact with another already laid, until the contraction of the latter has taken place. The under bed shall be laid, compacted, levelled and brought to proper grade with a screed or float. The topping shall be placed after about 24 hours while the under bed is still somewhat 'green' but firm enough to receive the topping. The surface of the under bed shall be roughened for better bonding. The topping shall be rolled for horizontal stress and thrown and pressed for vertical areas to extract all superfluous cement

And water to achieve a compact dense mass fully boned with the under bed.

The topping shall then be levelled up by trowel ling and finished smooth with a slurry made with already prepared cement and pigment mixture. About 2.0kg of the mixture shall be consumed/per Sq.M. for horizontal surface and 1.0 kg, for vertical surface. The surface shall be cured for seven days by keeping it moist.

g) **Polishing**



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About 16 hours after laying when the surface has hardened sufficiently it shall be polished with polishing stone till a smooth shiny surface to the satisfaction of the Engineer, is achieved. The finish shall washed and cleaned just before handing over.

2.1.6 TERROZO FINISH: IN SITE

It shall consist of an underbeds and a topping laid over an already laid and matured concrete base.

f) Thickness

Unless, otherwise specified the total thickness of the finish be minimum 550mm for horizontal and 25mm for vertical surface of which the topping shall be not less than 10mm. While, the topping shall be of uniform thickness the under bed may vary in thickness to provide necessary slopes. The vertical surface shall project cut 6mm from the adjacent plaster or other finish. Necessary cutting into the surface receiving the finish shall be done to accommodate the specified thickness.

g) Mix

i) Under bed

The under bed for floors and similar horizontal surface shall consist of mix of 1 part cement, 1 ½ parts sand and 3 parts stone chips by volume. For vertical surface the mix shall consist of 1 part cement to 3 parts sand by volume. The sand shall be coarse. The stone chips shall be 10mm down well graded. Only sufficient water to be added to give a workable consistency.

ii) Tapping

The mix for the tapping shall be composed of cement colour pigment, marble chips. Proportions of the ingredients shall be such as to two produce the terrazzo of colour texture and pattern approved by the Engineer. The cement shall be white or grey or a mixture of 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 1 1/2 parts of marble chips by volume shall be added and thoroughly mixed dry again.

The pigment must be stable and non fading. It must be very finely ground. The marble powder shall be from white marble and shall be finer than IS Sieve No.:30. The size of marble chips may be between 1 mm to 20mm.



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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 quantity that can be used up immediately before it starts to set.

h) Laying

The under bed 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 location the maximum area of 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 under bed plus topping.

After laying, the under bed 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 under bed 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 horizontal areas and thrown and pressed for vertical area to extract all superfluous cement and water and to achieve a compact dense mass fully bonded with the under bed. The surface of the topping shall be trowel led over, pressed and brought to a smooth dense surface showing a minimum 7% area covered by marble chips in a even pattern of distribution.

i) 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.

j) Grinding and polishing

When the surface has sufficiently hardened it shall be watered and ground evenly with rapid cutting coarse grade (no. 40) 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 in moist and then ground with fine grit blocks (no:120). It shall again be cleaned with water, the slurry applied again to full 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 pinhole. The grinding shall be done by a suitable machine. 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:80) and final rubbing and



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polishing with fine grade (no:120). The surface shall be cleaned with water, dried and covered with solid free, clean sawdust if directed by the Engineer. The final polishing shall be positioned till 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 if and the surface to be left glossy but not slippery.

2.1.7 GRANOLITHIC FINISH

Granolithic finish shall either be laid monolithically over base concrete or separately over hardened base concrete.

h) Thickness

The finish shall be average 20 mm and minimum 12 mm thick, unless specified otherwise.

i) 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 6mm and 12mm. Minimum quantity of water to get workability shall be added.

j) Laying of Monolithic Topping

The concrete base shall be laid as per specification “cement concrete” and levelled up to 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 be roughened by the Engineer, mechanical vibrators of suitable design shall be used to press the topping firmly and work vigorously and quickly to secure full bond with concrete base.

The latency brought to the surface during compression shall be removed carefully without disturbing the stone chips. The surface shall then be 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 16 Sq.M. area. The panels shall be laid in chequered board pattern.

k) Laying of Topping Separately on Hardened Base



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The base concrete shall be prepared as stated in clause 2.0.3 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 monolithic topping.

l) **Curing**

Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface has hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or pouring of water on the surface. The floor shall not be exposed to heavy traffic during this period.

m) **Grinding**

If grinding is specified, it shall start only after the finish has fully set, Clause 2.1.3 © shall be followed. However, the ultimate polish required shall be decided upon by the Engineer.

n) **Finishing**

Where specified, sodium silicate or magnesium or zinc silica fluoride treatment shall be done. The number of coats to be applied shall be as specified in the Schedule of items. The concentration and method of application of the solutions shall be as specified in IS:5481.

2.1.8 **PATENT STONE**

It shall consist of an underbed and a topping laid on an already laid and matured concrete base.

d) **Thickness**

The patent stone finish shall have thickness as stipulated under clause 2.1.2(a) except that the topping shall be 6mm thick.

e) **Mix**

i) **Underbed**

The mix shall be as stipulated under clause 2.1.3 (b)

ii) **Topping**

The mix for the topping shall consist of 1 part cement and 1 part fine sand by volume.

f) **Laying**



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The Patent Stone finish, including the under bed shall be laid in alternate bays or in chequered board pattern. No panel shall be as in contact with another already laid till the concentration 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 under bed then laid, compacted and levelled to proper grade with a screed or float. The topping shall be applied evenly on the under bed while it is not fully set but firm enough and rolled and pressed to get full bond. The topping shall be trowel led to a dense finish to the satisfaction of the Engineer. All trowel mark 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.

2.1.9 METALLIC HARDENER LIKE “IRONITE” 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 sample 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 8 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) The concrete floor shall be laid as per specification :Cement Concrete” and



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levelled up to the required grade. The forms, if any shall remain sufficiently projecting to take the finish the surface shall be roughened by wire brush as soon as possible.

The finish shall be laid while the concrete under bed 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 vigorously 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.

2.1.10 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 or schedule of items.

b) Materials

Bitumen shall be industrial bitumen of the graders 90/15 and 74/15 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 lime stone or other hard-work.

Coarse aggregate shall be crushed siliceous stone or other approved aggregate 6 mm stone chips shall be used for finish up to 20mm thick & 10mm chips for thicker finish.

c) Composition

Bitumen mastic shall conform to IS:1195 and shall be either brought to site 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 incorporated. At no stage during the remelting and mixing process, shall the temperature exceed 205 deg.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.



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The mastic shall be laid in suitable panels of about 15 Sq.M. in area each formed by formers. Succeeding panels be laid over lapping the finish panel so as to melt its edges and form a continuo finish without joint.

2.1.0 CHEMICAL RESISTANT IN SITU FINISH

Chemical resistant in situ finish shall be as epoxy resin with suitable filler material over a primer or called for in the Schedule of item. The minimum thickness shall be 6mm. 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 specialised manufacturer, get guarantee of performance from the organization and pass it on to the Owner in addition to his own guarantee.

2.2.0 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.

2.2.1 Terrazzo Tile Finish

The finish will consist of manufacture terrace tile 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 finished, to accommodate the specified thickness shall be done.

b) Tiles: Terrazzo

The tiles shall, unless specifically permitted in special cases by 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 trade mark of the manufacturer. All angles of the tiles shall be right angles all arises shape and true, colour and texture of the wearing face uniform throughout. Maximum tolerance allowance length and breadth shall be + or _ 1 mm and the thickness + 3 mm. Face of the tile shall be plane, free from pin holes 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.



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The total thickness including the topping shall be as specified but not less than 20 mm in any case.

The topping shall be as specified under clause 2.1.3 (b)

The tile shall be cured at the shop for at least 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 those colours 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

Underbed shall be same as CI. 2.1.2 (b) (1).

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 has 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.

All 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 both be allowed.



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If desired dividing strips as specified under Clause 2.1.3 © may be used for dividing the work into suitable panels.

c) Grinding and Polishing

Procedure shall be same as Clause 2.1.3 © 2. Grinding shall not commence earlier than 14 days after laying of tiles.

2.2.2 The finish shall consist of manufactured grey 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 2.2.1 (a)

b) Tiles: Chequered

The tiles shall have chequres 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 2.2.1 (b) except that these may have the topping interrezzo or plain grey cement of colour pigment added to cement as specified.

c) under bed

As per Clause 2.2.1 ©

d) Laying

As per Clause 2.2.1 (d)

e) Grinding and Polishing

As per Clause 2.2.1 (e) except that the tiles shall be ground and polished by hand after laying taking special care in polishing the grooves properly and uniformly.

2.2.3 Glazed Tiles Finish

This finish shall be composed of glazed earthen ware an under bed laid over a concrete or masonry base.

a) Thickness

The total thickness shall be between 20 mm and 25 mm including the under bed.



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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 10 mm thick unless otherwise specified. The tolerance shall be + or - 1.5 mm for length and breadth and + or - 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 homogenous. The tiles shall be strong and free from flaws like cracks, craze, spaces, crawling, etc., and other imperfections. The edge and the underside of the tiles shall 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: Under bed

The mix for the under bed 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 2.2.1 (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.

2.2.4 Tesserae Finish (Mosaic etc.)

This finish consists of manufactured vitreous, glass, ceramic or similar hard small pieces set in an under bed over a concrete or masonry surface, already laid.

a) Thickness

The total thickness including the under bed shall be between 16 mm and 23 mm.



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b) Tessa Rae 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 2.2.3 ©

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 2.2.3 (d) shall generally be followed. However, instead of grey 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.

2.2.5 Chemical Resistant Tiled Finish

This shall include all varieties of special tiles used for specific chemical resistance function and an underbed over already laid concrete or masonry.

a) Tiles

The chemical resistant tiles as detailed in the Schedule of items shall be of the best indigenous manufacture unless otherwise specified and shall be resistant to the chemical described in the Schedule of items. The tiles shall have straight edges, uniform thickness, plain surface, uniform non-fading colour and textures.

Glazed tiles if permitted to act as chemical resistant Finish shall be considered under Clause 2.2.3

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/cm². The surface shall be abrasion resistant and durable.

b) Laying



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The mortar used for setting or for underbed the tiles shall be durable and strong. The group 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.

2.2.6 Rubber, Vinyl or Vinyl Asbestos Tiles Finish

This shall include various types of tiles manufactured item rubber, vinyl, etc, set with a 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 mentioned in the Schedule or in drawing.

b) Tiles

Unless otherwise, desired the tiles shall be squares of approved dimensions. The tolerance shall be + / - 1.5 mm.

The face of the tiles shall be free from porosity, blisters, cracks, embedded foreign molters or either physical defects which affect appearance or serviceability. All edges shall be cut true and square. The colour shall be non fading 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 trade mark, 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 under bed 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: 4 parts coarse sand 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.



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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 or air pockets under the tiles. The joints shall be very fine. Any adhesive squeezed out through the joints shall be removed immediately.

c) 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 as approved type of polish just before handing over.

2.2.7 Stone slab finish: Marble, Stone and Similar Fine Grained Stone

a) Thickness

The underbed shall be minimum 12 mm and average 20 mm thick. The slabs may be 25 mm., 30 mm or 40 mm thick as specified.

b) Stone Slab

The stone slabs shall be made from selected stock which are hard, sound, homogenous and dense in texture and free from flaws. Angles and edges shall be true, square, free from chipping and surface shall be plane. The slabs shall preferably by machine cut to the required dimensions. Tolerance or + / - 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 cull 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 2.2.1 ©



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d) Laying

The sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand stone and washed clean 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 stiff on a little. Next, a thick cement slurry shall be buttered with slurry of cement, grey/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 vary find 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 2.2.1 (e). However, the joints shall be so fine in the case of stone slabs that grouting shall not be called for.

2.2.8 Stone Slab Finish: Sand Stone and Similar Coarse Grained Stone Finish

Generally Clause 2.2.7 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 up to + / - 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.

3.0.0 ACCEPTANCE CRITERIA

The finish shall be checked specially for:

- a) Level, Slope, Plumb as the case may be
- b) Pattern and symmetry



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- 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

4.0.0 RATES

Rates shall be for the complete finishing work including necessary forms, underbed, sticker and preparation of the surface including cutting and chipping to receive the finish but exclusive of the base unless specially included in Contract.

The dividing strips in case of in situ terrazzo finish shall be included in the rates. Similarly, indentations, lay in desired patterns and in panels shall be inclusive in the rates.

All necessary cutting tiles, slabs, etc., cost of specials if any shall be included in the rates. No extra shall be paid for rounding corners and edges. Unless, specifically mentioned otherwise, same rules will apply to floor skirting, dado, treads, nosing etc.

5.0.0 METHOD OF MEASUREMENT

The finished surface shall be measured for area. Any opening less than 0.1Sq.M. (and 0.05 Sq.M. in case of marble finish only) shall not be taken into account neither any extra shall be paid for it.

For terrazzo finish, either in situ or tiled shall be paid at the same rate unless mentioned separately in the Schedule of Items.

Except in case of in situ terrazzo finish and unless mentioned in the Schedule dividing strips shall be measured in length.

6.0.0 I.S. CODES

Important relevant codes for this section:

IS:777 : Glazed earthen ware tiles



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IS:1196	:	Code of practice for laying bitumen mosaic 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 site terrazzo floor.
IS:3641	:	PVC asbestos floor tiles.
IS:4660	:	Specification for acid resistant bricks
I:5516	:	Code of practice for laying of flexible PVC Sheet and tile Flooring
IS:5491	:	Code of practice for laying site Granolithic floor topping.



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GLASS AND GLAZING

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1.0 SCOPE

The work in general shall consist of supplying and supplying fixing all glass and glazing including all clips, putty, mastic cement etc., whatever required as shown on drawings and specification, supply of metal glazing beads and neoprene gaskets shall not be included in this scope.

This shall also include the fixing of all glass and glass supplied by the Owner at his site stores.

2.0 INSTALLATION

2.1 General

The Contractor shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louver, miscellaneous glazing and partitions, unless otherwise stated from approved manufacturer like Hindustan Pilkinton or equivalent, having uniform refractive index and free from flaws, specks and baubles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site. The cut edges shall be straight and free from chips, spalls or any other damages.

Materials

- a) Glare reducing or heat 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 or as specified in schedule of items
- b) Clear glass shall be flat drawn sheet glass and shall be at least 4 mm thick. Sheet glass for doors shall be minimum 5.5 mm thick or as specified in schedule of items
- c) Wired glass shall be thick rolled glass with centrally embedded 24c, wire mesh of Georgian type. This may be of clear or colored glass, as shown in drawings or schedules.
- d) Obscure glasses shall have a cast surface in one side.
- e) Colored and floured glass shall be as per approved sample.
- f) In general, the party 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; Quick setting putty glass is used where it shall be non-setting type. Type and thick of glasses shall be as per schedule of items.



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- g) Neoprene gasket with snap-fit glazing heads shall be fixed as per manufacturer's instructions and shall sit snugly against glass to give a leak proof installation.

2.3 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 be supplied shall be held in place by special glazing clips of approved type. As specified in relevant I.S: Codes, four glazing clips shall be provided per glass pane, except for large panes were six or more clips shall be sued as per Engineer's instruction. 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 molding 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 glass will be supplied by Owner, the contractor shall cut it to size and fix them in the same as specified above.

Necessary glazing clips, putty, mastic cement etc., shall be supplied by the contractor. The Contractor shall be responsible for damage of Glass supplied by the owner. During handing, transportation, fixing etc., maximum wastage allowance shall be 5%

After completion of glazing work, the contractor shall remove all dirt stains, excess putty etc., clean the 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.

3.0 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) Al glass be embedded in mastic or fixed by neoprene gaskets to give a leak proof installation.
- d) At completion, the shall be free from dirt. Stains, excess putty etc. to the complete satisfaction of the engineer.

4.0 RATES



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- a) Rates shall be unit rates for supply and/or installation of different kinds of glass mentioned in the Schedule of items.
- b) No separate payment shall be made for glazing clips, mastic Cement, putty, nails etc., for drilling holes in frames for inserting glazing clips.
- c) No separate payment shall be made for cutting of glass to required size. Edge finishing etc., if the glass is supplied by the contractor.
- d) Payment shall be made for cutting of glass to required size edge finishing etc., if the glass is supplied by the owner.
- e) No separate payment shall be made for cleaning the glass after installation.

5.0 METHOD OF MEASUREMENT

- a) All supply and /or installation of glass shall be measured for actual area of work done.
- b) When glass is supplied by the owner, the cutting of glass shall be measured for actual length of cut edges.

6.0 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: 1083 – Code of practice for fixing and glazing metal doors, windows & ventilators.



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ETC.**

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1.0.0 SCOPE

The work in general shall consist of supplying and/or erecting and installing of all metal doors, windows, ventilators, glazed partitions, etc., as shown on drawings, with all materials complete excluding supply of glass and glazing. The scope of work shall also include the assembly and erection of all doors, windows, louvers, glazed partitions, etc., for which fabricated materials shall be supplied by the Owner from the store of site. Supplying and/or fixing of all door and window accessories and hardware is also included in the scope.

2.0.0 INSTALLATION

2.1.0 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 in drawings and schedules.

Steel sheets for frames, shutters, louver blades etc., shall be of gauge mentioned in drawings and schedules.

Aluminum sections for fabrications doors, partitions etc., shall be extruded sections conforming to IS : 1048 and 1940 or as manufactured by Indian Aluminum Company Limited or approved equivalent. The alloy used shall conform to IS Designation He 9-wp of IS : 733.

Hardware and fixtures shall be as specified in “ Schedule of Fixture” and the best quality from approved manufacturers shall only be used. The Tendered shall specifically state the particular manufacturer’s materials he proposes to use “schedule of Fixtures” is for the purpose of stating the minimum requirement and improper alignment or faulty operation due to inadequate strength of Hardware of fixing 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 in schedule. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or the closer replaced free of charge. Concealed door closures 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 Engineer for comparison of bulk



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supply. The samples shall be returned to the contractor towards the end for incorporation in the job.

The mastic for caulking shall be of best quality from a manufacturer approved by the Engineer in general, the for fixing of metal frames shall be as per IS : 1081 and /or as approved by the Engineer.

2.2.0 Fabrication

2.2.1 Steel Doors, Windows, Ventilators, Louvers etc.

a) Door Frames

Frames shall be fabricated from 16 g sheets. They shall be mortised, reinforced, drilled and lapped for hinges and lock and bolt strikes, where necessary, frames shall be reinforced for door closures. Welded construction with mired corners shall be used. Rubber door silencers shall be furnished for the striking lamb. Loose “T” masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be supplied. Frames shall be brought to site with floor ties/weather bats installed in place.

b) Double plate Flush Door Shutters

Door shutter shall be 40 mm thick, completely flush design and shall comprise of two outer sheets or 18 G steel sheets, rigidly connected and reinforced inside with continuous vertical 20 C stiffeners, spot welded in position at not more then 150 mm on centers.

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 then 2.5 mm clearance at jambs and heads, shall be reinforced at corners to prevent sagging or twisting. Pairs or double doors shall have meeting – stile edges beveled or rebated. Where shown on drawing or called for in the schedule of items. The doors shall be sound deadened materials.

Doors shall be mortised, reinforced, drilled and tapped in shop for hinges, locks and bolts. They shall also be reinforced for closures. Push-plates and other surface hardware where necessary, any drilling and tapping required for surface hardware shall be done at site. Where shown in drawing, provision shall be made for fixing glazing, vision panels, louvers etc., glazing moldings shall be of 18 G steel or extruded aluminum sections with profiles shown in drawings and suitable for



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fixing 6 mm glass. Louvers blades shall be v or z shaped and made out of 16 g sheets.

c) Single 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 furniture. The frames shall be made from best quality 16 G mild steel sheets.

Whenever required as shown on drawings, provisions for fixing glass panes, louvers etc., shall be made.

The manufacturing shall be done as specified in 2.2.1 (b) "Double plate Flush Door Shutters".

d) Sliding Doors

Sliding doors shall be double plate or single plate construction as called for in drawing and schedules made out of 18 gauge steel sheets with adequate stiffeners. The Contractor shall specify the weight of the door in his shop and submit the manufacture's catalogue of the sliding gear he proposes to use. Where shown on drawing or call for in the Schedule of items, the Contractor shall make provision for openings to the door for mono- rail beams. Doors shall make positively to exclude rain water from seeping in when called for in schedule, sliding doors shall withstand specified under all ambient conditions.

e) Door Threshold

Door threshold shall be provided as shown on drawings. Doors without threshold shall have Boston tie of approved type.

f) Steel Windows, Sashes, Ventilators etc.

These shall conform in all respects to IS : 1038 and IS : 1361 latest editions and as shown on drawings. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, pivot arrangements for ventilators, etc., or as shown on drawings or called for in the Schedule of items

All welds shall be dressed flush on all exposed and contact surfaces.

Where composite unit openings are shown on drawings ,the individual window units shall be joined together, with requisite rooms and mullions



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as shown on drawings. All windows shall be outside glazed fixed with putty or metal glazing beads as shown on the drawings and/or specified, under Schedule of items.

All welds shall be dressed flush on all exposed and contact surfaces.

Where composite unit opening are shown on drawings, the individual window units shall be joined together, with requisite rooms and mullions as shown on drawings. All windows shall be outside glazed fixed with putty or metal glazing beads as shown on the drawings and/or specified under Schedule of items. Where aluminum glazing beads are specified, they shall be extruded aluminum channel :3 mm x 9.5 mm x 1.6 mm (India: section No. 2209) unless otherwise shown on drawings, Aluminum beads shall be given one coat of zinc chromate primer before fixing to windows.

2.2.2 Aluminum Door, Windows and Frames

Extruded sections shall have a minimum 3 cm 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 sulfuric acid to provide a mullions, coating of minimum 0.6 mm 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 a uniform color throughout the work, work on the above, other then 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 filed connections of all works may be made with concealed screws of other approved type of fasteners Glazing beads shall be snap fit type without visible screws and shall be of size to accommodate 6 mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

2.2.3 Shop Coat or paint

The shop paint for steel doors, Widows etc., shall be lead of zinc chromate primer paint from approved manufacturer. All surfaces shall be toughly cleaned of rust, grease, loose, mill scales etc., and even one coat of shop paint.

Portions like mullions, transoms etc., which will be inaccessible after assembly of units shall be given an extra coat of paint before assembly.



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Where called for in the schedule of items, all steel doors, windows, etc., shall be hot dry galvanized to give a coating weight of 1-1/2-2 or per sft. One coat zinc chromate primer coat shall than be applied as shop paint.

Portions of aluminum frame which come in contact with masonry construction, shall, before shipment from work shop, be protected with a heavy coat of alkali paint. Aluminum coming in contact with other incompatible metals shall be coated with zinc chromate primer.

2.4.0 Handing & Storage of Fabricated Material

All metal doors, windows, etc., shall be packed and crated properly before dispatch, to ensure that there will be do no damage to the fabricated materials boarding 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 upto 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 aluminum products by rest, mortar etc.,

2.5.0 Assembly & Erection at Site

In general, the fixing of steel doors, windows, ventilators, louvers, etc., shall conform to IS : 1081 and as shown on drawings. 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 as shown on drawing, keeping proper lines and levels, and in approved workman like manner, to give trouble free and leak-proof installations. The installation shall be done according to the 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 every 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 with the same quality or paint used in shop – coat.

All coupling mullions, shall be well bedded I mastic. The Contractor shall bring to the site the mastic cement in original sealed containers of



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manufacturer and shall apply it as per the instructions. 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 rooms.

Wherever required nylon cords of approved quality shall be supplied alone with pivoted sashes and shall be of adequate length to terminate one meters from the floor. Lose ends of cords shall end in metal or plastic pull as approved by the Engineer.

3.0.0 ACCEPTANCE CRITERIA

3.1.0 For fabricated items

- a) Over all 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 under cut where shown on drawings.
- e) Doors, windows, frames, etc., shall be on a true planes, free from warp or buckle.
- f) All welds shall be dress 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 at site.
- i) Glazing beads shall be cut with mired corners.
- j) Glazing clips, fixing devices etc., shall be supplied in adequate numbers.
- k) Shop coats shall be properly applied.



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- l) Exposed aluminum surfaces shall be free scratches, stains, and discoloration. Anodized surfaces shall present a uniform and pleasing look.

3.2.0 For installed Items

- a) Installation shall be at correct location , elevation and general, on a true vertical plane
- b) Fixing details shall be strictly as shown on drawings.
- c) Assembly of composite units shall be strictly as 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 openble section shall operate smoothly without jamming.
- f) Locks, fasteners etc., shall engage positively keys shall be non-inter changeable.
- g) Cutting to concrete or masonry shall be made good and abrasions to shop paint shall be touched up with paint of same quality as shop paint.
- h) Aluminum doors, windows, etc., shall be free from scratches, stain or discoloration.

4.0.0 INFORMATION TO BE SUBMITTED

4.1.0 With Tender

- a) Names of manufacturers for doors, windows etc.,
- b) Manufacturer's catalogue for all hardware and fixtures proposed to be used.

4.2.0 After Award

- a) Before starting fabrication of all metal doors, etc., the contractor shall submitted detailed fabrication drawings to the engineer for approval. The fabrication shall be started only after approval of drawings.



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- b) He shall submit a program of work to be done for the approval of the Engineer.
- c) Before bulk supply he shall submit for the approval of Engineer samples of all bought out items and samples of each type of fabricated items. The samples shall be retained by the Engineer for comparison of bulk supply and returned to contractor towards the end for final incorporation in the job.

5.0.0 RATES

Rates shall be unit rates for the complete work including supply installation and painting. All mullions and transoms, vision panels, louvers to doors, glass and glazing including glazing beds, weather stripping, fixing devices hinges, aldrops, lower bolts, mortise locks etc., shall be included in the rates. The rates shall also including cutting and/or grouting to concrete and jamming of frames and making good concrete and masonry and other related work. Only items specifically mentioned under 6.0.0 or in the Schedule of items shall be separately measured.

6.0.0 METHOD OF MEASUREMENT

- a) Supply and installation including painting of doors shall be measured in m^2 . The types shall be as shown on drawings and described in Schedule of Items.
- b) Supply and installation including painting of windows shall be measured in m^2 .
- c) Supply and installation including painting of louvers shall be measured for area of opening in which the louver is to be installed.
- d) Insulation between door faces shall be measured for actual area and paid separately over the basic rate doors.
- e) Door closures shall be measured in actual numbers used, if not specifically included in the description of door item in the schedule.

7.0.0 I.S.CODES

Following are some of the important I.S Codes as relevant to this section :

Steel doors, windows and ventilators	-	IS : 1038
Steel windows for industrial buildings	-	IS : 1361



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Aluminum doors windows and ventilators	-	IS : 1948
Aluminum windows for industrial buildings	-	IS : 1949
Steel door frames	-	IS : 4351
Code of practice for fixing and glazing of metal (Steel and aluminum doors windows ventilators.	-	IS : 1081



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ROLLING STEEL SHUTTERS AND GRILLS

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1.0 SCOPE

This specification covers the design, supply of materials fabrication, delivery and erection of Rolling Shutters / Grills with motor drive and /or mechanical operation including all accessories as here in after specified.

2.0 INSTALLATION

2.1 Components

- a) Slots for rolling shutters shall be made tested bright cold rolled annealed M.S.Strips, not less then 0.9 mm thick shutters up to 3.5 M wide and above, machine rolled 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 6 mm dia. Rods at 35 mm on centers running horizontally flexible connected with vertical links spaced not more then 200 mm centers. Alternatively, rolling grills shall be made from perforated slates of approved design reinforced with 6 mm rods.
- c) End locks shall be heavy type M.C.I/C.I. and shall be provide at each end of alternate slots unless specified otherwise in the Schedule.
- d) Bottom bars shall be finished with two angles not less then 6 mm thick for external shutters. When shown on drawings, a flexible weather strip shall be applied to make tight contact with the floor.
- e) Guides shall be of such depth as to retain the shutter under a wind pressure of 100 Kg/Sq.M. or as specified in Schedule.
- f) Shafts shall be of steel pipe of sufficient size to carry the torsional load with a maximum deflection of $1/360^{\text{th}}$ of span. Grease packed ball bearings or bushings shall be provided for smooth trouble free operation.
- g) Hoods shall be formed of not less then 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 chin with pad – lock provision for removable handle for hand cranks etc., shall be made as described in Schedule or as described by the Engineer.
- i) Power unit shall be suitable for 3 phase, 50 cycle, 400 volts A.C. power supply and shall be either floor or wall mounted unit. The motor shall be of sufficient capacity to move the shutter in either direction as a speed of 0.3 meters per second. In addition to the gear motor each standard power unit shall include a



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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 standard in Schedule or Drawings.

- j) Operating chins 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 gray cast iron, machine moulded from machine out patterns.

2.2 Manually Operated Shutters/ Grills

Manually operated shutters shall be easily operable by one person. The speed of operation shall be about 0.3 meters per second. In general, manually operated shutters shall be push pull type for opening upto 9 Sq. meter in area. Larger shutters shall be either chain and gear operated or crank and gear operated. The crank handle shall be removable. All shutters shall be lockable from one or both side as described in Schedule or as desired by the Engineer.

2.3 Power Operated Shutters/Grills

These shall be operable from a push button station conveniently located beside the door or as shown on drawings. One emergency hand chin/crank operation shall also be provided for use in case of failure of the electric system. Where called for in Schedule externally mounted shutters shall be operated by control mechanism located inside the building.

2.4 Shop Coat

Shutters shall be painted with one coat of red lead or zinc chromate primer. Where specified, doors shall be galvanized and subsequently paints one coat of zinc chromate for adhesion of field coat.

2.5 Erection

Door 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.

3.0 ACCEPTANCE CRITERIA

3.1 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.



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3.2 Field Inspection

After installing the shutters, the Contractor shall test the performance of the shutter in the presence of the Engineer. The doors shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault-free performance.

3.3 Guarantee

The Contractor shall give one year's guarantee for the successful operation of the shutter. This shall be supported by a separate and unilateral guarantee from the manufacturer of the shutters.

4.0 RATES

Rates shall be unit rates for complete items for supply and /or erection of rolling shutters, including all drives, accessories, hardware etc. No extra payment shall be made for cutting, drilling welding grouting etc. to structure for installation of the shutters.

The rates shall include the mounting of controls, wire and wiring from the nearest junction box, conduit and other electrical connections.

5.0 METHOD OF MEASUREMENT

- a) Rolling shutters or grilling shall be measured for area of opening in which they shall be installed. Attractively, shutters shall measure for actual number of different sizes used.
- b) Unless included in the main item, whether stripping at bottom bar and mullions shall be measured separately for length.
- c) Cylinder locks shall be for actual numbers used. Pad locks shall be supplied by others.

6.0 I.S.CODE

IS: 6248 - Metal rolling shutters and rolling grills.



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1.0.0 SCOPE

This specification covers furnishing installation, repairing finishing, curing, testing, protection, maintenance till handing over of roof water – proofing, insulation and allied works for buildings and at locations covered under the scope of the contact.

2.0.0 INSTALLATION

2.1.0 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 out 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 130 and as directed by the Engineer. Upto and average thickness of 25 mm 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 insulating of the case may be.

2.1.1 Plaster

The grading plaster shall be average 25 mm thick maximum. It shall consist of cement and coarse sand in the ratio 1:4 normal 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 in the desired grade in continuous operation. The surface shall be even and reasonably smooth.

2.1.2 Concrete

The concrete shall be used where the sub grade is more than average 25 mm thick. It shall consist of cement concrete 1:2:4 normal 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.



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The mix shall be laid to proper grade, fully consolidated and surface shall be smooth and even.

2.2.0 Insulation

The Tendered shall along with 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 water proofing treatment. If any plastering is used of shall be not lower than of cement sand by volume and not that of 12 mm and it shall be cured for seven days.

2.2.1 Foam Concrete

This shall be of light weight 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 in pre cast blocks. The insulating properties shall be such that the thermal conductivity shall not exceed $0.125 \text{ Kcl/m/m}^2 \text{ h degree C}$. The weight of the insulating material shall be from 0.3 to 0.5 gm/cm^3 .

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 make the usual work load and standard loads expected on the roof. Any damaged portion shall be removed and replaced forth with. 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.

2.2.2 Expanded Polystyrene Blocks

The expanded polystyrene block insulation shall be fire retardant quality and shall have a maximum thermal conductivity of $0.26 \text{ Kcl m/m}^2 \text{ h degree C}$. It must be strong enough to withstand without deformation the work load 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



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Engineer is not satisfied about the efficiency of the workers the Contractor shall secure manufacturer's supervision at no extra cost to the Owner.

2.3.0 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) normal mix by volume.

2.4.0 Water proofing

Water proofing treatment shall be laid by a specialist firm with long experience in the particular trade.

2.4.1 Bituminous Water Proofing

The waterproofing treatment for roofs with Bitumen Felts shall be done following relevant IS:1346. Bitumen felts 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 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 of pea sized gravel 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 layers of felt or Extra Heavy treatment with three layers of felt shall be indicated in the Schedule of items. Brief details of the various treatments shall be as follows:

a) Normal Treatment: Four courses:

1) Hot applied bitumen at the rate of 1.2 kg/m² Min.



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- 2) Hessian base self finished felt, type 3, grade 1.
- 3) Hot applied bitumen at the rate of 1.2 Kg/m² Min.
- 4) Pea sized gravel at the rate of 0.006 m³/m².

b) Heavy Treatment: Six Courses:

With Hessian base felt

- 1) Hot applied bitumen at the rate of 1.2 kg/m² Min.
- 2) Hessian base self-finished felt, type 3, grade 1.
- 3) Hot applied bitumen at the rate of 1.2 Kg/m² Min.
- 4) Hessian base self – finished felt, type 3, grade 1.
- 5) Hot applied bitumen at the rate of 1.2 Kg/m² Min.
- 6) Pea sized gravel at the rate of 0.006 m³/m².

Or

With fibre base felt

- 1) Hot applied bitumen at the rate of 1.2 kg/m² Min.
- 2) Fibre base self-finished felt, type 2, grade 2.
- 3) Hot applied bitumen at the rate of 1.2 Kg/m² Min.
- 4) Fibre base self-finished felt, type 2, grade 2.
- 5) Hot applied bitumen at the rate of 2.5 Kg/m² Min
- 6) Pea sized gravel at the rate of 0.008 m³/m².

c) Extra Heavy Treatment: Eight courses



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With fibre bases felt

- 1) Hot applied bitumen at the rate of 1.2 Kg/m^2 Min.
- 2) Fibre base self – finished felt, type 2, grade 1.
- 3) Hot applied bitumen at the rate of 1.2 Kg/m^2 Min
- 4) Fibre base self-finished felt, type 2, grade 1.
- 5) Hot applied bitumen at the rate of 1.2 Kg/m^2 Min.
- 6) Fibre base self-finished felt, type 2, grade 1.
- 7) Hot applied bitumen at the rate of 2.5 Kg/m^2
- 8) Pea sized gravel at the rate of $0.008 \text{ m}^3/\text{m}^2$.

Or

With Hessian base felt

- 1) Hot applied bitumen at the rate of 1.2 kg/m^2 Min
- 2) Hessian base self-finished felt, type3, grade 1.
- 3) Hot applied bitumen at the rate of 1.2 Kg/m^2 Min.
- 4) Hessian base self-finished felt, type 3, grade 1.
- 5) Hot applied bitumen at the rate of 1.2 Kg/m^2 Min.
- 6) Hessian base self-finished felt, type 3, grade 1.
- 7) Hot applied bitumen at the rate of 1.2 Kg/m^2
- 8) Pea sized gravel at the rate of $0.006 \text{ m}^3/\text{m}^2$.

However, in special cases, more courses or a combination of fibre bass 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



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water proofing treatment is being augmented the pea sized gravel or any other existing top course shall be completely removed and all damaged felts or other defects repaired.

The Engineer may instruct the Contactor to lay part of the stipulated courses at the first instance to be followed later on with the balance courses. This interim finish shall be done with 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 loose gavels, felt cuttings etc., do not find their way into rain water down comers.

2.4.2 Water proofing by epoxy resin based application

Exposed surfaces of cement concrete, lime concrete or brick work 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 from fire, sun, light, traffic. The application shall be resistant to growth of fungus and proof against salt petre 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 labours for the application. This item shall carry a guarantee as specified under the relevant item in the Schedule.

2.4.3 Flashing

Unless otherwise stated flashing shall be done in the same way as the water proofing except that the last layer, instead of being finished with pea-sized gravel, shall be finished with two coats of bituminous primer. The flashing shall be extended upto the vertical surfaces as sown on drawing. The flashing shall end in grooves in vertical walls. The grooves shall be at least 65 mm deep and caulked with waterproof mastic cement. The minimum overlap with horizontal roofing felt shall be 100 mm.

Where specified on drawings or directed by the Engineer, metal flashing shall be provided. The metal flashing shall be done as shown on the drawings. The materials shall be 18 G or 22 G.I. sheets, as specified on the drawings and / or as directed by the Engineer.

3.0.0 ACCEPTANCE CRITERIA

The surface level shall be such as to allow quick draining of rains with out leaving any pool any where. The finishing course shall be fully secured and shall have an even



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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 water-proofing 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 acceptable to the Owner.

4.0.0 RATES

Rates shall be for complete work as detailed in the specification unless any particular portion is specifically excluded in the Schedule of items.

5.0.0 METHOD OF MEASUREMENT

The method of measurement for various items of works shall be in general as per IS: 1200 and in particular, as specified below:

5.1.0 Garding Underbed

a) Plastering

- a) All plastering etc., shall be measured on actual area laid
- b) For openings, sleeves, pipes, etc., whose sides are not plastered, as deductions shall be made for openings upto 0.1 Sq.m in area each, and full deductions shall be made for openings above 0.1 Sq.M each.
- c) No extra shall be paid for finishing around openings, sleeves, pipes, ducts, inserts, etc.,
- d) Sides of plasters, projections, etc., shall be measured for actual size.
- e) No measurements shall be made for rounding and chamfering junctions, corners, etc.,

ii) Concrete

Actual volume of work shall be measured in Cum and deductions for openings, conduits, pipes ducts, etc., made but no deductions shall be made for openings upto 0.1 Sq.M in area shuttering shall not be paid for separately.



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5.2.0 Insulation / Water proofing / flashing

- a) These shall be measured on actual area laid in Sq.M. No deductions shall be made for openings, pipes, sleeves, etc., upto 0.1 Sq.M in area each
- b) If cast-in situ insulation is done, no separate payment shall be made for from work, etc.,
- c) No separate payment shall be made for laps in waterproofing flashing etc.
- d) No separate payment shall be made for finishing round roof drains.
- e) No separate payment payment shall be made for rounding, chamfering etc., of junction, corners etc.,
- f) No separate payment shall be made for cutting grooves and keying the flashing in the groove.
- g) Metal flashing shall be measured in Sq.M of finished area done.
- h) No payment shall be made for cutting, wastages, materials left over etc., which shall be the property of the Contractor.
- i) Fillets shall be measured for actual work done in R.M.
- j) No separate payment shall be made for plastering or similar items required for laying the water proofing felt.

6.0.0 I.S CODES AND STANDARD

- 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:3384 : Bitumen primer for use in water-proofing and damp proofing



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1.0 SCPOE

The work under this Section shall include the supply and installation of suspended ceiling using insulation/acoustic boards/plain asbestos sheet. Aluminium panels, plaster of paris boards, 'Prespex' etc., together with the materials labour and equipment. The work shall also include providing of openings in the ceiling for lighting, air conditioning diffusers etc., as shown on drawings or instructed by the Engineer.

2.0 INSTALATTION

2.1 Suspension system

2.2 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 walls, slabs and beams or trusses proved factory made handing system as approved by the Engineer may be used.

All member 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 $1/360^{\text{th}}$ of their span. All joint s in ceiling panels shall run straight and cross joint shall be at perfect right angles. Angle moulds where shown in drawings shall be suitable anchoring device. For installation including welding of the suspension system shall be included in the rate. All MS sections used for supports etc. shall be given one coat of synthetic enamel paint over a coat of red lead primer. All wood supports shall be painted with two coats of Solignum or other approved wood preservative before erection.

2.1.2 METAL GRID SUSPENSION SYSTEM

Aluminium grid ceiling system shall be "Bead lock" as manufactured by W.A. BEARDSHALL AND Co or Ajit India Ltd, or approved equal, Steal grid ceiling system shall be "jolly snap Grip" as manufactured by Anil Hardboards Ltd, or approved equal.

The Contractor shall ensure that the frame to support the ceiling is designed for its structural strength to withstand the weight of ceiling boards to be fixed, live load of 75 Kg/Cm^2 , and other loads such as that of air-conditioning ducts, grills, electrical wiring and lighting fixtures, thermal insulation, etc., as shown on the drawings. The Contractor shall also submit a detailed drawings to shown the grid work, sizes of grip members method of suspension position of openings for air-conditioning and lighting, access doors etc.



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Angles cleats or other suitable fixing device be fixed to the structural beam or slab above for fixing of hangers Main runners shall be hung by M>S flats, angles rods or 12g or heavier galvanised tie wire hangers at maximum 1.2 m 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. Turn buckles shall be provided in M.S. rods for adjustment in levels.

The cross-trees shall intersect main runners in pattern shown on drawing and positively locked together with intersection clips. All parameter areas shall have angles mouldings fixed to vertical wall surfaces and end trees shall rest on the moulding, unless otherwise shown on drawings.

As the work of false ceiling may be interconnected with the work of air-conditioning ducts and lighting, the contractor shall fully cooperate with other agencies entrusted with the above works and who may be working simultaneously. The Contractor shall provide necessary openings in the false ceiling work for air-conditioning lighting and other fixtures. Additional framing, if required for the above openings shall also be provided at no extra cost to the Owner. Removable or hinged type inspection or access trap door shall be provided at locations specified by the owner.

2.2. CEILING PANELS

2.2.1 MATERIALS

Ceiling panels shall be of best quality materials in thickness and properties call for in the "Schedule of Item". The Contractor shall submit test certificates to the Engineer for approval before bulk supply. The Ceiling panels may be of the following types manufactured by reputed manufacturers:

- a) Plaster of Pairs boards
- b) Expanded polystyrene insulation boards
- c) Fibre insulation boards
- d) Wood particle boards
- e) Perforated Aluminium Panels
- f) Mineral wood Ceiling tiles
- g) Glass fibre reinforced polystyrene sheets
- h) Flat asbestos sheets

Acrylic plastic sheets, translucent or figured glass sheets, moulded plastic louvers, etc., if used shall be from approved manufacturers and thickness specified in schedule.

2.2.2 INSTALLATIONS OF CEILING PANELS

Installation of Ceiling panels shall be strictly as per manufacturer's instruction.



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For exposed grid ceiling system, the hold down clips shall be used at the rate of maximum one per 1.2 meter length of perimeter. These shall however be omitted in access panels which shall be located as per the instruction of the Engineer.

For concealed grid ceiling 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. Where shown on drawings and schedule finished to give a neat uniform surface. Where shown on drawings and schedule of items, 6 mm thick cement : sand (1:3) plaster shall be applied on the under surface of ceiling boards and finished in a true and even surface without undulations suitable for subsequent painting. Special care shall be taken to neatly finish the ceiling at junctions with walls, light fixtures diffusers etc.

3.0 SAMPLES

Samples of acoustic panels and metal suspension system components as noted below shall be submitted for Architects approval:

Acoustic panels: 3 samples approximately 300mm square each.

Suspension system: 3 short sections each of main and secondary system

4.0 SHOP DRAWINGS

Shop drawings shall be submitted for approval as required and approval obtained prior to delivery of ceiling components. Shop drawings shall be co-ordinated with all related work and shall shown 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) Acoustical-unit support at ceiling penetrations
- e) Details of splicing methods for main and cross runners
- f) A table indicating load bearing capacity of main and cross runners.
- g) A note stating that the suspension system member furnished will not deflect more than 1/360 of a 1.2 meter span under the indicated loadings.

5.0 FINISHING



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- 5.1** It is essential that the false ceiling work should be firm and in perfect line and level and all boards free from distortion, bulge and other defects. All defective boards and other material shall be removed from site immediately and replaced, and ceiling restored to original finish to the satisfaction of the Owner.
- 5.2** The workmanship expected is of the highest order. The joints for aluminium frame work shall be interlocking type so that when the cross member is in place, it cannot be lifted out.
- 5.3** The fibre board ceiling shall finally be painted with two coats of fire resistant paint of approved manufacture and colour after filling all joints with painters putty.
- 6.0 RATES**
- Shall be units rates complete items called for in the "Schedule of Items". No extra payment will be made for arrangement for lighting fixtures, air conditioning, diffusers, access panels, etc. The rate shall include all cutting and wastage from standard size sheets, boards, runners etc.
- 7.0 METHOD OF MEASUREMENT**
- a) Actual area of work done shall be measured.
 - b) No deduction will be made for opening up to .25 sq.m . in area each.
 - c) Where a rigid steel framework is required to support the ceiling, it shall be measured and paid separately under relevant item in the Schedule of Items.
- 8.0 IS CODES**
- IS:2441: Code of practice for fixing ceiling coverings.



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CARPENTRY AND JOINERY

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1.0 SCPOE

This shall include supply, fitting and fixing of timber framers to doors and window with M.S. holdfasts, panelled or flush doors, windows, shutters, partitions, wall panelling, pelments, shelves, furniture, etc. as shown in drawings, including a prime coat of approved paint, varnish, or fixing of decorative plastic laminate where called for in the schedule. This shall also include the supply and fixing of all hardware and fixtures shown in drawing or specified in the “Schedule of Fixtures”.

2.0 INSTALLATION

2.1 MATERIALS

a) Timber

Unless otherwise specified, all timber shall be best quality well seasoned C.P teakwood free from large or loose, knots cracks or other defects. Where specified, timber shall be treated with approved wood preservative before use. Before starting the carpenters work, the Contractor shall have the rough timber approved by the Engineer.

b) Plywood

Plywood shall be commercial quality or with decorative surface veneer. Unless specifically permitted otherwise, the adhesive used in plywood shall be phenol-formaldehyde of B.W.R. grade conforming to IS:848.

C) Decorative laminated Plastic Sheet s

The colour, pattern, finish and texture shall be approved by the Engineer and the bulk supply procured in sheet sizes which will ensure the least number or joints in one surface.

d) Flush Doors

Flush doors shall be hollow or solid core doors with commercial or decorative faces and hardwood edges. The core for solid doors shall be of block board or wood particle board. Manufacture’s literature and test certificates shall be submitted for the approval of the Engineer. The Contractor shall give a guarantee that the adhesive used in phenol formaldehyde of BWR grade conforming to is:848. The thickness shall be as specified in the “Schedule of Items”.

e) Panel Doors



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Panel door shall be of teakwood frame unless otherwise noted and panels with teakwood/commercial, ply/teakwood particle board as per "Schedule of item". Other considerations shall be as mentioned in item (d) above.

f) Fixtures

Fixture for doors, windows, furniture, etc., shall be as shown on drawing or specified in the "Schedule of Fixture". These shall be of heavy type, best quality and from approved manufacturer.

2.2 WORKMANSHIP

2.2.1 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 paints before 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 40mmx6mmx300mm 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 poly-sulphide mastic. MS grills or guard bars shall be provided to windows where called for in the drawings or Schedule of items.

2.2.2 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.

2.2.3 SURFACE TREATMENT

When shown on drawings or called for in Schedule, decorative ply or laminated plastic sheets shall be boned under pressure to the surface to be finished. The adhesive used shall be of approved 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 manufacture's instructions. The edges of sheets shall be protected by teak lipping or be levelled as shown on drawings.



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3.0 ACCEPTANCE CRITERIA

3.1 Door and window shutters

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 fine vertical plane. All external door and window frames shall be caulked with mastic.

3.2 Door 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.

3.3 Partitions, Panelling, Pellets, Furniture, etc.

3.3.1 GENERAL

These shall conform to drawings in all details. No unsightly nail mark etc., shall be permitted. Plywood grains shall be matched to give a uniform and pleasing appearance.

3.3.2 Partition

Shall be checked for rigidity of fixing, plumb and horizontal as well as vertical alignment.

3.3.3 Pellets

Shall operate smoothly without jamming and locks, bolts and double ball catches shall engage securely. Single ball catches shall not be used.

3.3.4 Drawers

Shall operate smoothly and have back stops to prevent them from being pushed too far. Locks shall engage securely.

3.3.5 Loose Furniture

When placed on a level surface tables tops etc., shall be horizontal and the pieces stand stably on legs or supports.

4.0 RATES

Rates shall be unit rates including preservatives, shop coats, primers varnishing, polishing etc. against items mentioned in schedule. No separate payment will be made for fixing caulking etc., unless separately provided for in Schedule.



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5.0 METHOD OF MEASUREMENT

5.1 Door and Windows Frames, Handrails etc.

Wood work in frames handrails etc., shall be measured for the volume of timber used, i.e., the minimum theoretical rectangular section from which the shape can be obtained, multiplied by the length of timber required. In computing the length, timber required for tenons, scarves, embedding to walls over the finished length shall be added. Mitred pieces shall be measured along the longest length.

5.2 Holdfasts

Shall be measured for actual number used.

5.3 Door and Windows Shutters

Shall be measured for actual outer area of shutters for different thickness and types described in Schedule.

5.4 Glass & Glazing

Shall be measured separately in actual numbers used for different sizes and types described in Schedule.

5.5 Fittings and Fixtures

Shall be measured separately in actual numbers used for different sizes and types described in Schedule.

5.6 MS Grills & Guard Bars

Shall be measured and paid separately under relevant items.

5.7 Partitions, Panelling, etc.

Shall be measured for actual area excluding door shutters. Pelmet shall be measured for length of different types enumerated in the Schedule.

5.8 Pelmet, Shelves etc.

Shelves shall be measured for actual area of finished surface. Pelmet shall be measured for length of different types enumerated in the Schedule.

5.9 Furniture

Shall be measured for actual number of each type.



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6.0 IS CODES

Some be measured for actual number of each type.

IS:4021 - Timber door, window and ventilator frames.

IS:1003 - Timber panelled and glazed shutters.

IS:2919 - Wooden flush door shutter (Cellular and hollow core type).

IS:2202 - Wooden flush door shutter(solid core type).



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WATER SUPPLY WORKS

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1.0 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 manufactures. 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 mode and manufacturer lies completely with the Engineer.

It shall be the responsibility of the Contractor to procure the materials selected by the Engineer. Hence, orders 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 type:

- 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) Asbestos cement
- f) Lead (Not to be used for portable water)
- g) P.V.C.
- h) Cooper



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i) Brass

j) Wrought iron

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 earth work, masonry, concrete, steel work, cutting holes, chases, repairs and rectification associated directly with installation of water supply system shall come under scope of the Contractor unless specifically excluded. These works are not detailed out in this Specification.

1.0.5 REGULATION

This 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 the rules of such Authorities. The fee paid to the Authorities shall be reimbursed by the Owner.

2.0 INSTALLATION

While basis layout 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 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 PIPES LINES

2.1.1 LAYING

In addition to fulfilling the functional requirements shall 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 point and spacing as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every



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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 eastern or appliances, whether by siphon age or otherwise. All pipe works shall be so laid of fixed and maintained as to be to remain completely water-tight, thereby avoiding waste of water damage of property and the risk of contamination of water conveyed.

2.1.3 CONTAMINATION.

There shall be no cross connection whatsoever between a pipe of fitting for conveying or containing whole some 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 there with.

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 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 150mm layers and carefully consolidated. Special care shall be taken while filling in the civinity of the pipe to avoid damage. Before backfilling the laid pipe shall be fully tested and approved.

Where the pipe rest 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 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 coordinate with the building contractor for leaving the chases, opening, conduits as necessary. However, the contractor will rectify if required the chases, opening, conduits, supplement and make good after laying and testing of the concealed pipelines.

2.1.6 JOINTING OF PIPES



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Jointing of pipes shall be completely leak proof and durable instruction of the manufacture 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 vain up to depth and filling the remainder by running in mol tern lead taking care that no dross enters the joint and then thoroughly caulking the lead. The lead need not extent 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 jointing rings of good quality, smooth and hard compressed fibre board of thickness not lees than 1.5 mm and of such width as fit inside the circle of bolt. Diagonally opposite bolts shall be tightened in pairs in pairs and stages so that degree of all bolts in a joint are similar. Damaged gaskets shall be replaced.

b) **Steel**

Plain ended steel pipes maybe 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.

c) **G.I Pipes**

Threads shall be cut with sharp tools, and before jointing all scales shall be removed from pipes by suitable means. The screw/thread of the pipe shall be cleaned out and the joint made by screwing the fittings after treating the thread with approved pipe jointing compound. Once a joint has been screwed up it shall not be backed off unless thread are relearned and new compound applied.

d) **Asbestos Cement Pipes**

Socket and spigot ended pipes shall be jointed by caulking with tarred gaskets and grouted with 1:3 cement sand mortar

e) **Lead**



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Lead and lead alloy pipes shall be jointed with wiped solder joints.

f) Concrete

Concrete pipes may be socket and spigot ended, collar or band jointed. Joint shall be effected by caulking with 1:3 cement sand mortar.

g) P.V.C

Manufacturer's instruction shall be followed. For heating approved equipment with adequate control shall be used.

h) Tyton Joint

The manufacture'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.

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.

2.1.7 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 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 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 button 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



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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 Meter 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-coats of anti-corrosive paint over a suitable primer shall be applied to both internal and external surface of tanks paint if used shall not impact any taste or odour to water and of lead free composition.

Erection of tanks shall be in accordance with detailed drawings and manufacture's instructions, The two finishing coats of paints shall be applied to outside after erecting is complete.

2.2.1 G.I. WATER

G.I. water tanks shall be produced 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 2mm thick galvanised iron sheet. Plain sheets shall be fixed at the corner to angle iron frames by means 6mm rivets at 40mm pitch for tanks up to 100 liters capacity and 8mm rivets at 35mm pitch for tanks for tanks above 1,000 liters capacity. Tanks above 1,000 liters shall have 20mm. 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 riveting shall be drilled and not punched white lead shall be applied to the joints before riveting.

In case it is desired by the Engineer that corner of tank should be welded instead of riveted then the sheets shall be welded to from a tank will not have angle iron frame.

Tanks shall have 400mm dia. Holes at the top with hinged covers. The covers shall be made of galvanised 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 likable arrangement.

Tanks shall be provided with rising main inlets of 40mm 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.

The ball valve permits the entry of water when the tanks is empty and disconnects The supply when the tank is full. It consists of a hollow floating ball made of copper, plastic or hand rubber. 110mm 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 valves shall be fixed to the tank independent of the inlet pipe and



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1st in such a position that the body of the ball valve cannot submerge when the tank is full up to 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 75mm below the lip of the overflow pipe. Free surface shall be about 150mm above the maximum water filled level.

2.2 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.

2.3 PROTECTION

Open end of each pipe shall be protected during installation by suitable covers of plugs so that the ends, thread. 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 TESTING AND ACCEPTANCE

3.1 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 reflected and forthwith removed from the site.

3.2 TESTING OF MAIN AFTER LAYING

After laying and pointing, 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 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 causes 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 resist the end thrust of the water pressure in the mains.



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3.3 TESTING OF SERVICES 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 or pressure and flow when all draw-off taps are closed, the service pipes shall be absolutely water-light. All piping, fittings and appliances shall be checked for satisfactory support and protection from damage, corrosion and frost.

4.0 RATES

Rates shall be unit rates for the complete work as mentioned in the specification unless any particular portion is specifically excluded in Schedule of Items. If any material, fillings or fixture are provided by the Owner free, The Contractor shall have to take delivery, kept in safe custody and be responsible till fitted and handed over.

5.0 MEASUREMENT

For method of measurement regarding works under scope of the specification IS:1200 (part-XVI) latest edition shall be followed unless contrary to the following.

5.1 TRENCHES

Unless particular items are included in the schedule, no separate measurement shall be made to lead, lift, de-watering, dressing, sorting, backfilling consolidation etc., that may be required in this connection.

5.2 CONCRETE MASONRY

Unless particular items are included in the schedule, no separate measurement shall be made to lead, lift, de-watering, dressing, storing, backfilling, consolidation etc., that may be required in this connection.

5.3 SOILING

No separate measurement should be made for dressing and remaining the surface. The soiling shall be measured on cross area of the work under the item.

5.4 PIPE WORKS

No separate measurement shall be made for special, supports and fixtures, cutting chases, holes and rectification unless specially indicated in the Schedule of items. If the special are separately indicated in the Schedule the measurement for there shall be over and above the measurement of the pipe work as mentioned below:

The pipes of different nominal bores shall be measured separately.



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The pipes work shall be measured in inclusive of sockets specials, fittings etc., in position.

5.5 FIGGINGS AND FIXTURES

Measurement for fittings and fixtures where applicable shall be in number No separate measurement shall be made anchors unless they from a separate item in the Schedule.

5.6 CHASES, HOLES

If items for cutting and remarking of chases, holes and similar works are included in the Schedule the measurement shall be on gross length, area or volume as appropriate.

5.7 PAINTING

Painting pipe works shall be measured on the basis of length for different nominal diameters of pipes. Painting of steel work may be on the basis of weight or area otherwise as mentioned against the particular items.

5.6 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 basis requirements for water supply drainage and sanitation.

IS:1200 : Laying of water and sewer lines including accusant items.
(pt.xvi)

IS:1239 : Specification for Mild Steel Tubes and Mild Steel Tubulars and
(pt.I&III) other wrought steel pipe fittings (10 mm to 15mm nominal diameter)

IS:1536 : Specification for Centrifugally cast (Spun) iron pressure pipes for water gas sewage

IS:1537 : Specification for vertically cast iron pressure pipes for water, gas and sewage



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IS:3486	: Specification for Cast iron spigot and socket drain pipes (80 mm To 250mm nominal diameter)
IS:3589	: Specification for Electrically welded steel pipe for water, gas and sewade (200mm to 2000mm 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 type)
IS:404	: Lead pipes
IS:3076	: Low density polyethylene pipes for portable water supplies
IS:4984	: High density polyethylene pipes for portable water supplies
IS:2501	: Copper tubes for general purposes
IS:4047	: Brass tubes for general purposes
IS:1230	: Cast iron rain water pipes and fittings
IS:804	: Rectangular pressed steel tanks



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DRAINAGE AND SANITATION

REV. NO.	PRAPARED	APPROVED	DATE
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1.0 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, 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 leak proof. 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 emission of foul odour and gases.

2.1.0 Rainwater Down corners

Rainwater down corners shall be standards Cast Iron of Asbestos Cement pipes. In case where specifically desired. M.S. pipes may also be M.S. pipes shall be painted outside with two coats or anti corrosive paints under a coat of primer.

Rainwater down corners shall run along and be secured to walls, columns etc., where desired by the Engineer these may have to be installed in chase cut in the structured . All pipes shall be wall secured and supported by adequately strong brackets. The brackets may be wrought iron clevis type, split ring type of 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 junction shall be supplied with water tight clean outs.

Proof and floor drains and vard 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 grating.

All horizontal pipes shall have a minimum fall of 1 in 100.

2.1.0 Gutters

The gutters shall be made of G.I. of A.C. All gutters shall be supplied by reputable specialized firms. Each section shall be sufficiently rigid, edges and



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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 in 120. Adequate number of string supports shall be provided so that there is no deflection even when the gutter is full. Each point must have a support. Unless otherwise specified the supports shall be fabricated M.S. brackets. All junctions shall be thoroughly water tight. The joints may be made by riveting, bolting or soldering. All joints between successive lengths of gutters shall have an 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 water tight. Junction with rainwater down corners shall be made fully watertight and secured.

2.2.0 Soil and Drainage Pipes

2.2.1 Gradients

If not specified the minimum gradients of solid and drainage pipes 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 bonding rod fixed across trench at a height, equal to length of the bonding 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. The foot of the wall of the pipe. Each pipe shall be separately and accurately boned between sight rails.

2.3.3 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



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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.

The minimum support and protection for glazed stoneware pipes shall be as follows:

- a) When cover is less than 2 meter 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 solid with the maximum water table rising above the invert of the pipe, the sewer shall be bedded on concrete.
- c) Where the pipes have to be laid on soft solid with the maximum water table rising above the invert of the pipe, but below the top of the barrel the pipe sewer shall be hunched.
- 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.

Vitrified clay pipe shall be laid on a bed of 150 mm thick cement concrete (1:3:6) nominal mix by volume.

Cast iron pipes and concrete pipes may be supported on suitable concrete or brick support, where specified. The supports 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.

2.3.4 Entry into Structure.

For entry of the pipelines into any building of structure suitable conduit after 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 of chases are required to be made in the structure for entry of pipe lines, After laying of the pipeline the opening and chases shall be mended.



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2.3.5 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.

2.3.6 Traps and Ventilating pipes

Pipes are carrying of the waste from water a closets and water a closed 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 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 venting, anti – syphonage and similar pipe shall be covered on top with a cowl. The cowl. Shall be made of G.I. unless desired otherwise by the Engineer.

2.3.7 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 meters unless desired otherwise. Manhole shall be constructed so as to be water tight under test. The bending at the sides shall be carried out in such a manner as to provide no lodgment for any splashing 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 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 G.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.

2.3.8 Cutting of Pipes

Manufacture'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 squat to the axis of the pipe.

2.3.10 Jointing



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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 watertight. 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 here under 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 air lock. 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.

Joint in cast iron pipes with special jointing arrangements like ‘Tyton’ joints etc., shall follow the instructions of the manufacturers.

In special cases if fanged joints are accepted by the Engineer the joints shall be made lead-proof 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.

c) Glassed Stone water Pipes

Tarred gasket or hump yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe previously laid . The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly so as not to fill more than $\frac{1}{4}$ of the total depth of the socket. The remainder of the socket shall be filled with a stiff mixture of cement mortar of 1:1 proportion. Then the socket is filled, a fillet shall be formed round the joint with a trowel, forming an angle of 45 deg. With the barrel of the pipe. The newly made joints shall be protected, unit set and shall be covered with damp cloth or other suitable materials.

d) Vitrified clay Pipes



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The shall be made from refractory clay mixed with crushed pottery and stone and burnt at a height temperature. These shall be hard, compact and glazed to make them acid resistant and impervious, and shall be obtained from approved manufacturer.

Special care shall be taken in handing these pipes. The pipes shall not be jointed until the earth has been partly refilled over the portion of the pipe between the joint holes. Before laying the second pipe, the socket of the first pipe laid shall be thinly painted all round on the inside with cement slurry (1 part of cement and 2 parts of clean, sharp sand). A ring of rope yarn (closely twisted heap or jute dipped in neat cement paste or tar or bitumen, shall be inserted in the socket or pipe and driven home with caulking tools. The rope shall fully encircle the spigot with a slight overlap and shall not occupy more then one fourth of the total depth of the socket. Where the spigot end of the pipe is made for receiving the gasket, it shall be wrapped with two or three turns of tarred spun, as close to the end as possible, before inserting into the socket. The joint shall then be completely filled with cement mortar (1:1) which shall have very little water and leveled to from a splayed fillet at a an angle of 45 degrees with the outside pipe. Special care shall be taken so that any excess mortar etc., left inside the pipe joints is neatly cleaned off immediately after each joint is made . A semi-circular wooden scrapper or a rubber disc to which a long handle is fixed could be used for this purpose.

e) **Lead Pies**

No lead pipes shall be used unless specifically mentioned in the specification. The joints in lead pipes shall be made as wiped solder joint. The minimum and the maximum length of the wiped solder joints shall be 8 cm, and 9cm respectively. The solder shall generally consist of two parts of lead and one part of tin.

f) **Polythylene Pipes**

The joints shall be thermo-welded or bolted as per manufacturer's instructions.

g) **Jointing Cast Iron Pipes with Stoneware Pipes**

Where any cast iron soil pipe, ventilating pipe or trap is connected with a Stoneware or semi-vitrified waste pipe or drain communicating with a sewer, the beaded spigot end of such cast iron soil type, waste or ventilating pipe or trap shall be inserted in to a socket of such stoneware pipe or drain and the joint made with motar consisting of one part of cement and one part of clean shape sand after placing a ratted gasket or hemp yarn soaked in neat cement slurry round the joint and inserted in it by means of a caulking tool.

h) **Jointing Stone ware with Cast Iron Pipe**



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Where any water closet pan or earth ware trap connected to such a pan is to be jointed with a cast Iron soil socket, shall always be of a flexible nature. Such joint shall be made with admixture of bitumen and chopped asbestos fibre.

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 materials 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 hand packing 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 minimize inconvenience of traffic where applicable.

2.5.0 Fixtures

The Tenderer shall mention in his type and make of the fixtures he intends to enclose 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 fitting shall be of approved quality and type manufactured by well known manufacturers. All items brought to the site must bear



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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, coved and plugged till handed over.

All fittings , gratings, fasteners, unless specified otherwise, shall be chromium plated. The connecting lead pipes and bonds 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 herein after.

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 glazed stoneware flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. Colour of basin , cistern, seal and cover shall be as desired by the Engineer.

b) Squatting type

It shall include glazed vitreous chin pan with integrated foot rests and high level cast iron flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. The foot rests shall be made of white glazed vitreous china with grooved surface. The flushing cistern shall be painted as desired by the Engineer.

2.5.2 Urinals

It shall consist of wall type glazed vitreous china urinals, cast iron automatic flushing cistern complete with supply connections, flush pipe PVC pipes, gratings, traps and all other necessary fittings. Automatic flushing shall be approximately once every five minutes for a number of urinals located together may be served by cistern of adequate capacity. 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 pillar Cocks. PVC waste pipes with traps, perforated waste complete with necessary fittings. All fittings, including faucets shall be chromium plated. Hot and cold mixer waste



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chin and waste washers shall be provided where specified in the Schedule of items.

2.5.4 Sink

It shall be made of glazed stoneware. It shall be wall hand by painted cast iron brackets and complete with one brass faucet with nylon washers, chin, waste washers, PVT waste pipes with traps, perforated waste with necessary fittings. All fittings including facets shall be chromium plated.

2.5.5 Bathroom mirror

It shall be made of the best quality 6 mm thick beveled glass and produced by a reputed mirror manufacturer. It shall be wall mounted with adjustable revolving brackets. The brackets, screws and other fitting shall be chromium plated, fixed type square edged installed mirrors shall be provided where indicated and flush with the wall face.

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 and screws shall be chromium plated.

2.5.7 Towel rail

Towel rail 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 screw 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 fitting and fixtures shall be installation in most workman like manner by skilled workers. These shall be perfect in level, plump , 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.



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2.6.0 Septic tank & effluent disposal

2.6.1 Septic tank

Septic tank shall consist of the tank itself with inlet and outlets there from complete with all necessary earthworks and back fitting. The details of septic tank shall be as shown on drawings. This items shall also including ventilating pipe of at least 100 mm dia whose top shall be provided with a suitable mosquito proof wire mesh 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 building when it is located closer then 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 in to a soak pit for absorption by soil or shall be allowed to be absorbed by soil through open pointed SW pipes laid in a trench filled with broken bricks.

2.6.3 Soap pit

The soak pit shall be complete as shown on drawings. 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 Open joined SW pipe/Dispersion Trenches

Minimum dia. Of the SW pipes shall be 150 mm nominal. The trench for laying the pipes shall be minimum 600 x 600 mm pipes. The joint of the pipes shall be left unsealed. 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

After the septic tank has been proved water tight and the seawater 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



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3.1.0 Inspection before Installtion

All pipes, fittings and fixtures shall be inspected, before delivery at to see

Whether they conform to accepted standards. The pipes shall again
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 testes shall be decided by the Engineer. All test data
shall be recorded and submitted to the Engineer for review and instruction. The
Engineer's description regarding tolerance shall be final.

General guidance are given below.

a) Smoke test

All soil pipes, waste pipes and vent pipes and all other pipes when above
ground shall be approved gas tight any a smoke test conducted under a
pressure of 25 mm of water and minted 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 then 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 liters 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 bond shall be temporarily jointed in at the top end
and a sufficient length of the vertical pipe jointed to it so as to provided
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 of joints
- c) Leakage at joints or from defective pipes
- d) Trapped air.



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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 glazed water 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 pipe bore. In the absence of obstruction. Such as yarn or mortar projecting through the joint, the ball will roll down the invert of the pipe and 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 pipeline is not straight.

3.3.0 Tasting septic tank

The septic tank shall be tested for water tightness. 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 fitting shall be connected by water tight joints. No dripping shall be accepted.

4.0.0 RATES

Rates shall be unit rates for the complete work as detailed out in the Specification unless any particular portion is specifically excluded in the Schedule of Items.

If any material fittings or fixtures are provided by the Owner free, the Contractor shall have to take delivery, keep in safe custody and be responsible till fitted and handed over.

5.0.0 MEASUREMENT

For method of measurement regarding work under scope of this Specification IS: 1200 (part-XVI) shall be followed unless contrary to the following:



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5.1.0 Trenches

Unless particular items are including in the Schedule, no separate measurement shall be made for lead, lifted dewatering, dressing, storing, backfilling consolidation etc., that may be required in this connection.

5.2.0 Concrete, masonry

Unless lumped with other items in the Schedule the measurement shall be on gross area or volume basis as mentioned under relevant items.

5.3.0 Pipe Work

No separate measurement shall be made for special supports and fixtures, cutting chases, holes and rectification unless specially indicated in the Schedule of items. If the specials and separately indicated in the schedule, the measurement for these shall be over and above the measurement, of the pipe work as mentioned below:

The pipes of different nominal bores shall be measured separately. The pipe work shall be measured in length inclusive of sockets specials, fittings etc., in position.

5.4.0 Fittings and fixtures

Measurement for fittings and fixtures where applicable shall be in number for the complete item inclusive of anchors, brackets and fasteners required. However, in special cases anchors, brackets and similar items may be measured separately if included as such in the Schedule of items.

5.5.0 Chases and holes

No measurement shall be made for cutting chases, holes etc., and making good for any work within the scope of this specification and shall be inclusive.

5.6.0 Painting

All items likely to rust shall be painted with one coat of primer which shall not be measured separately. Where finishing coat of paints are supplied that shall be measured as indicated in the Schedule of items. Usually, painting of pipes shall be measured in length for each different nominal diameter without giving any extra allowance for specials sockets, etc.

5.7.0 Septic tank, Soak pit

Usually it shall be measured in number for the complete septic tank or soak pit as per drawings. All earthwork, backfilling masonry, concrete, manhole, pipes



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and fittings including. In case, it is intended to pay for individual items the same shall be indicated in the Schedule and measured in number, length area or volume as appropriate.

6.0.0 CODES AND STANDARDS

Some of the important Codes and Standards relevant to this specification

Shall be follow : Latest editions shall always be consulted.

- IS : 1172 - Code of basic requirements for water supply drainage and Sanitation.
- IS : 1200 - Laying of water and sewer lines including appurtenant (Pt: XVI)
- IS : 1239 - Mild steel Tubes and Mild steel Tubular and other wrought (Part I & II) steel pipe fittings.
- IS : 1536 - Centrifugally cast (Spun) iron pressure pipes for water gas 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 polyethylene pipes for potable water supplies
- IS : 4984 - High density polyethylene pipes for potable water supplies.
- IS : 1537 - Vertically cast iron pressure pipe for water, gas & 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



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- 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 of laying of concrete pipes
- IS : 784 - Prestressed Concrete pipes
- IS : 651 - Salt glazed stoneware pipes & fittings
- IS : 4127 - Code of practice of laying of glazed stoneware pipes.
- IS : 1726 - Cast Iron manhole covers & frames intended for use in drainage works
- IS : 5961 - Cast Iron gratings for drainage purposes
- IS : 5219 - 'P' & 'S' traps
(Part I)
- IS : 771 - Glassed earth-ware sanitary appliance
- IS : 772 - general requirements of enamelled cast iron sanitary appliances
- IS : 774 - Flushing Cistern for water closets & urinals (Valueless Siphonic type)
- IS : 775 - Cast Iron brackets & supports for wash basins and sinks
- IS : 2548 - Plastic water closed seats & covers
- IS : 2527 - Code of practice for fixing rain water gutters and down-pipes for roof drainage



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SUPPLY AND LAYING R.C.C. PIPES

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1.0 SCOPE

This specification covers the supply and laying of R.C.C Hume Pipes as per drawings and instruction of the Engineer. The entire work shall be carried out as per latest editions of Indian Standards IS:458 and IS:783.

2.0 Supply of PIPES

The Contractor shall supply the R.C.C Hume Pipes of various diameters along with complete fittings required for carrying out the work. All R.C.C Hume Pipes should conform to IS:458 and should be in a good condition. The Contractor must furnish, on being demanded by the Engineer, manufacturer's certification and/or test certificates from recognized authorities.

3.0 ALIGNMENT, LEVELS AND GRADE

The work shall be carried out in conformance to the alignments, levels, and grades specified in the drawings. The layout and levels shall be made by him at his own cost from one reference grid and bench mark given by the Engineer. He shall give all help in instruments, materials and men to the Engineer for checking and detailed layout and levels as and when required.

Making of reference layout and level pillars along the pipeline route and maintaining them

Upto completion of the work shall be the responsibility of the Contractor.

No extra payment shall be made for these.

4.0 LAYING OF PIPES

a) General:

The laying of R.C.C. Pipes shall conform to the Clause 9 of IS:783.

b) Conditions for laying:

The conditions for laying of pipes to suit the conditions at site and/or as per drawings and instructions of the Engineer shall be as classified below.

i) Culvert Condition

In this condition the pipe is laid under combankment and may project wholly or partly above the original ground surface.

ii) Trench Condition



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In this condition the pipe is laid in a trench excavated for the purpose. The trench shall be refilled with thoroughly tampered earth after laying and jointing of pipes in approved manner.

iii) Open Condition

In this condition the pipe is laid such that it projects wholly or partly above original ground surface, there being no superimposal over burden on the pipe.

c) Bedding & Supports

i) Culvert Condition

In this condition the pipes shall be laid generally on First Class Bedding” as per Clause No. 4.3. of IS:783, unless directed otherwise.

ii) Trench Condition

In this condition the pipes shall be laid generally on “First Class Bedding” as per Clause No.4.2.3 of IS:783, unless directed otherwise.

iii) Concrete Cradic Bedding

If required by the drawing or so instructed by the Engineer, the pipes, shall be laid on Concrete cradles, conforming to Clause No.4.2.3 of IS:783 in case of trench condition and conforming to Clause 4.3.4 of IS:783 in case of culvert condition.

iv) Open Condition

In open condition the pipeline shall be supported over rigid pedestal constructed at intervals not greater than the length of one individual piece of pipe. As per drawings and instructions of the Engineer. In no case shall the joint between two pieces of pipe shall lie at center of the span between two supports. The pedestal shall be of rubble masonry, or brick masonry or plain/reinforced concrete with a properly shaped out top to receive the pipe.

d) Handling of Pipes

The pipes shall be handled with all possible care while loading, uploading, transporting and lowering them in position. The method of handling during all the stages of the work should be to the approval of the Engineer and should preferably employ mechanical means like use of chain pulley block an the like.

e) Jointing of Pipes



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The Clause 10 of IS:783 shall be applicable for jointing of pipes and every possible care shall be taken. The Contractor to ensure that the joints made are leak proof, Curing of joints shall be done for a period of 10 days. No extra payment shall be made for making and curing of joints.

5.0 MEASUREMENT

R.C.C. Pipes shall be measured on running meter basis and paid for at the unit rate quoted by the Contractor. The rate shall include supply, laying in position, preparation of "First Class bedding", jointing with supply of all fittings, fixtures and joint materials, complete as per drawings and schedule of items.

Payments for excavation of trenches, backfilling of trenches, making of embankments, brickwork, rubble masonry work, plain and /or reinforced concrete work in concrete cradle beddings, pedestals for pipe supports and other associated works shall be made as per relevant unit rates quoted by the Contractor in the Schedule of Items.



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**PREMOULDED BITUMINOUS JOINT FILLER
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1.0 .0 SCOPE

The work under this section sources supply of all materials and all operations required for sealing of joints in concrete.

2.0 Material

Premoulded joint fillers shall be of non-deteriorating and resilient type conforming to IS:1833. Sealing Compound shall be of grade “B” as per IS:1834, Bitumen shall conform to IS:3384.

3.0 Fixing of Joint Filler

- 3.1 The concrete surface shall be made clean , smooth and free from dirt or loose particles. When the surface is completely dry, a coat of hot blown bitumen conforming to IS:702 of grade 85/25 shall be given with brush or spray. When the bitumen is still hot, the premoulded joint filler fibre board shall be pressed against the surface held in position, till the time it automatically remains fixed in position. Where the joint filler has been specified in two layers, the second board will be fixed as above with a few jacking patches of bitumen between the two. After placing the filler in position, the surface of filler against which further concreting is to be done is given a coat of bitumen.

4.0 Filling of Joint Sealing Compound

- 4.1 Before application of the sealing compound, the sides of the joints are sprayed of brushed with bitumen primer. The primer is then allowed to dry out thoroughly for at least 24 hours and then filled with a mix of 30% fine sand and 70% sealing compound by weight.

5.0 Measurement

- 5.1 Joint filler shall be measured in square meter and sealing compound in lineal meters as per dimensions shown in drawings both correct to two decimal places.



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DEMOLITION AND DISMANTLING

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STANDARD TECHNICAL SPECIFICATION FOR DEMOLITION AND DISMANTLING

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1.0 SCOPE

This specification defines the demolition, dismantling of reinforced concrete, plain concrete, brick work and structural steel work or any such other work. Any special requirement as shown or noted on the drawing shall govern provision of this specification.

1.1 DEMOLITION

The term demolition implies breaking up. This shall consist of demolishing whole or part of work including all relevant items as specified or shown on the drawings.

1.2 DISMANTLING

The term dismantling implies carefully removing without damage (up or down). This shall consist of dismantling one or more part of the buildings as specified or shown on the drawings.

2.0 GENERAL

2.1 PRECAUTIONS

- 2.1.1 All materials obtained from dismantling or demolition shall be the property of the “Owner” unless otherwise specified and shall be kept in surface custody handed over to the Engineer-in-Charge.
- 2.1.2 The demolition shall always be planned before hand and shall be done in reverse order of those in which the structure was constructed. The scheme shall be got approved from the Engineer-in-Charge before starting the work.
- 2.1.3 Necessary propping and/or under – pinning shall be provided for the safety of the adjoining work or property before dismantling and demolishing is taken up and the works shall be carried out in such a way that no damage is caused to the adjoining work or property. Whenever specified temporary enclosures or partition shall also be provided.
- 2.1.4 Necessary precautions shall be taken to keep down, dust, nuisance.
- 2.1.5 Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height of demolishing roofs, masonry etc. shall be carefully removed first. The dismantled articles shall be passed by hand, where necessary lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer – in – Charge.
- 2.1.6 Where fixing is done by nails, screws, bolts etc. dismantling shall be done by taking out the fixing with proper tools and not by tearing or ripping off.



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2.1.7 Any serviceable materials, obtained during dismantling or demolition, shall be separated out and stacked properly as directed by the Engineer-in Charge within a lead of 50meters. All unserviceable materials etc. shall be disposed off as directed by the Engineer-in-Charge.

2.1.8 The contractor shall maintain disconnected services whether temporary or permanent, if required.

2.2.0 PAYMENT

2.2.1 All works shall be measured in the decimal system, as fixed in its place, subject top

The following limits unless otherwise stated hereinafter:-

- a. Dimensions shall be measured correct to a cm.
- b. Areas shall be worked out correct to two places of decimal.
- c. Cubic contents shall be worked out to the nearest 0.01.

2.2.2 Parts of work required to be dismantled and demolished shall be measured separately.

2.2.3 Measurement of all works except hidden work shall be taken before demolition or dismantling and no allowance for increase in bulk shall be allowed.

2.2.4 Specifications for deductions for voids, openings etc., shall be on the same basis as that employed for construction of the work.

2.2.5 The rate shall include the cost of all labour involved and tools used in demolishing including scaffolding. The rate shall also include the charges for separating out and stacking the serviceable material properly within a distance of 50 meters and disposing off unserviceable materials as directed by Engineer-in-charge.

3.0 Roofs

Ridges, heaps and valleys shall be girthed and included with the roof area. Corrugated or semi corrugated surfaces shall be measured flat and not girthed.

Supporting members, such as rafters, purlins, beams, joints, trusses etc. shall be measured in metric tonnes.

4.0 Concrete and Brick Roofs and Suspended Floors

Demolition of floors and roof of concrete or brick shall be measured in cubic



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meters(M) beams, cantilevers or other subsidiary supports of similar materials, shall be included in the item. In measuring thickness of roofs provided with water proofing treatments with bitumen felts, the thickness of water proofing treatment shall be ignored.

5.0 Walls and Piers

5.1 Taking down walls and independent piers or columns of brick stone or concrete shall be measured in cubic metres (M). All copings, corbels, cornices and other projections shall be included with the measurements.

In measuring thickness of plaster, walls, the thickness of plaster shall be ignored.

5.2 Ashlar face stones, dressed stone work, precast concrete article etc. if required to be taken down shall be so stated, and measured separately in cubic meters (m).

5.3 Cleaning bricks, stacking for measurements including all extra handling and Removed and disposing rubbish as stated shall be enumerated in the thousand of cleaned bricks.

5.4 Cleaning stone obtained from demolished/dismantled stone masonry of any Description including ashlar facing, dressed stone slabs or flanging and precast concrete blocks including all extra handling and disposing of rubbish as stated shall be measured in cubic meters (m) of cleaned stone.

5.5 Honey comb work of cavity walls of bricks , stone or concrete as solid.

6.0 Reinforced Concrete and Brick work

Reinforced concrete structures and reinforced brick roofs and walls shall be measured in cubic meters and square metres as specified in schedule of rates and reinforcement if required to be salvaged, shall be stated.

Where reinforcement is required to be separated, scraped and cleaned, the work shall be measured separately in metric tonnes (MT) of salvaged steel.

7.0 Steel and Iron Work

7.1 All steel and iron work shall be measured in metric tonnes(MT). The weight shall be computed from standard tables unless the actual weight can readily to be determined.

7.2 Riveted work, where rivets are required to be cut, shall be measured.

7.3 Marking of structural steel required to be re-erected shall be measured



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separately.

- 7.4 In framed steel items, the weight of any covering material or filling such as iron sheets and expanded metal shall be included in the weight of the main article unless such covering is not ordered to be taken out separately.



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TYPE AND MAKE OF MATERIALS TO BE USED

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Only the following makes of materials are approved for use the contractor on this work. In case of items not listed here and also if products of listed vendors are not available in the market for some reason, advice of Project Engineering Department, BHEL, Hyderabad shall be sought for suggesting alternate vendors.

All the material shall be got approved by site incharge prior to their use

1. Mortice lock	Godrej/Harrison
2. Hinges/tower bolt	ECIE/GARNISH/Everite
3. GLUE	Movicol/Fevicol
4. Door Handles	Godrej/ECIE/HARDIMA
5. Screws	Nettle Fold/Guest keen william
6. Hydraulic door closer	Everite/Prabhat/Garnish
7. Double action hydraulic door closer	Everite/Prabhat/Garnish
8. Ply Wood	Mysore/Seastic/National/Indian Plywood
9. Teak wood	First class Indian Teak wood.
10. Flush door shutter	Sitapur/Mysore with phenol formal dehyde resin
11. Wooden panned shutter	1 st class teak wood frame work with 12mm thk Nova teak/Novapan/Eco board.
12. Prelaminate board	Novapan/Anchor/Bhutan/Ecoboard.
13. Mirror	Modi/Atual/Swastic
14. Sanitary ware	Hidustan/Nycer/Parry/Classica
15. Plumbing fixture	Parco,Gem.
16. False ceiling tiles	Nova teak/Jolly lotone/Armstrong
17. Metallic false ceiling	Tracdek/Luxalon
18. Interior Paints	ICI/Berger/Asian paints/Jenson&Nicolson Garware/Goodlac nerolac/ shalimar
19. Exterior water proof	Snowcem.
20. PVC tiles	Caliplast/Brite.
21. Acid proof tiles	Coromandel.
22. Floor tiles	Spartek/Kataria/Bell/Decora/Murudeshwar/ Regency/Cera.
23. PVC tiles	Bhor.
24. Gypsum Board	India Gypsum/Trac.
25. Plate glass	Modi-Gurdian/Atual.
26. Asbestos cement sheets & accessories.	Charminar/Everest/Visakha/Ramco
27. Non shrink grout	Shrinkomp 30/Conbextra GP2/Pagel V12
28. MS Doors	Shaktimet.
29. Polymeric Waterproofing	IWL Ltd.



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1.0 SCOPE

This specification covers furnishing, instalation, finishing, testing, protection and maintenance till handing it over of recoverable free access false flooring systems consisting of an assembly of panels mounted on adjustable pedestal and supporting steel grid system to provide an under floor space for the accommodation of flexible electrical cables and ground panles for Computer and Control room Equipment.

2.0 FLASE FLOORING SYSTEM

2.1 Base

The system shall be placed over a base of R.C.C. Floor slab and Beams as indicated in the drawing, Any grouting etc. that is necessary to fix the supporting structure shall be done by the false flooring contractor without any additional cost to the Owner.

2.2 SUPPORTING STRUCTURE

Pedestals shall be made of steel and will be of height as indicated in drawing. Pedestal shall be vertically true, located on centers to conform with size of pencil and shall be equipped with locking devices to prevent loss of finished elevation. Base of pedestal shall have integral load dispersion ribs to transmit load evenly to the base floor. Adjustment of pedestal shall be provided by threaded rod member and use of an elevating nut. The pedestal head shall prevent lateral shifting. Pedestal head shall be equipped with conducting grounding pad if so desired by Engineer-in charge. The grid channels shall be made of steel and shall be levelled to support the floor panel units.

2.3 FLOOR PANELS

The floor panels be made either of steel panels, die-cast aluminium or particle board treated with fire resistant chemicals as per schedule of items. Size of eachof panels shall be 600mmx600mm with all panel edgws finished to a tolerance of $\pm 0.2\text{mm}$. All panels shall be completely interchangeable and easily removable with a suction lift tool, Panel shall be square to within a tolerance of $\pm 0.25\text{mm}$ on the diagram.

2.4 STRENGTH

Each 600mm x 600mm floor panel must be capable of supporting an uniform live minimum load load of 1220 kg/sq.M. or a contracted minimum load of 460kg applied through a phenolic caster 75mm in diameter and 45mm. Wide, or rolling minimum load of 460Kg. At any point with a maximum deflection of 2mm. The ultimate strength shall provide a 3.0 safety factor. Each pedestal shall be capable of carrying a 2,300 Kg. Axial without deformation of any part.

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.



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2.5 SURFACE FINISH

All removable panels shall have the top surface finished with either « Decomet » polymer flooring 2mm. Thick or BHOR vinyl flooring 2mm thick or 2mm thick, 'Micalam' double wear high pressure fire resistance decorative laminate bonded to the surface with compatible high creep resistant adhesive.

2.6 SKIRTING

Skirting shall be 150mm high and 2mm thick, completely matching with the false flooring surface finish materials and fixed to the wall surface as per manufacturers installation instructions.

2.7 INSTALLATION

The concrete sub floor shall be sealed with two coats of polyurethane paint to prevent moisture for contacting cables and to minimise dust problem.

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 Owner.

All steel surface 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. Finished floor surface, when specified by the Engineer-in-charge shall be protected by the Contractor with kraft paper taped and sealed at edges to prevent tearing. In case the loads exerted by the weight of machines are above the stated characteristics of floor covering materials, the floor shall be protected by overlaying here after during installation of machine or equipment. Such hard board shall be supplied by the Owner.

All installation work of good flooring system shall be supervised by the manufacturer's representative.

3.0 ACCEPTANCE CRITERIA

The false flooring system shall be checked specially for :

- Level.
- Alignment of joints.
- Thickness of joints.
- Surface finish.
- Colour and texture.
- Details at edges junctions.
- Performance.
- Criteria specified for strength.



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4.0 I.S. CODES

Important codes applied to this section are :

IS : 2571 : Code of practice for laying in situ concrete flooring.

IS : 3461 : 7 VC (vinyl) asbestos floor tiles.

IS : 5310 : Code of practice for laying of flexible PVC sheet and tile flooring.

IS : 2046 : Specification for Decorative Thermosetting Synthetic Resin Bonded Laminated sheets.

5.0 METHOD OF MEASUREMENT

5.1 Actual area of work done shall be measured

5.2 No deduction shall be made for openings upto 0.25 sq.m in area each.



**STANDARD TECHNICAL
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WATER BOUND MACADAM ROAD
SURFACES**

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**50 MM THICK PREMIX BITUMEN CARPET
(HOT PROCESS) OVER
WATER BOUND MACADAM ROAD SURFACES**

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**1.0 SPECIFICATION FOR 50MM THICK PREMIX BITUMEN CARPET
(HOTPROCESS) OVER WATER BOUND MACADAM ROAD SURFACES**

1.1 The work shall consist of construction, in a single course of 50mm thickness of compacted aggregates premixed with a bituminous binder, laid immediately after mixing, on a prepared base with a tack coat of bitumen and finished with a seal coat, in conformity with the lines, grads and cross section shown in the drawings or as directed by the Engineer.

1.2 Water Bound Macadam surface on which premix carpet is to be laid shall be thoroughly Swept, scraped clean and made free from dust or any other foreign matter. WBM surface shall have the desired gradient and camber.

1.3 Tack coat shall consist of application of single coat of low viscosity liquid bituminous material on the prepared road surface before laying the bituminous carpet. The binder used for tack coat shall be bitumen of a suitable grade conforming to IS:73. Bitumen shall be heated to the temperature appropriate to the grade used and shall be sprayed on the base at the rate of 15kg per 10 sq.m of area. The binder shall be supplied uniformly with the aid of sprayers. Tack coat shall be applied just ahead of the incoming bituminous construction.

1.4 The aggregates on the premix carpet shall consist of crushed stone which shall be clean, strong, durable of fairly cubical shape and shall be free from disintegrated pieces, organic or other deleterious matter. Aggregates shall be Hydrophobic and of low porosity.

1.5 The aggregates shall conform to the following grading.

<u>Sieve designation</u>	<u>Percent by weight Passing the sieve</u>
25mm	100
20mm	70-100
10mm	35-60
4.75mm	15-35
2.36	5-20
.75micron	0-4

1.6 The bituminous binder shall be straight run bitumen of suitable grade conforming to IS:73. The binder content for premixing shall be 4 (four) percent by weight of the total mix. The quantity of aggregates to be used shall be sufficient to yield the specified thickness after compaction.



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- 1.7 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 of 150-160 C and that of aggregates in the range of 125-150C, provided the difference in temperature between the binder and aggregates at no time exceeds 25⁰C. Mixing shall be thorough to ensure that a homogeneous mixture is obtained, in which all particles of the aggregate are coated uniformly. The mixture shall be transported from the mixing plant to the point of use in suitable vehicles. The mix shall be spread immediately after mixing by means of a self-propelled mechanical paver with suitable screeds capable of spreading, tamping, and finishing the mixture to the specified lines, grade and cross section. In locations where the plant cannot operate, Engineer shall premix manual laying of the mix. The temperature of mix at the time of laying shall be in the range of 110 -135C.
- 1.8 After the spreading the mix, rolling shall be done by 8-10 smooth wheeled power rollers or other approved plant. Rolling should start as soon as possible after the material has been spread. Rolling shall be done with care to keep from unduly roughening the pavement surfaces. Rolling of the longitudinal jaunted shall be done immediately behind paving operation. After this, rolling shall commence at the edges and progress towards the centre longitudinally except that on super elevated portions, it shall progress from the lower to the upper edge parallel to the centre line of the road. The initial rolling shall be done as soon as it is possible to roll the mixture without cracking the surface by having the mix pickup on the roller wheels. The second or intermediate rolling shall follow the initial rolling as closely as possible and to 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.
- 1.8 When the roller has passed over the whole areaonce, any high spots or depressions which become apparent shall be corrected by removing or adding fresh material. The rolling shall then be continued till the entire surface has been rolled to compaction, there is no crushing of aggregates and all roller marks are eliminated. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceeding pass. The roller wheels shall be kept damp, if necessary to avoid bituminous material from sticking to the wheels and being picked up. In no case shall fuel, lubricating oil be used for this purpose. Rolling operations shall be completed in every respect before the temperature of the mix falls below 80⁰C. The edges along and transverse of bituminous carpet laid and compacted earlier shall be cut to the full depth so as to expose fresh surface which shall be painted with hot bitumen before the mix is placed against it.
- 1.9 Seal coat shall be applied for sealing the voids of the premix carpet surfaces laid



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to the specified levels, grade and camber. Seal coat shall be premixed seal coat comprising a thin application of fine aggregate premixed with bituminous binder. The binder shall be bitumen of a suitable grade conforming to IS:73. The quantity of binder to be utilized, in terms of straight run bitumen, shall be 7Kg per 10 Sq.m of area. The fine aggregate shall be sand of fine grit and shall consist of clean hard, durable dry particles and shall be free from dust soft or flaky materials, organic or other deleterious substances. The fine aggregate shall pass 1.7mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.06cu.m per 10sq.m area.

- 1.10 The seal coat shall be applied immediately after the premix carpet is laid. Before the application, the premix carpet surface shall be cleaned free of any dust or extraneous matter. Mixers of approved type shall be employed for mixing the aggregates with the binder. The binder shall be heated in boilers to the temperature appropriate to the grade of bitumen. Aggregates shall be dry and also suitably heated before the same are placed in the mixer. Mixing shall be continued till all the aggregates are thoroughly coated with the binder. The mix shall then be immediately transported from the mixing plant to the plant to the point of use and spread uniformly on the surface to be sealed. As soon as sufficient length has been covered with the premixed material, the surface shall be rolled with 8-10 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.



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1.0.0 BOX CUTTING

1.1.0 EXCAVATION

After the earthwork in cutting, and the earth work in embankments have been done properly up to the final road level with gradient and camber as per drawings and proper consolidation of the filling is completed, earthwork in box cutting shall be taken in hand. Before starting of box cutting, the Contractor shall obtain Engineer's approval of cutting and embankment work.

The surface of the formation for a width equal to that of the sub base course shall be properly prepared before any further courses are laid. Surface shall be cut to a depth below the ground level equal to depth of sub base course due allowance being made for compaction. Preparation of sub grade also includes removal of any and all foreign substance accumulation and removing undulations up to 1500mm by filling and cutting as required. The sub grade shall be dressed parallel to the finished profile.

The box cutting shall be done in such a way, that width of cutting is exactly the clear distance between the edging blocks. The depth of cutting shall be the total thickness of consolidated soling and road metal ling. The formation shall have the same profile and camber as shown on drawing.

The excavated spoil shall be transported and utilized in filling of low areas or as directed by the Engineer. The filling shall be done in layers or as directed by the Engineer. The filling shall be done in layers of 150 mm and clods and lumps shall be broken and consolidation done to the satisfaction of the Engineer.

In case of presence of weak soil-pockets below the formation, the Contractor shall excavate and remove such soil to an extent as instructed by the Engineer. The extra depth shall then be filled up with 38mm down stone-metal and voids in metal shall be filled up with morrum. Then, the filling shall be rammed and rolled uniformly with a road-roller of 8 tonnes minimum weight. These operation of removing weak soil pockets and filling with stone-metal shall be done by the contractor and paid at the earthwork rates plus the cost of stone-metal only.

If by mistake the depth of box cutting is made than required, the Contractor shall make up the extra depth by metal consolidation, specified above, at his own cost.

1.2.0 ROLLING

After the box cutting is completed, the sub grade shall be compacted with powered roads rollers 8-12 tonnes. The roller shall run over the sub grade till the soil is evenly and densely compacted, to achieved a dry density of not less than 95% of maximum density as obtained from standard proctor compaction test. There shall be a minimum of five (5) roller passes. All the undulations on the



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surface which develop due to rolling shall be made good with earth and quarry spills as approved by Owner and the sub grade re-rolled. The top of the sub grade shall be dressed evenly to the required camber and necessary drainage of rolling shall be provided. Care shall be taken to avoid excessive rolling of the formation, If, after rolling, the formation is higher than required, the excess earth shall be Removed by carefully cutting and dressing and the formation shall be rolled as specified above. In case after rolling the formation is depressed below the required level, the Contractor shall continue the process of filling and rolling as above till the correct level is attained up to a limit as decided by the Engineer at Contractor's cost.

1.3.0 MEASUREMENT

The actual volume of box cutting shall be measured in cubic meters (Cu.M) and paid at the unit rate tendered. The unit rate tendered shall include layout, excavating of earth in all lifts, disposing the excavated earth as specified up to 150 M lead and in all lift, rolling, bailing of water, if any, including all labour, tools and plants required for the work.

2.0.0 EDGING

2.1.0 MATERIALS

The edging shall be of cement concrete blocks and be of average 450mm deep, 100mm wide and suitable length and shall be of 1:2:4 nominal mix by volume (1part cement, 2 parts clean sharp coarse sand, 4 parts 10 mm down hard crushed graded stone aggregate). Cement, sand and stone aggregates shall-be as specified in Technical Specification for cement concrete (Plain and Reinforced). Concrete edging blocks shall be cast in moulds approved by the Engineer and cured for a minimum period of 28 days.

2.2.0 LAYING

After rolling of the box cutting is completed, trenches shall be cut for edging. The width of the trenches shall be minimum and just sufficient to insert the edging bricks. The clear width between the inside faces of the edging blocks shall be exactly the same as shown on drawing. The inside faces shall be in plumb and gap between the block shall not be more than 10mm. The top of the edging shall be at the same level as shown on drawings and the inside face shall be in a neat line.

The edging block is shall be thoroughly packed with a mixture of stone chips (50%) at the outside face. The laying and packing shall be done in a proper workman like manner acceptable to the engineer.

If, after consolidation of the road-metalling, any portion of the edging is found to be out of line and level, the Contractor shall take out the the blocks and really the same to the satisfaction of the Engineer at his own cost.



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2.3.0 MEASUREMENT AND PAYMENT

The actual length of edging laid shall be measured in “Running Metres” (R.M) and paid at the unit rate tendered. The unit rate shall include excavating trenches, transporting and laying the blocks in line and levels and filling the outside face and ramming etc., including all labour, materials, tools and plants required for the work.

3.0.0 SOLING

3.1.0 MATERIALS

The soling shall be done with assorted rough stone-boulders or quarried stone. The stone shall be tough and it shall not flake or crumble when being rolled with a road-roller of 8 tonnes minimum weight. No stone shall be less than 75mm in thickness and shall be not more than the depth of soling as specified in drawings.

The width of stone shall not exceed twice its thickness. The filling of bigger voids shall be done with smaller pieces of stone. The smaller voids shall be filled with blinding material made with a mixture of small stones (50%) 25 mm down and moorum (50%).

The soling stone shall be laid on narrowest side closely on the formation so that minimum voids are left between the adjacent blocks. The bigger voids shall be filled up by wedging in smaller blocks of suitable size with hand hammer. The laying of blocks and wedging smaller block shall be such that the soling shall be a compact mass with minimum voids and shall not move when being rolled for consolidation.

Then the blinding material (50% small stone plus 50% moorum) shall be spread over the soling and worked into the voids by booms. The blinding materials shall be sufficient to fill up all voids and to produce an even surface after rolling. Excess use of building materials shall be avoided.

3.2.0 ROLLING

The stone soling shall be thoroughly consolidated with a smooth wheeled power roller of minimum 8 tonne weight, starting at edges and working towards the centre with a minimum of 10 passes.

The rolling shall be done in such a way that the whole soling shall given a compact base without any voids. After initial rolling is done, inspection shall be made to see if voids are still left in the soling. If all voids are not lifted up, further blinding material shall be added. The rolling shall be continued till there is no settlement or voids, and the surface is true and even. The finished soling shall give the correct thickness, gradient and camber as specified on drawings.



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3.3.0 BAD WORKMANSHIP

If the Engineer finds that the soling done is not up to the specifications, the whole soling over the defective portion shall be taken out, re-laid and compacted with specified roller as specified above by the Contractor at his own cost.

3.4.0 MEASUREMENTS AND PAYMENT

The actual area of soling of (length of road multiplied by clear width between edging) shall be measured in square metres (Sq.M) and paid at the unit rates tendered which shall include supply and laying of soiling stone, smaller stone, mixing and spreading blinding materials, rolling as specified, watering etc. including all labour, materials and tools and plants required for the work.

4.0.0 METALLING (WATER-BOUND MECADAM)

4.1.0 MATERIALS

The road metal shall consist of 38mm down graded approved quality crushed stone. The metal shall be of close, tough durable and hard texture and shall not flake or crush under pressure. The metal shall be of granite., ballast or equivalent quality with high density and shall not absorb. When immersed in water for 24 hours, more than 1 percent own weight. In general, unless otherwise specified, the metal shall conform to the standards laid down by the "Indian Road Congress" regarding toughness, abrasion co-efficient of hardness, attrition loss and cementation values. The grading of the metal shall be such that not more than 55 by weight shall be retained on 38 mm sieve and not more than 50 to 60% retained on 25mm sieve, not more than 10 to 15% by weight retained on 20 mm sieve, but 100% shall be retained on 12mm sieve. Metal shall be screened, if so desired by the Engineer and fines from 12 mm to dust screened out and may be used as blind age if found suitable by the Engineer.

4.2.0 LAYING

The metal shall be laid to camber and profile in such a way that total thickness of loose metal over stone soling is not less than 120mm but more shall be used, if required to make the consolidated thickness at least 75 mm after rolling. While spreading the metal, proper profile and camber shall be maintained and checked with templates at every 6 to 7 metres. No rolling shall be done until laying has been approved by the Engineer.

4.3.0 ROLLING

a. Dry Rolling:

After metal have been laid and dressed as above, metal shall be rolled dry with a road – Roller of 8 tones minimum weight until well compacted and



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there is no appreciable movement of the stone or no appreciable gap in front of the advancing roller and no lines of roller are left on the surface.

Excessive dry rolling should also be avoid. When the desired degree of compaction has been obtained by dry rolling, screenings of approved chipping 12mm down in size should be spread uniformly over the surface by brooming and this should be pushed into the interstics by rolling. Successive layers of screening being added till no more chipping are observed shall be rectified by removing stones up to a depth of 50 mm to 75mm, refilling the same, hand packing and re-rolling. No watering should be done till this process is complete.

The amount of screening used should be less than 1 Cubic Metre per 1000Sq.m . of road surface (3 c.f,t 1000Sq.f.t).Rolling operation has to be very carefully carried out. Rolling should be commencing from the edges of the road and working towards the centre. Roller should be passed equal and sufficient number of times on the metal spread at every stage so as to secure equal and thorough compaction. Speed of roller to be very slow and uniform and reversing shall be quick and free from jerks. As far as possible, the reversing process should be at different section of the length rolled during each successive trip.

b. Wet Rolling (Water-bound Macadam):

When the dry rolling has been completed to the satisfaction of the Engineer, the surface is to be watered an kept saturated and rolled a few times as specified above. Approved quality blind age (moorum) shall then be spread uniformly over the surface to a thickness of 20mm to 12mm. The roller wheels as well as the road surface should be continued until a slurry is formed over the entire surface and the same moves in the from of wave in front of the roller when the rolling operation may end and the surface allowed to dry. The finished surface shall be smooth and uniform and free from waviness and corrugations and as per specified profile and camber.

After 24 hours of rolling, the surface shall be sprinkled with a thin layer of sand not less than 2c.f.t per 100s.f.t. or 56 cu.m . pet 100sq.m of road surface. Traffic shall be allowed after four days of sprinkling the sand or as approved by the Engineer.

4.4.0 BAD WORKMANSHIP

The compaction and finish shall be as per specifications to the satisfaction of the Engineer. If the Engineer so desires, the defective portions shall be removed, metal re-laid and compacted as specified above by the Contractor at his own cost.

4.5.0 MEASUREMENT AMD PAYMENT



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The actual area of metal ling (length of road multiplied by clear width between edging) shall be measured in square metre (Sq,m) and paid at the unit rate tendered. The unit rate shall include supply and laying of stone metal of 75mm consolidated thickness and blinding materials and sand, rolling, watering etc. including all labour, materials and tools and plants required for the work.

**TECHNICAL SPECIFICATION
FOR PILING.**

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1. Random rubble Masonry : 1.1 Stone : Stone shall be of approved quality . it shall be sound, uniform in colour and free from decay and weathering. Stone with round surface shall not be used. Unless otherwise approved stones from one single quarry shall be used for any one work 1.2 Stone shall be hammer- dressed on the face and side. The ‘busing’ on the face shall not project more then 20 mm on an exposed face and 15 mm on the face to be plastered. 1.3 Mortar: The mortar to be used for jointing shall be as specified on the schedule of rates. 1.4 Laying : All stones shall be wetted before use. They may laid at random without being brought up to any level except at plinth, window sills and roof level and top legal in case of compound wall. The bond shall be obtained by fitting in closely the adjacent stones and by using bound stones. Face stones shall extend and bond well in to the backing . proper breaking of joints shall be done. Their height shall not be grater then the breadth at that face or the depth inward. Interior filling of carefully laid, hammered down with a wooden mallet into position and solidly bedded in mortar. No hollow space shall be left anywhere in the masonry. Chips not more then 20% of quality of stones in hearting wherever necessary to avoid thick upward about 50 to 200 mm shall be firmly embedded to from a bond between successive courses. The masonry in a structure shall be carried regularly. 1.5 Bond Stone : Bond or through stone running right through the thickness of wall shall be provided in the walls having thickness upto 60 mm. If the walls are thick then 600 mm, two or more bond stones overlapping each other by at least 150 mm shall be stones shall be provided for every 0.5 sq.m. of wall surface. 1.6 Quoins : The quoins shall be of selected stones neatly dressed to the required angle and shall be of the same height as the course in which they occur and laid header and stretcher alternately. No quoin stone shall be less then 0.03 Cu.M. 1.7 Joints : Stones all be so laid that all joints are full of mortar. Face joints shall vary from 12 mm to 25 mm thick, but not less then 12 mm. Joints shall be struck/flush/and finished with C.M. :3 at the time of laying when plastering and pointing is not required. Joings shall be raked to a depth of 20 mm during construction, if walls			

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are to be plastered or pointed. For the faces of walls which are not to be plastered stone surfaces shall be cleared of mortar dropping to give uniform appearance. 1.8 Curing Green work shall be protected front rain by suitable coverage. Masonry work shall be kept constantly wet for a minimum perior of 10 days. 1.9 payments : Stone masonry shall be measured in cubic metres (m3). The rate shall include cost of all operations involved at all the stages of work. 2.0 Exposed Coursed Rubbic Masonry: 2.1 Stone : Stone shall be type specified. It shall be hard, sound and free from decay and weathering. 2.2 Dressing: Face stone shall be hammer dressed and to be squared on all sides and joints so as to give them ret angular block shape. The bed joint shall be rough chisel dressed, true and ‘Squares’ for the least 75 mm back from the face and the side joints for at least 40 mm, such that no portion of the dressed surface is more then 6mm from a straight edge placed on it. The “Bushing “ on the face shall not project more then 40 mm on exposed face. 2.3 Mortar: The mortar to be used for jointing shall be as specified in schedule of rates. 2.4 Laying: All stones shall be wetted before use. The stones shall be laid in horizontal courses and each course shall be of equal height. Into the work for length not less then twice their height. The hearting or interior filling of the wall shall consist of flat bedded stones carefully laid on their proper beds solidly bedded in mortar. Chips not more then 10% of quantity of stone masonry may be used where necessary to fill interstices between adjacent stones to avoid thick beds or joints of mortar. The mensonry in structure shall be carried up regularly, but where breaks are unavoidable, the joint shall be raked at an angle not exceeding 45. teething shall not be allowed. 2.5 Bond Stone :			

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Same as for random masonry given under para 1.5 except that a bond stone or a set of bond stones shall be inserted 1.5 mm apart, in every course. 2.6 Quoins : The quoins shall be of the same height as the course in which they occur, shall be formed of stones at lest 0.5m long, laid stretcher and header alternately They shall be laid square on their beds, which shall be rough chisel dressed to depth of at least 100 mm. 2.7 Jointing & Pointing : All bed joints shall be horizontal and all side joints vertical. All joints shall be full of mortar. Face joints shall not be more then 12 mm thick unless otherwise specified. The joint shall be either flush or struck with c.m. 1:3. Raised or cut pointing if specified in items, shall be done with c.m. 1:3 using wooden mould/template of minimum 12mm depth for uniformity. 2.8 Curing : Same as per “Random Rubble” given in para 1.8. 2.9 Payment : Same as for “Random Rubble” given in para 1.9.			



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STANDARD TECHNICAL SPECIFICATION FOR CHAIN LINK FENCING

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1.0.0 SCOPE

The work under this specification covers the supply and fixing of galvanised steel chain link fencing with galvanised steel posts and chain link fabric.

2.0.0 MATERIAL

The fencing shall consist of 80 mm 50 mm nominal diameter galvanised steel pipe posts, galvanised steel chain link fabric and galvanised steel binding wires. The galvanised steel chain link fabric shall conform to IS 2721. The mesh size of fabric shall be 50 mm. The diameter of mesh wire and line wire shall be 3.15 mm and 4.0 mm respectively. 1'6 gauge galvanised wires shall be used for binding the fabric to the stretched bars and posts. The pipe posts shall conform to IS: 1161 and shall be of medium grade and galvanised.

3.0.0 FIXING

The GI pipe posts shall be embedded in plain cement concrete not leaner than 1:4. 8 foundations. The height of posts above top of foundations and spacing of post shall not be more than 3 m. the chain link fabric shall be fixed to the fencing posts with the help of stretcher galvanised bars (25 X 6 flats) which will be bolted to the lugs welded to the post. The stretcher bars shall be provided in the lapping of fabric also.

4.0.0 RATE

The rate for fencing shall include the cost of labour and all materials such as fabric, GI stretcher bars, line wires, fabric bolts, nuts, binding wires, involved.



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BC : 16 : SHEETING WORK IN ROOF AND SIDING

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1.0.0SCOPE This specification covers the technical requirements for the furnishing of all labour, materials, supervision, tools, equipment and services necessary for or incidental to the fabrication and installation of asbestos cement, C.G.I., Fibreglass reinforced plastic roofing and siding in accordance with the drawings and as specified herein. 2.0.0MATERIALS Corrugated asbestos- cement sheets shall be composed of a combination of asbestos fibre and hydraulic cement with no more then 1 weigh percent of organic fabric. Asbestos cement roofing and siding shall be of the following types as indicated on the Contract drawings: - a)Corrugated sheet b)Trafford sheet and c)'S' Type Louvres Corrugated asbestos-cement sheets shall be 6 mm thick unless otherwise directed by the Engineer or specified in the Schedule of Items. Flashing shall be G.I. sheet metal, aluminium, etc. The thickness of C.G.I. sheets vary with purlin spacings. Spacings shall not be greater then the following for the sicknesses mentioned: <table><tr><td>Thickness of CGI sheets</td><td>Spacing of Purlins</td></tr><tr><td>0.63 mm 24 G</td><td>1.6 m</td></tr><tr><td>0.80 mm 22 G</td><td>1.8 m</td></tr><tr><td>1.0 mm 20 G</td><td>2.0 m</td></tr><tr><td>1.25 mm 18 G</td><td>2.4 m</td></tr><tr><td>1.60 mm 16 G</td><td>2.8 m</td></tr></table> Fibreglass reinforced plastic sheets shall be translucent translucent or opaque as shown on drawings. These sheets be shatterproof and should not crack, chip or rot.				Thickness of CGI sheets	Spacing of Purlins	0.63 mm 24 G	1.6 m	0.80 mm 22 G	1.8 m	1.0 mm 20 G	2.0 m	1.25 mm 18 G	2.4 m	1.60 mm 16 G	2.8 m
Thickness of CGI sheets	Spacing of Purlins														
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1.60 mm 16 G	2.8 m														

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The sheets shall have uniform ; thickness, translucency (if specified) and strength. The sheets shall be of approved manufacture and shall match the roofing profiles. Wherever necessary and as shown on the drawing, caulking shall be non-hardening and non – staining type. The Contractor shall also supply all necessary louvers special fittings, fasteners, Flashing, caulking and bituminous paint required for installation of the sheets in strict accordance with manufacturer’s instructions. Roof & siding sheets shall be capable of withstanding 200 kg/sq.m wind loads. 3.0.0 INSTALLATION 3.1.0 Storage of materials All materials shall be stored by the Contractor in proper way to prevent any damage. 3.2.0 Workmanship The erection shall be according to the best construction practice to give a water-tight finish to the satisfaction of the Engineer. Fixing of gutters and downpipes shall be according to the relevant Indian standard specification. Aasbestos sheets of profiles as stated in the drawings shall be fixed with minimum, 150 mm end alp and side laps as per manufacturer’s specification Unless otherwise specified in the drawing hook bolts or j-bolts shall be 8mm diameter placed at 300 mm centres maximum. 6 mm dia galvanised iron seam bolt and nut with G.I. flat washers and bitumen washers shall be used for stitching ridge cappings, corner pieces, Ventilators, north light curves, etc. a) <u>C.G.I.Sheeting</u> 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 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 305 mm apart. the length of the hook of 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. Galvanised iron seam bolts and G.I. flat washers and bituminous washers. b) <u>Fibreglass reinforced plastic Sheetting</u>			

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These shall be of thickness and profile as mentioned in the Schedule of Items. Colour and light transmittance shall be as mentioned on drawings and or Schedules. 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 as completely watertight and able to withstand the designed wind-pressure as mentioned in schedule.			
4.0.0 SAMPLES Samples of different types of sheets with method of fastening shall be submitted for approval.			
5.0.0 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 cracks, holes or damages of sheet c) Spacing of bolts d) Provision of double washers (G.I. and asbestos or bituminous washers) e) Proper installation of flashings., etc.			
6.0.0 RATES Rates shall be unit rate for complete item described in the Schedule of Items including all wastages.			
7.0.0 METHOD OF MEASUREMENT a) No allowance shall be made for laps. b) Roofing and side sheeting shall be measured for flat ares of work done Corrugated of trailers sheeting shall be measured flat and not girthed. Openings less then 0.1 sq.m. shall not be deducted. c) Special features like flashings, ridge pieces, corner pieces, north-light curves, etc. shall be length of installation. d) Gutters and downcomers shall be measured for length along their centre lines and bends, junctions, shoes, ends, etc. shall not be paid separately. e) S-type asbestos louvers shall be measured for area of opening for which it is installed. f) Curved asbestos roofing sheets shall be measured for area of curve.			

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g) Asbestos ventilators, roof lights, etc. shall be measured for actual numbers used. h) Structural supports to sheeting work shall be measured and paid separately under relevant item. i) Glazing to asbestos roof lights shall be measured and paid separately. 8.0.0 CODES AND STANDARDS The following are some of the important I.S. codes relevant to this section:- IS: 459 : Unreinforced corrugated and semi corrugated asbestos Cement sheets IS : 2096 : Asbestos cement flat sheets IS :3007 : Code of practice for laying asbestos cement sheets IS : 730 : Fasteners for corrugated sheet roofing. IS :8869 : Washers for corrugated sheet roofing. IS :3451 : Fibre reinforced translucent sheets.			



HYDERABAD

TECHNICAL SPECIFICATION FOR MISCELLANEOUS STEEL WORKS

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TANK PADS

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1.	SCOPE		
This specification description the technical requirements for the materials and construction of tank of tanks pads of sand fill or Murrum fill construction.			
2.	REFERENCE STANDAREDS		
IS 383 Aggregates – Coarse and fine, from natural sources for concrete.			
IS 2720 Part VII – Determination of water content- dry density relation using light compaction			
IS 2720 Part VIII – Determination of water content – dry density relation using heavy compaction.			
IS 2720 Part IV – Grain size analysis.			
IS 1498 Classification and identifications of soil for general Engineering purposes.			
3.	SUB GRADE PERPARATION		
The surface of natural siol exposed at the bottom of excavated pit shall be throughly compacted by rolling or other means as directed by Engineer-in-Charge to obtain 90% of Max. laboratory dry density for the siol as per Is 2720 part VII.			
4.	TANK PAD CONSTRUCTION		
The tank pad shall be either of sand fill or Murum fill construction as specified in construction drawings.			
4.1	SAND FILL		
Sand for filling shall be clean and well graded conforming to IS 383 with grading Zone II or III> It shall not contain any vegetable and organic materials. Sand shall be obyained from a source approved by Engineer – in – Charge.			
4.2	SAND FILL		
Sand for filling shall be clean and well graded conformings to Is : 383 with grading zone II or III. It shall not cotain any vegetable and organic materials. Sand shall be obtained from a source approved by Engineer – in – Charge. Sand shall contain an average 15% of cohesive fines such as clay (grain size less than 0.074) in natural state or artificially mixed with it. If artificially mixed, the mixture shall be subjected to through mixing to obtain a uniform mix.			
4.3	MURRUM FILL		
It shall of coarse and granual murrum containing not more than 20 ⁰ Cohesive			

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finer such as only. Size than 0.075mm. The murrum shall be of 20 mm and covered size and shall be taken from approved qualities.			
4.4	Sand murrum shall be spread in not exceeding 15cm in loose increase over than area each of these shall be uniform on density. Quality of materials and moisture content before compaction. The moisture content shall be within (2) two percent of optimum moisture content (OMC) on side OMC as per IS : 2720.		
4.5	Compaction of each layers shall be done Mechanical means as per the directions of Engineer-in – Charge shall be worked manually. Each layer should be uniformly compacted to obtain 90⁰, of standard perforation in the material fails to achieve the required density, the layer should be renewed. With necessary alteration in the composition So that the required compaction is obtained.		
4.6	Further layer shall be placed only after the layer already laid has been compacted to the required density.		
4.7	The finished surface must be dressed to required grade and stops Excess material must removed from Compaction site.		
4.8	PAYMENT Payment for sand/Murrum filling shall be made on the basis of volume of fill, after placement and Compaction. The rate quoted should include cost of material royalties, transportation, handling compacting, watering, testing at various stages, dressing removal of surplus material and other work incidental to this.		
5.	CRUSHED ROCK RING		
5.1	A crushed rock ring shall provided below the tank shall as per details given in construction drawings. The stone aggregates for the ring wall shall be 50 mm and down grade size and shall be of hard black trap, granite or such other approved materials, sand used shall be medium to coarse grade as per IS 383 and shall be clean and free organic/clayey materials.		
5.2	LAYING The stone aggregate shall be laid in laid layers of 150mm thickness and such shall be compacted to obtain a hard core ring wall to the satisfaction of Engineer – in – charge. The surface shall be checked from time to time during spreading and compaction to ensure a finished surface true to levels and grade as per drawings. Use of fine aggregate such as sand or finer stone aggregates may be required to fill voids and pockets, to obtain a uniform compacted hard core. Over the final compacted layer of stone aggregate sand shall be evenly spread and compacted by tamping rolling.		

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5.3	PAYMENT The rate shall include the supply of all materials, feels, labour including cutting a trench, supporting the sand suitably, during such a cutting, placing, the hard core and compacting the same to the satisfaction of Engineering- in – Charge. The payment shall be made on the cubic metre basis, with the finished cross section of the hard core. 6.0 ANTI CORROSIVE LAYER 6.1 Anti corrosive layer shall of succeded coarse sand mixed with 80,100 bitumen or equivalent 8 to 10 inches by volume. 6.2 Bitumen shall be heated to a temperatur 175 ⁰ C to 190 ⁰ C with 3 kerosene if required and sand shall be throughly moved with in in a mixing drum to give uniform mixture and shall be laid over the compacted surface of paid in line, grade and levels as shown on the drawings, as shown on the drawings, as directed by the Engineer- in – charge Bitumem shall not be heated bryoned the temperature limits....above. 6.3 The layer shall be temped to from hard mass of uniform compacted thickness as per the schedule of items and drawings. 6.4 PAYMENT The payment shall be made on Squire Meter basis of the area of layer laid on top Of Tank pads. The quoted rate shall include cost of Materials. Transportation. Mixing, Laying, Tamping finishing etc. all complete. 7. PERMIX CARPET FOR TANKPADS 7.1 MATERIALS 7.1.1 SAND		



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CONCRETE PAVEMENTS

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HYDERABAD

1. MATERIALS

1.1 WATER

Water used for cement concrete, mortar, plaster grout, curing etc. shall be clear and free from injurious amounts of oils, acids, alkalis, organic matters or other harmful substances. Only natural water suitable for drinking shall be used. It shall conform to IS:456.

1.2 AGGREGATE FOR CONCRETE

The aggregate for concrete shall comply in all respect with IS:383. This should be furnished in at least two separate sizes with separation at 20mm when combined material graded from 5 to 38mm is specified and 25mm Is sieve when combined material graded from 20 to 50mm is specified. This shall be obtained from a source approved by Engineer-in – charge and shall be chemically inert, strong, hard, durable and of limited porosity. This shall be of the gauge specified in the schedule of rates and approximately cubical in shape. It shall be free from soft or decayed pieces, dirt, clay, leaves or any organic matter. The aggregate shall not have any injurious effect when mixed with cement nor shall it corrode the reinforcement, nor otherwise impair the strength and durability of the concrete. The size of coarse aggregate mentioned in this specification denotes maximum size aggregate and the same shall be graded downwards as per IS:383.

1.3 SAND FOR CONCRETE AND MORTAR

Fine aggregate shall preferably be natural sands. In case of crushed sand the very fine natural sand amount passing IS: NO: 383. Sand shall consist of clean, hard, strong, sharp, durable uncoated particles free from any mix of clay, dust, vegetable matter, mica, iron pyrites, shells, soft or flakey and elongated particles, alkali organic matter, salts, Loam and other impurities which may be considered by the Engineer-in-charge as harmful. Sulphate content should not exceed 5''. The source or sand shall be approved by the Engineer – in – charge. Sand obtained from river bed subject to tidal effect will not be allowed in works. All sand shall be washed before being brought to site.

1.4 STORAGE OF AGGREGATES

The subcontractor shall at all times maintain at the site of work such quantities of aggregate as are considered by the Engineer-in-charge to sufficient to ensure continuity of work.

Earth type and grade of aggregate shall be stored separately. The ground on which the aggregate are stored shall be firm and have sufficient slope to ensure adequate drainage of rain water.

Any aggregate delivered to site wet shall be placed in storage for at least 24 hours to ensure adequate drainage before it is used for concreting.



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Sand heaps shall be covered with bricks or such other materials to prevent blowing off and to assist in good house keeping.

1.5 CEMENT

1.5.1 The cement used shall be ordinary Portland cement, conforming to IS:8112 unless otherwise specified.

1.5.2 The cement used to the contractor to the contractor shall be stored in suitable weather tight building and in such a manner as to permit easy access for proper inspection. All cement stored at site by the contractor shall be arranged in batches and used in the same orders as received from owner. Contractor shall maintain a cement register in which all entries shall be completed day to day showing quantities received, date of receipt and daily cement consumption.

1.5.3 REJECTION OF CEMENT

The Engineer-in-charge may reject cement which has deteriorated after issue to the contractor owing to inadequate protection against moisture or other causes or in other case where the cement is not to his satisfaction.

1.5.4 ADMIXTURE

No admixture shall be normally permitted for concrete or mortar. Water proofing compound to be used in concrete, plaster, damp proof course etc, where specified, shall be either CICO or approved equivalent make. It shall be mixed as per manufactures specifications and as approved and directed by the Engineer-in-charge.

1.5.5 JOINT SEALING IN PAVEMENTS AROUND FOUNDATIONS.

Joint sealing in pavements and around equipment structural columns shall be of approved compound conforming to IS : 1834 type "B" (Shalitex or approved equivalent).

2 GRADE AND PROPORATIONING

2.1 The grade indicated in drawings and schedules shall conform to IS:456, the strength being indicated below.

Grade Min Crushing Strength of 15 cm. Cube in Kg. Sq. Cm. At 28 days.

Test

Prel.test

Work cube



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M-10	135	100
M-15	200	150
M-20	260	200
M-25	3200	250
M-30	380	300

- 2.2 The water cement ratio, aggregates and grading for each shall be predetermined From the results of cube tests of trail mixes. The mix proportions determined thus shall be followed at site and shall in no way relive the contractor of his responsibility as regards the prescribed strength of mix. The mix proportions, however, shall be revised if the results of the cube tests during the construction show consistently lower or higher strength than the prescribed one. No claim to alter the rates of concrete work will be entertained, due to such changes in mix designs, as the concrete work will be entertained. Due to the concrete in mix designs, as the contractor will be responsible to produce compacted by vibrations should not be more than 25mm & that for manual compaction not more than 50mm.

- 2.3 All concrete shall be controlled concrete conforming to IS:456. For mud-mat and filling purpose, ordinary concrete 1:4:8 mix proportion may be used as indicated in drawings.

3 EQUIPMENTS

All equipments like weighing devices, measuring boxes, mixers, sub grade templates, hand tampers, vibrating screeds, internal vibrations, longitudinal floats, bridges, belts, push brooms, straight edges, tools etc. shall be on the worksite in first class working condition and shall have been inspected by the Engineer-in-charge before paving operations are permitted to start. Through out the construction period class working conditions to ensure the proper execution of the work.

4 PREPARATION OF SUB GRADE

- 4.1 The sub grade of sub base for laying of the concrete slabs shall comply with following requirements.
- 4.1.1 That no soft spots are present in the sub grade or sub base.
- 4.1.2 That the uniformly compacted subgrade or sub base extends at least 300mm on either side of the width to be concreted.
- 4.1.3 That the subgrade is properly drained.
- 4.1.4 That the minimum modulus of subgrade reaction obtained with a plate bearing test shall be 5.54 kg/cm^3
- 4.2 Sub grade shall be prepared to the lines and grades shown on the drawings.



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4.3 No concrete shall be placed around manholes or other structure until they have been brought to required grade and alignment.

4.4 The subgrade shall be in most condition at time of concrete placement.

5 FORMS

5.1 All side forms shall be of mild steel unless use of wooden sections are specially permitted. The steel forms shall be MS Channel section and their depth shall be equal to thickness of the pavement. The sections shall have a length of at least 3.00 m except on curves, where shorter sections may be used.

These forms should be provided with ample bracing and supports to prevent the springing of the forms under the concrete pressure or thrust of machinery operation near by.

5.2 The forms should be in sufficient number and they should not be removed until concrete is hardened sufficiently.

5.3 In case wooded forms are permitted, these shall have minimum base width of 100mm for 200mm slabs and 150mm for more than 200mm thickness.

6 REINFORCEMENT

6.1 All reinforcement work shall conform to IS :456. Reinforcement steel shall be free from dirt scale or other foreign matter and rust. The number, size, from and position of all the reinforcement shall, unless otherwise directed or authorised by Engineer-in-charge, be strictly as per drawings. The placing or reinforcement shall be such that when properly placed into the work, extreme longitudinal bars will be located not less than 50mm nor more than 100mm from the edges of the slabs. Except for dummy joints, the length of reinforcement will keep clear or transverse joints by not less than 50mm nor more than 100mm as measured from the centre of the joint to the ends of longitudinal bars.

6.2 While overlapping the bars in either direction the overlap shall be atleast equal to spacing between bars in the respective direction.

6.3 To prevent displacement before or during concreting, the bars, shall be secured to one another with 16 SWG black annealed binding wire. Wooden planks soft labour to move shall be supported independent of reinforcement and the cage shall never be permitted to sag or get displaced during concreting Concrete spacer blocks shall be used to ensure r\correct cover of concrete over bars as shown in drawings.

6.4 Dowels if used as load transferring device shall be checked for exact position before concreting. Dowels shall be parallel to the surface and perpendicular to the joint and shall not place any restraint on the movement of joint.



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7 MIXING

- 7.1 Mixing should be carried out in mechanical mixers. Drum of the mixer shall Rotate at a peripheral speed of 60mm per minute. Hand mixing can however be permitted by Engineer-in-Charge in special cases. Water cement ration shall be rigidly controlled during mixing. Mixers shall be fitted with automatic devices to discharge measured quantity to water directly into the mixing pan. The water shall be introduced into the drum within first 15 seconds of mixing, but not until all the cement and aggregate constituting the batch are thoroughly mixed. Mixing shall continue until the concrete is uniform in colour and for not less than 2 minutes after all the materials and water are in the drum. The entire content of the drum shall be discharged before any materials are placed therein for the succeeding batch.
- 7.2 Correcting for Building-In volume batching suitable allowance shall be made for the bulking of fine aggregates due to presence of water. For this pupose the bulking shall be determined as directed by Engineer-in-Charge.

8 PLACING

- 8.1 The place where concrete is to be poured should be clean and free from all loose dirt, wooden pices, dust, standing water etc.
- 8.2 Walking on reinforcement layers is permissible, walkways of wooden planks or similar material can be placed with removable supports, and should be independent of the reinforcement. The reinforcement position should not be disturbed not should it sag during carriage and placement or concrete.
- 8.4 Concrete should not be dropped from a height of over 1.5 m
- 8.5 To ensure bond and water tightness between old concrete surface and fresh concrete to be placed, the surface should be cleaned and, roughened by 'Initial geen cut' by wire brushing or chipping. The initial green may be done by wire brush after 6 hours of placing concrete in order to facilitate the work. Chipping can be done only after 48 hours. A layers of cement slurry with 1 :1 mix (1cement : 1 sand) shold be poured to obtain a uniform coating on old concrete. Immediately thereafter the fresh concrete should be poured.
- 8.6 Concrete shall be mixed in quantities required for immediate use and shall be besposited on the sub-grade in single operation to the required depth and width of the pavement Spreading shall be as uniform as possible to avoid rehandling of Concrete, where however, a certain amount of redistribution is necessary it shall be done with shovels and not with rakes. Concrete shall be vibrated with internal vibrators, Concrete shall placed continuously until complection of the part of the work between continuously until complection of the part of the work between construction joints or as directed by Engineer-in-charge.



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8.7 PLACING IN INCLEMENT WETHER

All precautions shall be taken for concreting to weather in accordance with the relevant clauses of IS :456. Due protection shall be provided to prevent cement being blown away while proportioning and mixing during windy weather. No concreting shall be carried out in continuous heavy rains. Necessary arrangements to cover the freshly poured concrete shall be provided, to protect it from the direct rays of the sun and from drying winds.

8.8 All concreting placement should be co-ordinated with placement of conduits, inserts, embedded parts etc., executed either by same agency or separately.

8.9 Concrete in standing water shall be executed strictly as per IS : 456. This shall be paid as a separate item where applicable.

8.10 The concrete shall be laid in panels not exceeding 3 Mx3M as shown in layout drgs. Or as directed by Engineer-in-charge.

9 COMPACTION & FINISHING

9.1 COMPACTION

The surface of the pavement shall be compacted either by means of power driven finishing machine or by a vibrating hand screed for areas where width of the slab is very small as the corner of street junctions etc. hand consolidation and finishing shall be done as follows :

9.1.1 Concrete soon as placed be struck off uniformly and screeded to the crown and section shown on the plans and to such level above the base that when compacted and finished the pavement shall conform to the grade and cross section indicated by the plans. The entire surface shall then be tamped until a close knit dense surface is obtained.

9.1.2 The tamper shall rest on the side forms and shall be drawn ahead with a swing motion in combination with a series of lifts and drops alternating with lateral shift, the aim of this operation being compaction and screeding to the approximate level required. Subsequent tamping should advance 75mm at a time in the direction in which the work is proceeding and final stages the tamping should be closer about 12mm at a time until a level and in final stages the tamping should be closer about 12mm at a time until a level dense surface is obtained.

9.13 If so directed by Engineer-in-Charge hand operated vibrating tamper consisting of Normal type of hand tamper attached to a pneumatic or electric vibrating unit shall be used for compaction.

9.14 Segregated particles of coarse aggregate which collect in front of the tamper shall be thrown outside the forms or thoroughly mixed by hand with a mass of concrete already on the base.



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9.15 Compaction by tamping shall be carried on till the mortar in the mix just works upto the surface. The surface shall be examined after compaction correction if needed, shall be made by adding or removing concrete followed by further compaction finishing.

9.2 FLOATING

As soon as particable, after concrete has been struck off and compacted, if shall be further smoothened and compacted by means of longitudinal float 1200mm long and 75mm wide operated from a foot bridge.

9.3 STRAIGHT EDGING

After floating is completed and excess water remove water but while concrete is still plastic the slab surface shall be tested for truness with a straight edges and rectified if necessary.

9.4 BELTING

Just before the concrete becomes non-plastic, the surface shall be belted with a two ply canvas belt not less than 200m wide and at least 1.0m longer than the width of the slab, Hand belts shall have suitable handles to permit controlled uniform manipulation. The belt shall be operated with short strokes transverse to the carriage way centreline and a rapid advance parallel to the center line.

9.5 BROOMING

After belting and soon as surplus water has risen to the surface the pavement shall be given a broom finish to produce corrugations of uniform appearance of not more than 1/16 inch in depth.

9.6 EDGING

Before the concrete has its initial set the edges shall be carefully finished with an edges of the radius required and pavement edges shall be left smmoth and true to line.

10 CURING

10.1 INITIAL CURING

Immediately, after the complection of the finishing operations, the surface of pavement shall be entirely covered with wetted burlap, cotton or jute mats.



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10.2 FINAL CURING

Upon the removal of the mats, the slab shall be thoroughly wetted and covered by the following method. Curing with wet earth-A system of transverse and longitudinal dykes of clay about 50mm shall be laid over the slab. The dykes shall be blanketed with sandy soil free from stones to prevent drying up. The rest of the slab shall be covered with sufficient sandy soil so as to produce the blanket of earth not less than 37mm depth after wetting. This earth shall be kept thoroughly wet till the concrete has attained strength but not less than 14 days.

11 JOINTS

11.1 Wherever called for on the drawings expansion joints, dummy joints and longitudinal joints shall be provided as per detailed indicated in the drawing and as directed by Engineer-in-Charge.

11.2 Sealing of Joints.

11.2.1 After the temporary seal or other intruded materials of all expansion and contraction joints which shall be allowed to dry before the sealing compound is applied.

11.2.2 The edges of the joints shall be thoroughly cleaned and primed with a thin bituminous paint which shall be allowed to dry before the sealing compound is applied.

11.2.3 The primer shall be applied with a brush. The composition of primer shall be as follows :

Name of the material	percent of weight
1. 200-penetration Bitumen	66) Blended Blended
2. Light creosote oil	13) Hot cold
3. Solvent Naptha	20)

The bitumen shall be melted and fluxed with oil, When cold, solvent, Naptha shall be added. Bituminous emulsion shall not be used as primer. Care shall be taken to ensure that the sealing compound is not heated above 200⁰ C and the temperature does not exceed 180⁰ C for long periods.

11.2.4 Sealing compound shall be poured into the joint opening in such a manner that the material will not spill on the exposed surface of the exposed surface of the concrete. When required to prevent pick up under traffic, the exposed surface of the exposed surface of the sealing compound shall be dusted with hydrated lime.

12 OPENING TO TRAFFIC

12.1 Traffic shall not be allowed for a period of 28 days after laying of concrete.



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- 12.2 Before opening the roads to traffic all joints shall be filled and trimmed or topped as required.

13 METHOD AND BASIS FOR PAYMENT

- 13.1 Payment for concreting in pavements shall be made on cubic meter basis of the actual finished work done. The rate shall be inclusive of all labour, materials, curing, cost of leaving pockets, if necessary making recesses drain including casting and testing of cubes, all complete. The rate for concreteing shall include the cost of shuttering but exclude only the cost of reinforcement and joint sealing. E making grooves at construction/expansion joint for joint sealing compound, compaction of sub-grade, if required,

- 13.2 Payment for MS reinforcement, deformed or twisted bars shall made on the basis of weight. The weight shall be derived from the sizes and corresponding weights given in hand book of Indian Standards Institution. Standard hook lenth, chairs, spacer bars and authorised laps only will be inclded in the weight calculations. Binding wire will not be weighed nor otherwise measuerd. Measurement for weight-shall not include cutting, bending, placing, binding with subcontractor's own binding wire and providing necessary cover bloks of concrete etc. all complete including cost of wastage and cutting allowance and rolling margin.

- 13.3 Payment for joint sealing shall be made on running meter basis of joints. The rate shall inclde cleaning joints and sealing with approved compound all material labour etc complete as per drawing.

14 PAYMENT FOR JOINTS

Payment for expansion joints, longitudinal joint, dummy joints, shall be done on running meter basis.



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ANTI TERMITE TREATMENT

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1.0.0 SCOPE

The scope of work is to set up a chemical barrier against attack by subterranean termites while the building is under construction.

2.0.0 EXCAVATION

2.1.0 GENERAL

All work shall in general be executed as specified in IS :6313 part 11 and per approved specification of the agency having special know-how for the job.

All necessary work to ensure uniform distribution and proper penetration 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 treatment soil barrier shall not be disturbed.

2.2.0 CHEMICAL AND RATE APPLICATION

Any of the following chemical (conforming to relevant Indian Standards) in water emulsion shall be applied by pressure pumps, uniformly over the area treated.

Chemicals	Concentration by Weight. Percentage
Dieldrin(IS :1052-1962) :	0.5
Heptachlor	0.5
Aldrin (IS :1306-1958) :	0.5
Chlordane (IS :2863-1964) :	1.0

2.3.0 METHOD OF TREATMENT

2.3.1 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 500mm below ground level. The bottom surface and sides of excavation (upto a height of about 300mm) for column pits, walls trenches and basements shall be treated with chemical at the rate of 5 liters / m² of surface area. Backfills around columns. Walls etc. Shall be treated at the rate of 15 liters / m² 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 150mm centers close to the walls surface and spraying the chemicals in the specified dose.



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2.3.2 Treatment of Top Surface of Plinth Filling

Holes 50mm to 75mm deep at 150mm centers both ways shall be made crow-bars on the surface of compacted plinth fill. Chemical emulsion at the rate of 5liters/m² of surface shall be applied prior to laying soiling or sub-grade. Special care shall be taken to maintain continuity of the Chemical barrier at the junction of vertical and horizontal surface.

2.3.3 Treatment of soil surrounding pipes and conduits

Special care shall be taken at the points where pipes and conduits enter the building and the soil be treated for a distance of 150mm and a depth of 75mm at the point where they enter the building.

2.3.4 Treatment of Expansion Joints

These shall receive special attention and shall be treated in a manner approved by the Engineer.

3.0.0 ACCEPTANCE CRITERIA

The Contractor shall given a 10 years service guarantee in writing supplemented by a seperate and unilateral guarantee from the specialised agency for the job to keep the building free of termitee for the specified period at no extra cost to the Owner.

4.0.0 RATES

Rates shall be lump sum rate per m² of plinth area for the complete treatment.

5.0.0 METHOD OF MEASUREMENT

Treatment to building shall be measured in m² of the building for the buildings where treatment has made and accepted.

No separate measurement shall be done for treatment to foundation walls of trenches, DPC at plinth level, top surface of plinth filling, treatment around pipes, etc.

6.0.0 I.S.CODE

Relevant code applicable for this Specification.

IS :6313 (Part II) : Code of Practice for Anti-Termite Measures in Buildings.



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FIRE PROOFING OF STEEL STRUCURES WITH R.C.C

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1.0SCOPE The specification covers materials and methods of application for fireproofing of steel structures and equipment supports. 2.0MATERIALS/APPLICATION Fire proofing shall be provided by in- situ-concreting. Steel surface to be fire proofed shall not be painted and shall be cleared of all loose dirt, rust, mill scale, soot and concrete by mechanical wire brushing or sand blasting. Oil and grease deposit shall be removed with detergents and steel surface made clean and dry. 3.0FIREPROOFING BY IN-SITU-CONCRETE 3.1Fireproofing shall be done as indicated in enclosed drg. No 4-38144-00049. 3.2oncrete for fireproofing shall be of M15 grade with 6mm and down aggregates. Mixing and placing shall be done as per BHEL specified for plain laid reinforced concrete. 3.3Thickness of fireproofing concrete shall be as drawings no. 4-38144-00049 enclosed. 3.4Centering and shutting shall be approved quility, properly designed to give smooth and even surface. Any defects honeeycomb etc. shall be made good at contractor’s cost. All other specifications regarding from work shall be in accordance with BHEL ‘s specification for plain and reinforced concrete. 3.5Concrete shall be poured into well made forms properly oiled and made to correct dimensions to give 50mm minimum coverage Concrete shall be vibrated as necessary to ensure smooth free from voids and irregularities. 3.6Reinforcement materials and placement shall be as per enclosed drg no. 4-38144-00049. 3.7Concrete shall be cured by constant wetting for fifteen days 4.0MEASUREMENT 4.1Concrete will be paid for on volume basis. For encasing of ‘I’ section outer dimensions of encased section will be taken for measurement and not deduction will be taken for measurement and not deduction will be made for steel sections encased. For laced columns the difference in volume taking outer dimensions of encased and unencased sections will be considered. No deduction will be made for batten plates, lacing angles etc.		

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4.2.1 Reinforcement in the form of ungalvanised wiremesh will be paid for on area basis. Overlaps will also be measure. 4.2.2 Formwork will be measured on area basis of the outer surface area of encased section.		



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COATING AND WRAPPING OF UNDERGROUND PIPES

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4. MATERIAL AND PROCEDURE OF WORK
5. REPAIR OF PIPE



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1. OBJECT AND SCOPE

The object of the specification is to described the method of protecting the underground by the peocess of coating and warpping. The job shall be generally performed in the following operation :-

- i) Cleaning the external pipe surface
- ii) Priming with synthetic primer
- iii) First coat of coal tar enamel
- iv) First layer of inner warpping with glass fibre
- v) Final coat (2nd coat) of coal tar enamel
- vi) Outer warp of coal tar impregnate glass fibre
- vii) White wash

In addition, this specification also covers an defines the material specifications, method of cleaning, priming, procedures of coating & Wrapping testing, repairing, handling and storing etc,required for the satisfactory complection of the job.

2. REGULATIONS

- 2.1 All materials used shall conform to the quility and testing requirement indicated in AWWA-C-203-86 or BS 4164-1987 or ASTM Standards and or directed by Engineer-in-charge.
- 2.2 All appurtenances and equipment to be used for cleaning, priming, coating an warpping and testing shall be approved by the Engineer-in-Charge.

3. LIMIT OF UTILISATION

The underground pipe line protected by coating an warpping as described in this specification should be able to carry a liquid at a temperature upto 60⁰ C.

4. MATERIAL AND PROCEDURE OF WORK

4.1 Preparation and cleaning of Piping

The pipe line shall be throughly cleaned of all rust, grease, dirt, mill scales, weld scales, weld burns etc. by means of cleaning machine. This cleaning operation shall be immediately followed by priming with the airless spray priming machine.

Altenatively, if permitted by the Engineer – in – charge, the pipeline shall be adequate scrubbed manually with stiff wire brushes and scrapped where necessary. The primer coating should immediately follows the cleaning of pipes. The primer coating may also be done manually if permitted by the Engineer – in – charge.



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The cleaning and priming operation may be carried out in the contractor's workshop or on site. The entire pipe length shall be cleaned but the end of the pipes shall be left without coating and warping for a distance of 20mm for joints, which shall be coated and warped manually on site after laying, welding and testing the pipes.

4.2 PRIMING

4.2.1 MATERIALS, COAL TAR PRIMER

The Primer shall be a type B (fast drying, synthetic) certified to meet AWWA C-203-86 or British Standard BS – 4164, Section 3. The primer shall consist of chlorinated rubber, synthetic plasticiser and solvents suitably blended to produce a liquid coating which may be applied by brushing or spraying and which will produce an effective bond between the metal and subsequently coating of coal tar enamel. Primer should not contain benzol or other toxic and/or highly volatile solvents, added pigments or inert fillers or other substances and shall show no tendency to settle out in containers. The main characteristics of the primer shall be as follows :

- Drying time to touch at normal humidity @ 30 ⁰ C (70 %)	Approx 5-15 mts.
- Flash point, BS 2000, part 170	23 ⁰ C (minimum)
- Flash time 4mm flow cup (ISO) at 23 ⁰ C, BS 3900, part A6	35-60 sec
- Volatile matter (105-110 ⁰ C), max. by mass. BS, Appendix A	75% loss
- Coverage	8-12 M ² / lit / coat

4.2.2 PRIMING OPERATION (COLD APPLICATION)

The primer shall be applied on the pipes in uniform thin film (Single coat) leaving no drips or runs. The entire surface of the pipe should be primed without any patch left out. Any holidays or unprimed places shall be reprimed immediately. Any flooded areas or primer applied on improperly cleaned pipes shall be cut down to surface of pipe and reprimed at Contractor's cost. The primer shall be cold applied to a clean dry surface, immediately after cleaning operation.

- The surface shall be dry at the time of applying primer coat. Primer shall not be applied during rain or fog or on wet surface.
- Primer which comes foul with foreign substances or thickened through evaporation of solvent shall not be permitted.



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- Freshly primed pipe shall be placed on clean square cut skids and shall not be allowed to come in contact with the ground or with any other foreign matter. It shall remain on skids until lifted or cradled for the coating & wrapping operation.

- All primed pipes which have excessive coat of dust or primer accumulated over them before the primer is dry or where primer has become dead shall be reprimed. Drying time shall be minimum 24 hrs. The application of coal tar coating shall be taken up after primer coat has dried up completely and normally within 24hrs after priming with applied Contractos's cost. The Engineer-in-charge shall approve the primer coat before the next coat is applied.

- The primer shall be kept in tightly sealed containers when not in use to prevent evaporation.

- The primer shall be applied as received from the manufacturer and should not be thinned under any circumstances.

4.3 COATING AND WRAPPING

4.3.1 COAL TAR ENAMEL

Enamel shall be composed of a specially processed coal tar pitch combined with an inert mineral filler.

Asphalt of either petroleum or nature base shall be acceptable as part of the ingredients. The enamel shall have the following physical characteristics conforming to AWWA C 203/86 or 4164-1987.

Softening point (Ring and ball)	Min	Max
ASTM Z-36	105 ⁰ C	115 ⁰ C
Filler (Ash) ASTM-2415 by wt.	25%	35%
Fineness filter, through 200 mesh ASTM D 546 by wt.		
Specific gravity at 25 ⁰ C ASTM X 71	1.4	1.6
Penetration, AWWA C 203-86, Sec 2 : 8 : 1 @ 77 ⁰ F (25 ⁰ C)-100 gm. Wt . 5 Sec.	5	10
@ 115 ⁰ F (46 ⁰ C)-50 gm. Wt . 5 Sec.	12	20
High Temperature Test (SAG)		
@ 62 ⁰ F (71 ⁰ C) AWWA C-203-86 Sec.2.8.9		1/16" (1.6mm)
Low Temperature test @ - 10 ⁰ F, (-25 ⁰ C)		

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	(Cracking) AWWA C-203-86 Sec.2.8.10		None
	-Impact test @ 77 ⁰ F, (25 ⁰ C) Direct impact 650gm ball,8ft drop AWWA C 203-86, Sec.2.8.12)Indirect impact.		16 in 2 (10,323mm2) 6in2(3841mm2)
	-Peel test, AWWAC- 203-86, Sec.2.8.11		No peeling
	-Spark test 15 KV low Amperage		None
	-Water absorpion, 35 weeks		0.3%
	- Application temperatures	225 ⁰ C	245 ⁰ C
4.3.2	GLASS FIBRE MAT FOR LANNER WRAPPING		
	The Fiberglass mat for inner warpping shall be thin, flexible, uniform mat, composed of chemical resistant borosilicate glass fibre or hydrolitic class 3-m conforming to DIN-12-111 mono-filaments distributed in random open poyous structure, bonded together with a thermosetting phenolic type resin which shall be compatible with the coal tar enamel. The innerwrap glass fibre tissue shall be longitudinally reinforced by continuos flamet glass yard- embedded in mat & shall have nominal thickness of 0.5 mm (0.02 ⁰) and shall Conform to AWWA C 203-86, Appendix section A.@.		
	- No disbonding of individual glass fibre shall occur during or following the embedding process.		
	- The glass fibre mat shall not cause bubbling under the condition of application.		
	- The glass fibre mat shall be sufficiently porous so that it can embedded in the hot coal tar enamel as it is applied to the exterior of the pipe.		
	- The glass fibre mat(reinforced glass warp) shall also conform to AWWA C 203-86 section A2 and the following Charecteristics.		
	- Weight (minimum)	41gms/m2	
	Nominal thickness	0.5mm± / - 0,1 mm	
	Tensile (average, breaking Strength)		
	Longitudinal direction	2277 N/M OF width (mIn)	
	Transverse direction	700N/M of width.	



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Porosity

The glass fibre mat shall have a porosity of not more than 1.90mm water gauge measures at pressure difference across the sample at an air velocity of 1.02 M / sec.

Temp. Resistance

The glass fibre tissue shall be unaffected Unaffected under load in hot enamel at 53⁰F (288⁰C) for minute.

Moisture absorption by Wt. At
relative humidity of 95⁰ at 125⁰(50⁰C) 5%(max)
for 24 hrs

4.3.2 OUTER WARP COAL TAR IMPREGNATED GLASS FIBRE

The outer warp shall be non-woven, thick reinforced glass fibre mat uniformly impregnated with coal tar enamel and shall conform to AWWA C-203-86 Section 2.10.3 with following characteristics :

Glass tissue Base :83 gm/m2 (min)

Weight (finished material) :586-732 gm/m2
(12-15 lbs/100 ft2)

Thickness : 0.76 mm (30 mills)

Tensile strength
(Average Breaking Strength)

Longitudinal Direction : 6130 N / M of width (min)

Transverse Direction : 4730 N / M of width (min)

Pliability (1 » dia Mandrel 25⁰C,
2sec) : No cracking

Weight loss on heating at 82⁰ C
For 2 hours : 2% (max)

Moisture absorption percentage
Weight at a relative humidity of
A relative humidity of 95% an
50⁰ C For 24 hours.

The finishing reinforced glass fibre mat outer warp have a smooth, uniform surface free of visible defects. When unrolled at a temperature from 0⁰C to 50⁰C , the outer warp shall not crack or stick to such an extent as to cause breaking or tearing. The outer a 3'' diameter core in widths and lengths as specified at the time of purchase. The rolls shall be packed to exclude dust and



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dirt during shipping and handling and shall have card board separators and end shield adequate to prevent roll damage when stacked. The sides of the rolls shall be clean, smooth and square cut and shall have no telescoping.

- 4.3.3 The white wash used as a final coat shall be manufactured in accordance with white wash formulas as specified in AWWA C- 203-86, Section 2.11. coal tar enamel. The fibrous glass mat shall be of suitable uniform width for smooth spiral application. The over lap of the fibrous mat shall not be less than ½ inch (12mm).

A second coat of hot coal tar enamel shall then be applied of such a thickness that finished thickness of two layers of enamel inner and outer warps shall be a minimum of 4.0mm.

4.4.2 BY MANUAL APPLICATION

The already primed pipe is placed in a fixed position. The coal tar enamel heated to 225⁰ - 245⁰ C is then applied by means of sling as follows.

A canvass strip (alternatively a tinplate strip) about 450mm wide and 1.5m long held under the pipe by two men. Molten enamel is poured on the sling at each end of the pipe and some on top of pipe. The men holding this sling move it up and down and walk slowly forward whilst fresh enamel is poured on the pipe as they manipulate the sling so that an even coating is obtained all around. This work shall not be any formation of 'Whiskers' and holes in the coating must be made good.

The glass fibre mat warping may be applied with hand with the approval of the Engineer-in-charge.

4.5 APPLICATION OF SECOND (OUTER) LAYER OF COAL TAR ENAMEL COATING & GLASS FIBRE WRAPPING

Immediately after application of the 2nd layer of coal tar enamel, outer wrap Of coal tar impregnated glass fibre shall be applied in a tight uniform spiral and shall be spirally wound round the pipe with a minimum of 15mm overlap on each spiral.

The thickness of final coat of enamel shall be so adjusted that total finished thickness of double coating & wrapping in dividing outer warp is maintained minimum 4.0 mm. The coating and wrapping must be free of pin holes, bubbles on holidays. The engineer- in- charge shall cut samples from the coating from time to time to determine the thickness and bond of coating.

4.6 PRIMER, COATING AND WRAPPING APPLICATION FOR FIELD JOINTS OF PIPES AFTER LAYING AT SITE.



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- 4.7 Primer shall be applied with brushes after cleaning the pipe thoroughly (joints portion etc.) as per specification.

Originally offered to comply with these specifications will be borne by the contractor.

In addition to above, the contractor shall submit manufacture's certificates, in original for each batch of materials used on the job.

The contractor shall furnish the inspector reasonable facilities and space without charge for the inspection, testing and obtaining of such information as he desire regarding the characteristics of materials used and the manner in which the work is progressing.

The Field Bond Test Procedure as per AWWA C 203-86 sectionn 2.8.11 or BS 4164 Appendix L shall be applied to each pipe initially till the Engineer-in-charge relaxes it later to a random of one in ten pipes.

The pipe shall be thoroughly inspected for any holiday, pinholes, torn, abraded or mutilated spots.

The contractor shall furnish and operate at his own cost, a high voltage electronic holiday detector of type acceptable to Engineer – in – charge. The detector will have to be calibrated by the contractor at his own cost before use and the calibration shall be witnessed and approved by the Engineer-in-charge.

4.7 TESTING AND REPAIRS

- 4.8.1 All the finished insulation shall meet with the requirements spark tests to be applied with Holiday detector. All pinholes, voids, holidays, air bubbles, cracks and outer breaks, shall be carefully marked. Repairs may be made immediately following the coating and wrapping operation or may be deferred but in any case shall be repaired and re-inspected prior to installation. Repairs to coal tar enamel coating shall be made by removing the damaged coating back to the pipe surface, hot coal tar enamel shall then be pored over this area and a piece of outer wrap of similar size shall then be embedded and bonded to the enamel. All coating repairs shall be made with the wrap smoothly applied and without wrinkles or buckles. Repairs must successfully pass a test by the electronic holiday detector.

- 4.8.2 The thickness of coating and wrapping shall be checked with suitable instrument by the contractor at his own cost. If the thickness is found insufficient, the contractor shall have to modify the same to the satisfaction of the Engineer-in-charge without any extra cost.

4.9 HANDLING AND SUPPORTING COATED PIPES

- 4.9.1 Contractor shall develop the method of stock piling and loading out coated pipes

 HYDERABAD	STANDARD TECHNICAL SPECIFICATION FOR COATING AND WRAPPING OF UNDERGROUND PIPES	PEDC/STD.SPEC/38 REV 00 Page 10 of 11
	and shall receive approval from Engineer-in-charge prior to handling of coated pipes. 4.9.2 The coated pipes shall be carefully handled so as not to damage them in any way. No wire ropes or chains shall be used to lift the coated pipe. Canvas or rubber belts of minimum 300mm width and sufficient strength shall be used. The use of tongs, bane pinch bars, chain slings, protruding rivets, pipe hooks without proper Padding or any other handling equipment that may injure the coating shall not be permitted. 4.9.3 If the pipes are coated in a shop, one pipe should not be placed above another during transit in the wagon or truck. The pipe shall be carried on suitable padded skis mounted on the wagon or a truck to ensure that the coating will not be damaged in any way. 4.9.4 Pipes shall be stored in the field under covered protection during rains. Pipe shall be kept on clean square cut padded wooden skids protected with fibre glass mat felt or straw until ready to be lowered in the trench. 4.9.5 The contractor handling and transporting the pipe shall conform to standards as set out in AWWA C 203 – 86 section 4.1 ‘Transporting and Handling Enamelled Pipe’. 4.10 ADJACENT PIPE – LINES, STRUCTURES ETC. If any damage is caused to the coating and wrapping of adjacent pipe or any other existing structure during excavation of subsequent work or during coating and wrapping if field joints the contractor shall carry out necessary repairs at his own cost in a manner as directed by the Engineer-in-charge, 5.0 REPAIR OF PIPE Any damage to the pipe, such as dent, gouges, flatter damage caused by contractor to bevels shall be cut out, the pipes bevelled and if necessary, rewelded with prior approval of Engineer-in –charge. All such rewelding shall conform to the applicable provisions of codes. The cost of work, plus the cost of pipe lost due to repair will be to the account of contractor. 6.0 RATE 6.1 Rate shall be for coating wrapping laying, testing and commissioning of the pipeline and shall be inclusive of cost of all materials, labour, equipments etc., reqd for the work including cost of pipes (pipe will be issued by BHEL at issue rate specified elsewhere), primer, coater enamel, impregnated glass fibre, white wash, jointing the pipes, testing and commissioning. 6.2 Rate shall be inclusive of all tests to be carried out on raw materials and also for	



HYDERABAD

STANDARD TECHNICAL
SPECIFICATION FOR COATING AND
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finished pipeline.

6.3 Excavation of trenches and backfilling for laying of pipes will be paid for separately.

7.0 **MEASUREMENT**

7.1 The work will be paid for in Meters of finished pipeline.

7.2 Excavation of soil and backfilling will be measured in Cubic M.

STANDARD CIVIL DRGS. AVAILABLE IN PED.

S.NO	DRAWING	TITLE	NO. OF SHEETS	COM FILE NAME.
1	3-38144-00009	SEPTIC TANK (25 USERS)	01	301
2	3-38144-00001	TYP. DETAILS OF BOUNDARY WALL	01	303
3	3-38144-00003	SOAK PIT DETAILS	01	304
4	3-38144-00004	DETAILS OF ANCHOR BOLTS	01	
5	4-38144-00003	STANDARD GRATING DETAILS	10	
6	4-38144-00005	MS HANDRAIL DETAIL	07	409S2
7	4-38144-00009	REINF. DET. AT CIRCULAR CUT OUT IN SLAB	02	
8	4-38144-00010	CRANERAIL FIXING DETAILS	02	411S13
9	4-38144-00011	METAL INSERT PLATES	13	
10	4-38144-00021	GEN.NOTES ON CONCRETE WORKS	03	
11	4-38144-00014	GEN.NOTES ON STRUCTURAL STEEL WORKS	04	415
12	4-38144-00015	COLUMN EXPANSION JOINT DETAILS	01	
13	4-38144-00022	PRE-CAST ROOFING PANELS	02	435S8
14	4-38144-00035	REIN. WALL FOUNDATION FOR STORAGE TANKS	08	436
15	4-38144-00036	STANDARD LUGS	01	437
16	4-38144-00037	GRATING DETAIL FOR CATCH BASIN	01	438
17	4-38144-00038	FOOT PATHS	01	439
18	4-38144-00039	PEDESTAL FOR STAIRS & LADDERS	01	440S6
19	4-38144-00040	WELDING SYMBOLS	06	441S5
20	4-38144-00041	STD. LAPS & HOOKS FOR REINFORCEMENT	05	442S2
21	4-38144-00042	RCC PAVEMENT DETAILS	02	443
22	4-38144-00043	DETAILS OF M.S. RUGS	01	446S17
23	4-38144-00046	CABLE TRENCH	17	
24	4-38144-00047	TYPICAL ROAD DRAIN DETAIL	01	
25	4-38144-00048	TYPICAL MANHOLES	01	
26	4-38144-00049	TYPICAL DETAILS OF COLUMN ENCASING	01	
27	4-38144-00012	DETAIL OF HALF ROUND DRAINS	01	
28	4-38144-00053	DRAIN FUNNEL DETAIL FOR O.W.S	01	
29	4-38144-00054	BRANCH PIPE TO HEADER CONNECTION DETAILS FOR O.W	01	
30	4-38144-00055	DRAIN FUNNEL DETAIL FOR O.W.S	01	
31	4-38144-00056	BRANCH PIPE TO DETAIL FOR O.W.S	01	
32	3-38144-00015	BARED WIRE FENCING	01	
33	2-38144-00007	RCC DETAIL OF LINTELS		

Abstract

CONCLUSIONS

100% (95% CI 94.5-100%) and 100% (95% CI 94.5-100%) respectively.

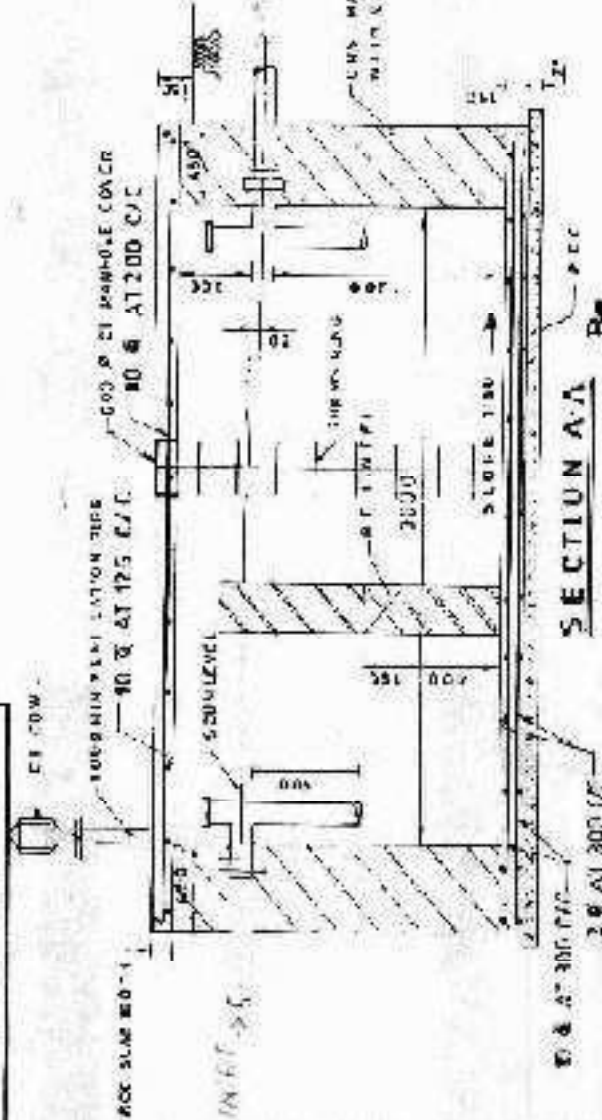
[illegible]

Technical drawing of a rectangular plate with a central rectangular hole. The drawing includes dimensions: overall width 1000, overall height 1000, hole width 600, hole height 400, and hole offset 100. The hole is labeled "H12 (TOP)".

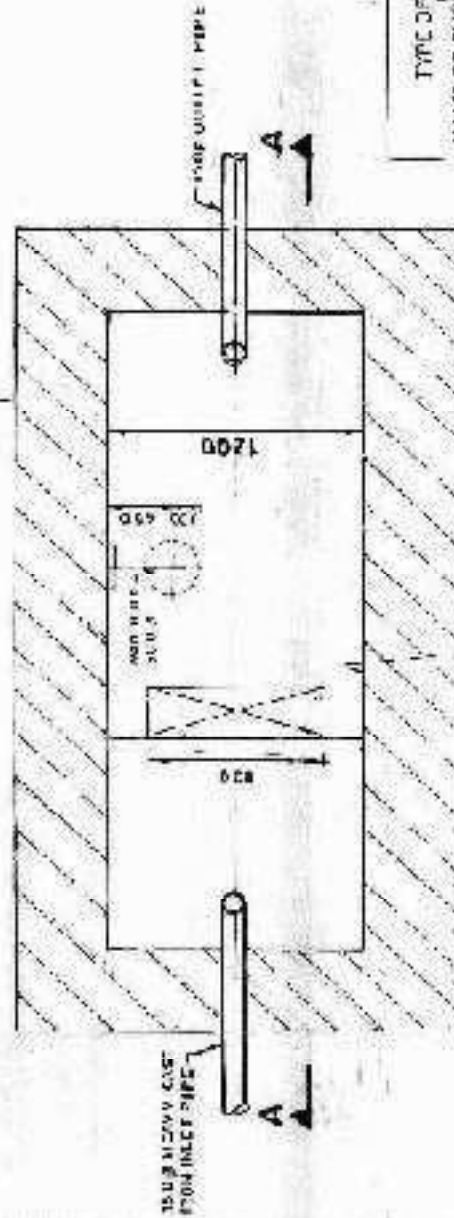
THE AUTHOR — stluc@protonmail.ch

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088 2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 2101 2102 2103 2104 2105 2106 2107 2108 2109 2110 2111 2112 2113 2114 2115 2116 2117 2118 2119 2120 2121 2122 2123 2124 2125 2126 2127 2128 2129 2130 2131 2132 2133 2134 2135 2136 2137 2138 2139 2140 2141 2142 2143 2144 2145 2146 2147 2148 2149 2150 2151 2152 2153 2154 2155 2156 2157 2158 2159 2160 2161 2162 2163 2164 2165 2166 2167 2168 2169 2170 2171 2172 2173 2174 2175 2176 2177 2178 2179 2180 2181 2182 2183 2184 2185 2186 2187 2188 2189 2190 2191 2192 2193 2194 2195 2196 2197 2198 2199 2200 2201 2202 2203 2204 2205 2206 2207 2208 2209 2210 2211 2212 2213 2214 2215 2216 2217 2218 2219 2220 2221 2222 2223 2224 2225 2226 2227 2228 2229 2230 2231 2232 2233 2234 2235 2236 2237 2238 2239 2240 2241 2242 2243 2244 2245 2246 2247 2248 2249 2250 2251 2252 2253 2254 2255 2256 2257 2258 2259 2260 2261 2262 2263 2264 2265 2266 2267 2268 2269 2270 2271 2272 2273 2274 2275 2276 2277 2278 2279 2280 2281 2282 2283 2284 2285 2286 2287 2288 2289 2290 2291 2292 2293 2294 2295 2296 2297 2298 2299 2300 2301 2302 2303 2304 2305 2306 2307 2308 2309 2310 2311 2312 2313 2314 2315 2316 2317 2318 2319 2320 2321 2322 2323 2324 2325 2326 2327 2328 2329 2330 2331 2332 2333 2334 2335 2336 2337 2338 2339 2340 2341 2342 2343 2344 2345 2346 2347 2348 2349 2350 2351 2352 2353 2354 2355 2356 2357 2358 2359 2360 2361 2362 2363 2364 2365 2366 2367 2368 2369 2370 2371 2372 2373 2374 2375 2376 2377 2378 2379 2380 2381 2382 2383 2384 2385 2386 2387 2388 2389 2390 2391 2392 2393 2394 2395 2396 2397 2398 2399 2400 2401 2402 2403 2404 2405 2406 2407 2408 2409 2410 2411 2412 2413 2414 2415 2416 2417 2418 2419 2420 2421 2422 2423 2424 2425 2426 2427 2428 2429 2430 2431 2432 2433 2434 2435 2436 2437 2438 2439 2440 2441 2442 2443 2444 2445 2446 2447 2448 2449 2450 2451 2452 24	

DATA NO 3-38144-000009



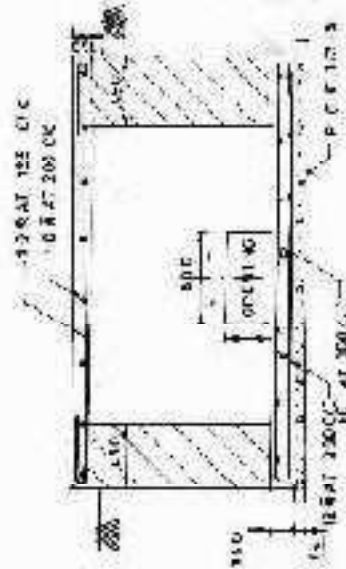
SECTION A-A



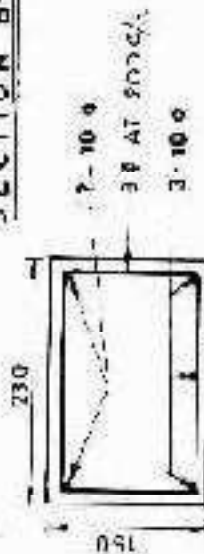
PLAN

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12-14 PLASTER 302
WITH 3/8" REINFORCING
BARS AND 1" COARSE
AGGREGATE - FINISH
WITH GROUT - FINISH



8-B COLLECTION



LINTEN BEAM DETAIL

NOTES

ALL DIMENSIONS ARE IN MM UOS.

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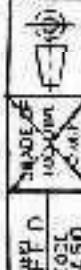
TYPE OF PRODUCT	NAME OF CUSTOMER	PRO. FCT.
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364	365	366

STANDARD



EL ARAT HEAVY ELECTRICALS LTD.

HYDERABAD



5.7.26	(9)

REF. TO 435-743

100	100

TITLE	DATE
...	...

SEPTIC TANK (25 USERS)

10

ON SALE



CALL DIMENSIONS ARE IN MM

FIRST ANGLE PROJECTION

3-38144-00003
IN DWG

1:2:4 R.C.C. SLAB (150TH)
BRICK EDGING 75MM WIDE
& 150MM DEEP

EARTH LAYER (150TH)

G.L.

SWORAN

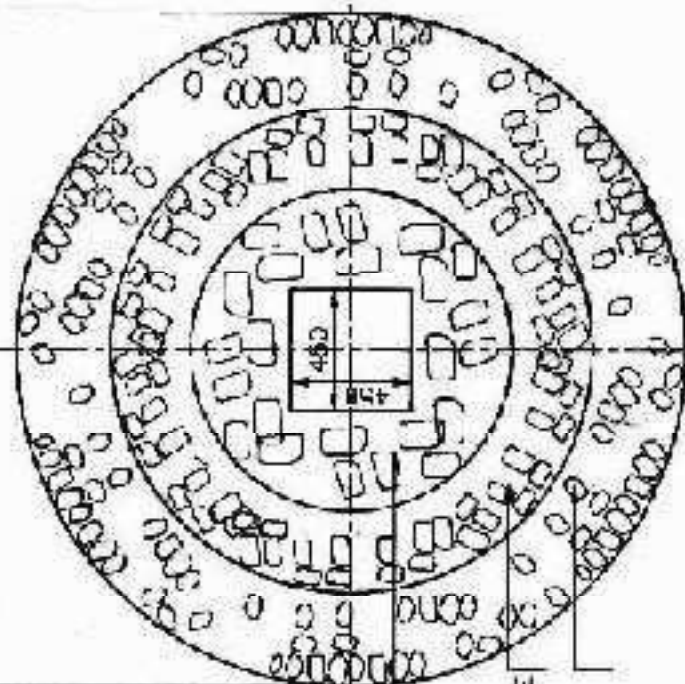
BITUMEN
COMB SHAF- 45CX450

BRICK BATS

THICK BALLAST 50
TC 80MM NORMAL SIZE

BRICK BALLAST 40MM
NORMAL SIZE

2500 DIA



PLAN

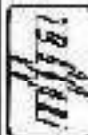
2500

SECTION A-A

STANDARD

TYPE OF PRODUCT

NAME OF CUSTOMER/PROJECT



BHARRAT HEAVY ELECTRICALS LTD.
HYDERABAD

DATE

BY

CHECKED

DATE

BY

CHECKED

DATE

BY

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DATE

BY

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DATE

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TITLE

SOAK PIT DETAILS

DATE

BY

CHECKED

DATE

BY

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DRAWING NO.
3-38144-00003

REV.

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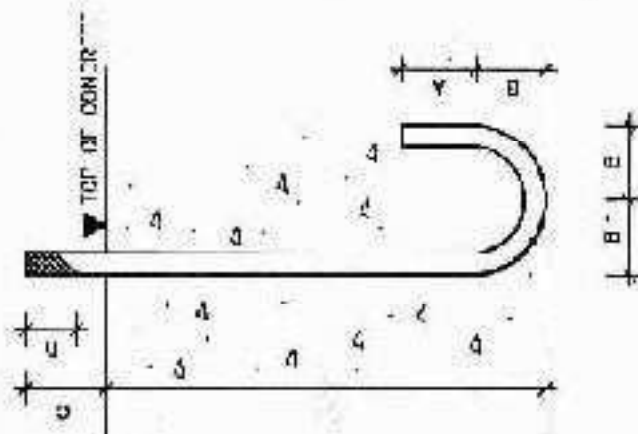
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DATE

DRG, NLI
3-38144-00004



BOLT DIA. mm	DIMENSIONS (mm)			
	A	B	C	E
12	46	46		200
16	64	64		260
20	80	80		320
22	88	88		350
24	100	100		400
28	112	140		470
32	128	160		530
36	144	180		600
40	160	240		700
45	180	270		800
50	200	300		900

NOTES :-

1. $D = 4d$ WHERE d IS THE BOLT DIA
2. $d = D - T + C$ WHERE T IS BASE PLATE THICKNESS AND C IS GROUT THICKNESS
3. THE BOLT DIMENSIONS ARE VALUE FOR M22 & ABOVE SIZES OF CONCRETE ONLY
4. BOLT TO BE Bent AND T-BEAD FROM MS ROUND BAR CONFORMING TO S.432.

[illegible]

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CIVIL ENGINEERING

NO

DATE

REVISIONS

DRN

CHD

APPD

0

05/02/83

ISSUED AS STANDARD

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[Signature]

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CONTENTS

SHEET NO

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2 & 3

2. LOADING TABLE

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3. GRATING LAYOUT : ELECTROFORGED

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4. GRATING LAYOUT : HAND WELDED

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5. SERRATED LOAD BEARING BAR DETAIL

7

6. FIXING DETAIL

8

7. TYPICAL DETAIL AT OPENINGS

9

8. STEP TREAD

10

SHEET 1 OF 10



PROJECT ENGINEERING
BHEL HYDERABAD

STANDARD GRATING
DETAIL

DRAWING NO

4-38144-00003

REV

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	0	05/02/93	ISSUED AS STANDARD	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>

NOTES

1. THIS STANDARD GIVES THE LOAD CARRYING CAPACITY AND FABRICATION DETAILS OF ELECTROFORGED AND HAND WELDED MILD STEEL FLOOR GRATINGS INCLUDING STEP TREADS.
2. ALL DIMENSIONS ARE IN MM.
3. THE TYPE OF GRATING TO BE USED SHALL BE CALLED OUT ON THE DESIGN DRAWING. MATERIAL FOR THE GRATING SHALL CONFORM TO THE FOLLOWING STANDARDS :
FLATS - IS : 226, ROUNDS - IS : 432 (GR-1)
4. ROLLED FLATS ARE PREFERRED FOR THE MANUFACTURE OF FLOOR GRATINGS. IF SHEARED PLATES ARE USED SHARP EDGES SHOULD BE ROUNDED OFF AND SHALL BE FREE FROM BURRS. COMMERCIAL QUALITY MATERIAL WILL BE ALLOWED ONLY AFTER ASCERTAINING WELDABILITY.
5. TOLERANCE :-
 - (a) PITCH OF MAIN MEMBERS — ± 1 mm
 - (b) SQUARENESS OF THE PANEL CHECKED BY DIFFERENCE IN DIAGONALS — ± 5 mm
 - (c) PERMISSIBLE LONGITUDINAL/TRANSVERSE UNILATERAL DEVIATION FROM STRAIGHTNESS (BOW) — 3 mm / METRE
 - (d) ROLLED FLAT DIMENSIONS - AS PER IS 1852
6. THE STANDARD PANEL OVERALL WIDTH AS SHOWN IN SHTS 5 AND 6 IS 1005. IT MAY BE INCREASED OR DECREASED AS REQUIRED TO SUIT THE GEOMETRY OF THE PLATFORM AND CONVENIENCE OF HANDLING.
7. IN CASE OF PANELS WITH CUT OUTS, ADEQUATE WORKING LOAD CAPACITY SHALL BE ENSURED BY PROVISION OF

SHT 2 OF 10



PROJECT ENGINEERING
BHEL HYDERABAD

STANDARD GRATING
DETAIL

DRAWING NO
4-38144-00003

REV
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CIVIL ENGINEERING

NO	DATE	REVISIONS	DRN	CHD	APPD
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- ADDITIONAL SUPPORTING MEMBERS WHEREVER REQUIRED.
8. FABRICATION OF THE FLOOR GRATINGS ARE TO BE DONE BY ELECTROFORGING METHOD UNLESS STATED OTHERWISE ELSEWHERE IN DESIGN DRAWINGS, TENDER DOCUMENT, ETC.
9. FINISH SHALL BE ONE OF THE FOLLOWING, TO BE SPECIFIED SEPARATELY :-

(a) RED OXIDE PRIMER - FOR NORMAL CONDITIONS

(b) GALVANISED - FOR CORROSIVE AND DAMP SITUATIONS

GALVANISING SHALL BE AS PER IS:2629 WHICH GUARANTEES A MINIMUM COATING OF ZINC OF 86 MICRONS. FURTHER, THE SPELTER USED IN THE HOT DIP PROCESS SHOULD NOT CONTAIN LESS THAN 98% PURE ZINC. GALVANISING SHOULD ALSO CONFORM TO

ASTM: 123 GIVING A COATING OF 610 gms/Sq mtr OF ZINC. GALVANISING SHALL BE DONE AFTER ALL WELDING WORKS ARE COMPLETED. ALL EXPOSED AREAS WHERE SITE WELDING IS EMPLOYED SHALL RECEIVE TWO COATS OF ALUMINUM PAINT OVER A PRIMER COAT/COLD GALVANISING PASTE PAINTED.

SHT 3 OF 10



PROJECT ENGINEERING
BHEL HYDERABAD

STANDARD GRATING
DETAIL

DRAWING NO
4-38144-00003

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CIVIL ENGINEERING

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LOAD TABLE FOR STEEL GRATING

40mm CENTRE OF LOAD BEARING BARS (ELECTROFOR6EO)

BEARING BAR SIZE IN mm		S P A N							
		300	450	600	750	900	1050	1200	1350
25 X 3 (TYPE 1)	U	11000	4880	2740	2760	1230	900	680	
	D	0.6	1.4	2.6	3.9	5.9	7.9	10.0	
	C	1660	1100	820	660	550	470	410	
	D	0.5	1.1	2.0	3.1	4.3	6.1	8.0	
25 X 5 (TYPE 2)	U	18300	8100	4560	2920	2020	1490	1150	850
	D	0.6	1.4	2.6	3.9	5.6	7.5	10.0	12.7
	C	2740	1820	1370	1100	910	780	690	570
	D	0.5	1.1	2.0	3.1	4.3	6.1	8.0	10.5

UNIT STRESS 1650 Kg/sq m.

U - UNIFORMLY DISTRIBUTED LOAD IN Kg/sq m.

C - CONCENTRATED LOAD IN Kg/METRE WIDTH AT MID SPAN

D - DEFLECTION IN MILLIMETERS

SPANS TO LEFT OF HEAVY LINE PRODUCE A DEFLECTION OF 6mm OR LESS UNDER A UNIFORM LOAD OF 500 Kg/sq m.

THIS DEFLECTION IS RECOMMENDED AS PER IS : 4532 - 1970.

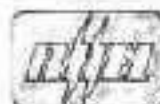
NOTE :

AVERAGE WEIGHT OF GRATINGS BASED ON SIZE 900_{LENGTH} X 1005_{WIDTH} ARE AS FOLLOWS :

TYPE 1 : 22.76 Kg/sq m

TYPE 2 : 34.32 Kg/sq m

SHT 4 OF 10



PROJECT ENGINEERING
BHEL HYDERABAD

STANDARD GRATING
DETAIL

DRAWING NO	REV
4-38144-00003	0

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DATE

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05/02/93

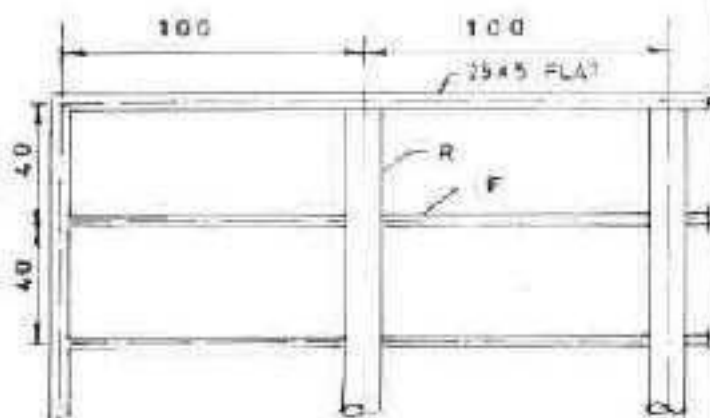
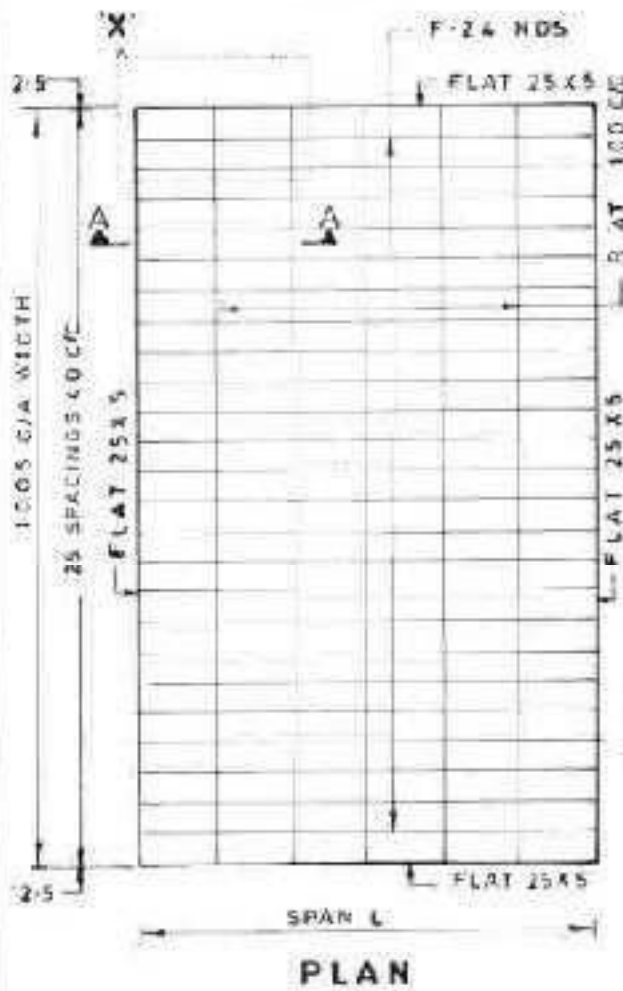
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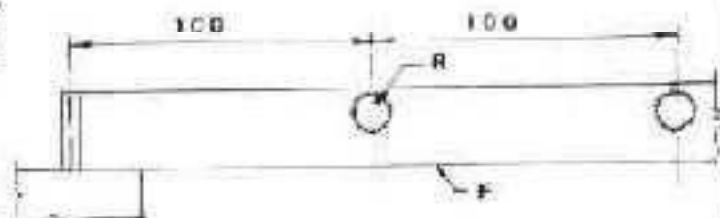
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APPD

GRATING LAYOUT (ELECTROFORGED)



DETAIL 'X'



SECTION A-A

		F	R	
TYPE 1	ORD.	25X3	10 Ø	FOR LIGHT LOADS
	ANTISKID	25X3 SERRATED	10 Ø TWISTED	FOR LIGHT LOADS
TYPE 2	ORD.	25X5	12 Ø	FOR MEDIUM LOADS
	ANTISKID	25X5 SERRATED	12 Ø TWISTED	FOR MEDIUM LOADS

SHT 5 OF 10



PROJECT ENGINEERING
BHEL HYDERABAD

STANDARD GRATING
DETAIL

DRAWING NO

4-38144-00003

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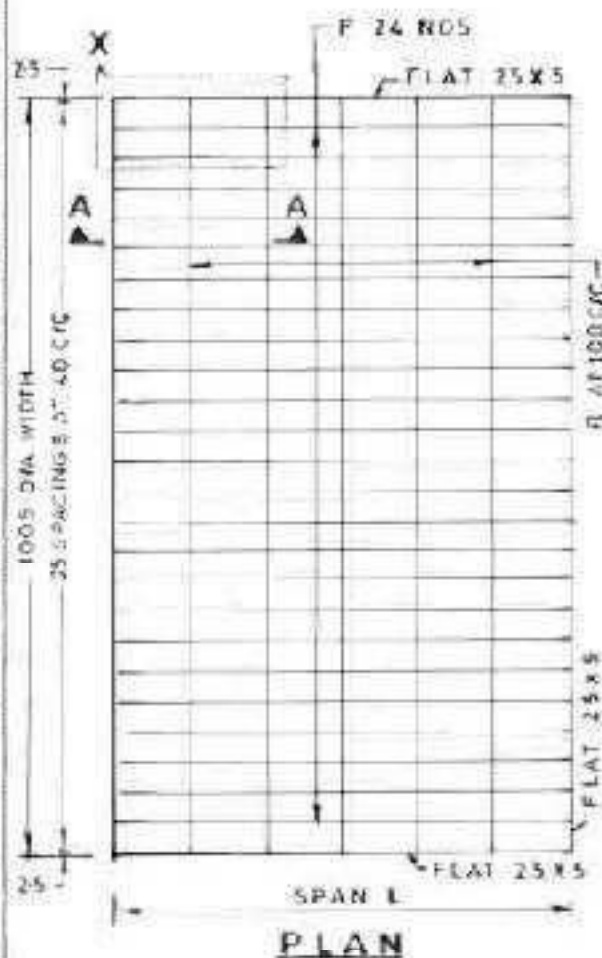
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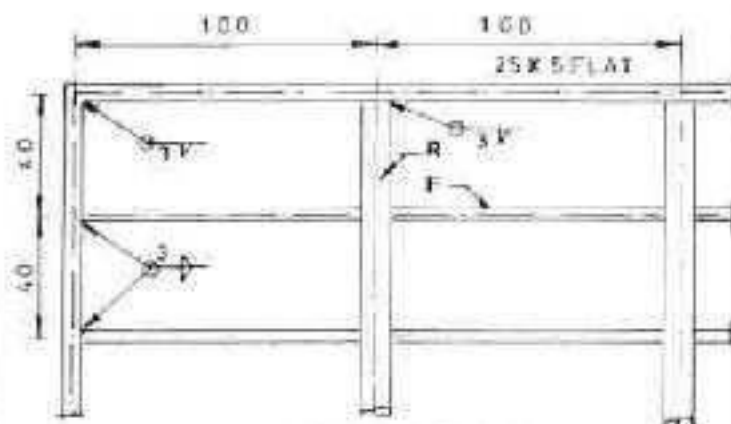
CIVIL ENGINEERING

NO	DATE	REVISIONS	DRN	CHD	APPD
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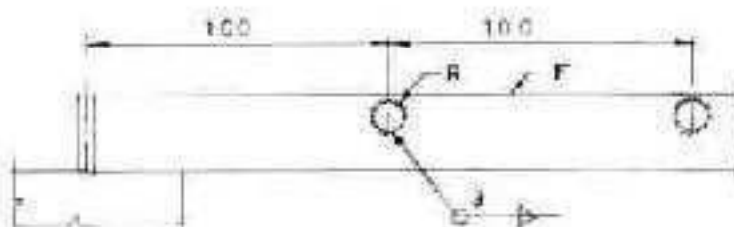
GRATING LAYOUT (HAND WELDED)



PLAN



SECTION X-X



SECTION A-A

		F	R	
TYPE 1	ORD	25X3	10 Ø	FOR LIGHT LOADS
	ANTISKID	25X3 SERRATED	10 Ø TWISTED	FOR LIGHT LOADS
TYPE 2	ORD	25X5	12 Ø	FOR MEDIUM LOADS
	ANTISKID	25X5 SERRATED	12 Ø TWISTED	FOR MEDIUM LOADS

SHT 6 OF 10



PROJECT ENGINEERING
BHEL HYDERABAD

STANDARD GRATING
DETAIL

DRAWING NO

4-38142-00003

REV

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CIVIL ENGINEERING

NO DATE

REVISIONS

DRN

CHD

APPD

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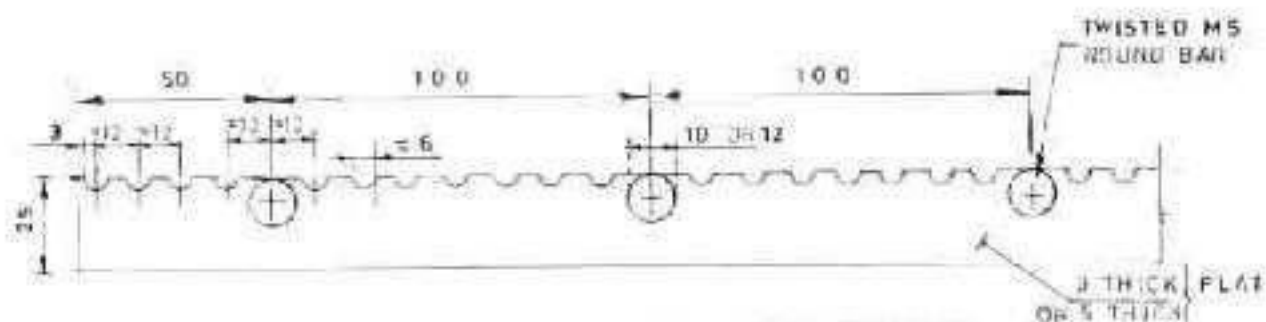
05/02/93

ISSUED AS STANDARD

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SERRATED LOAD BEARING BAR DETAIL

NOTES:-

1. THESE ARE TO BE USED FOR FABRICATION OF ANTI SKID GRATINGS.
2. FURTHER DETAILS AS PER SHIS 5 & 6

SHT 7 OF 10



PROJECT ENGINEERING
BHEL HYDERABAD

STANDARD GRATING
DETAIL

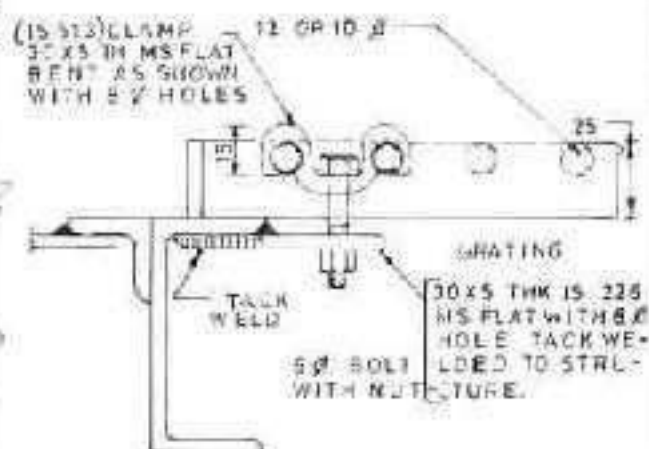
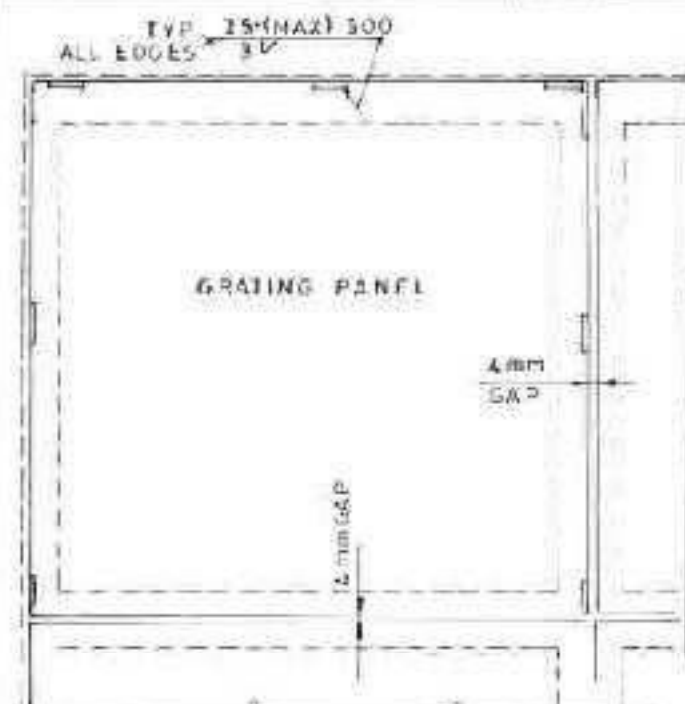
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REV

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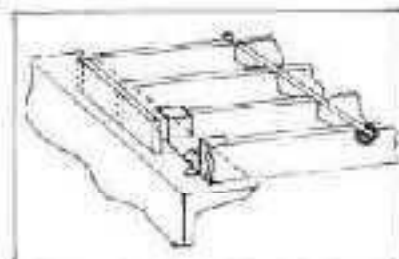
NO	DATE	REVISIONS	DRN	CHD	APPD
0	05/02/93	ISSUED AS STANDARD			



TYPICAL CLAMP DETAIL (TYPE)

GRATING TO BE CLAMPED AT EVERY 900mm
WITH ATLEAST 4 NOS OF CLAMPS PER
GRATING UNIT)

FIXED



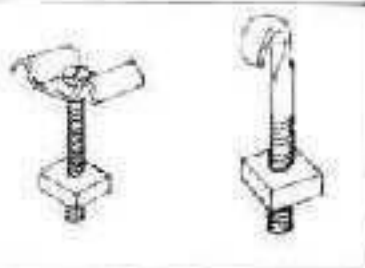
FIXING DETAIL

CLAMP TYPE 2

STUD BOLTS ARE CENTERED BETWEEN TWO MAIN BARS AND WELDED TO SUPPORTING MEMBERS. U-SHAPED CLIP ENGAGING TWO MAIN BEARING BARS IS PLACED OVER STUD BOLT AND THEN HEX NUT IS TIGHTENED.

CLAMP TYPE 3

HOLES ARE DRILLED IN THE BEAM TO SUIT 6mm SCREWS THE CLIP FITTED FROM ABOVE ON TWO ADJACENT BEARING BARS. THE SCREW IS FITTED AFTER WHICH THE NUT CAN BE SCREWED ON FROM BELOW.



CLAMP TYPE 4

HOLE IS DRILLED IN THE
BEAM SUIT 6mm SCREWS.
THE HOOK IS PASSED OVER
A BEARER AND THE NUT
TIGHTENED FROM BELOW.

NOTE:-

REMOVABLE COATING PANEL SHALL BE CLAMPED OR TACK WELDED TO SUPPORTING MEMBERS AS CALLED OUT ON DESIGN DROG. IN LATER CASE PANEL CAN BE REMOVED AFTER GAS CUTTING THE TACK WELDS.

FLYING DETAIL

SHT 8 OF 10



PROJECT ENGINEERING
BHEL HYDERABAD

STANDARD GRATING DETAIL

DRAWING NO

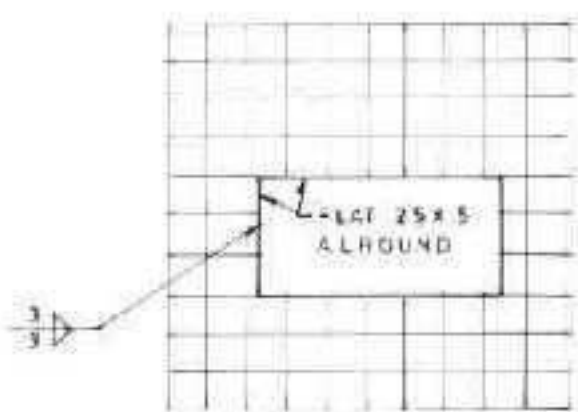
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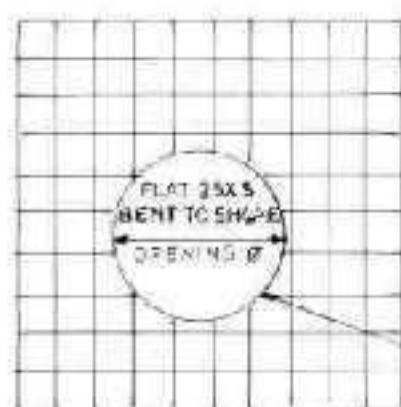
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RECTANGULAR



CIRCULAR

TYPICAL DETAIL AT OPENINGS

SHT 9 OF 10



PROJECT ENGINEERING STANDARD GRATING
BHEL HYDERABAD DETAIL

DRAWING NO	REV
4 38144 00003	0

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NO DATE

REVISIONS

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CHD

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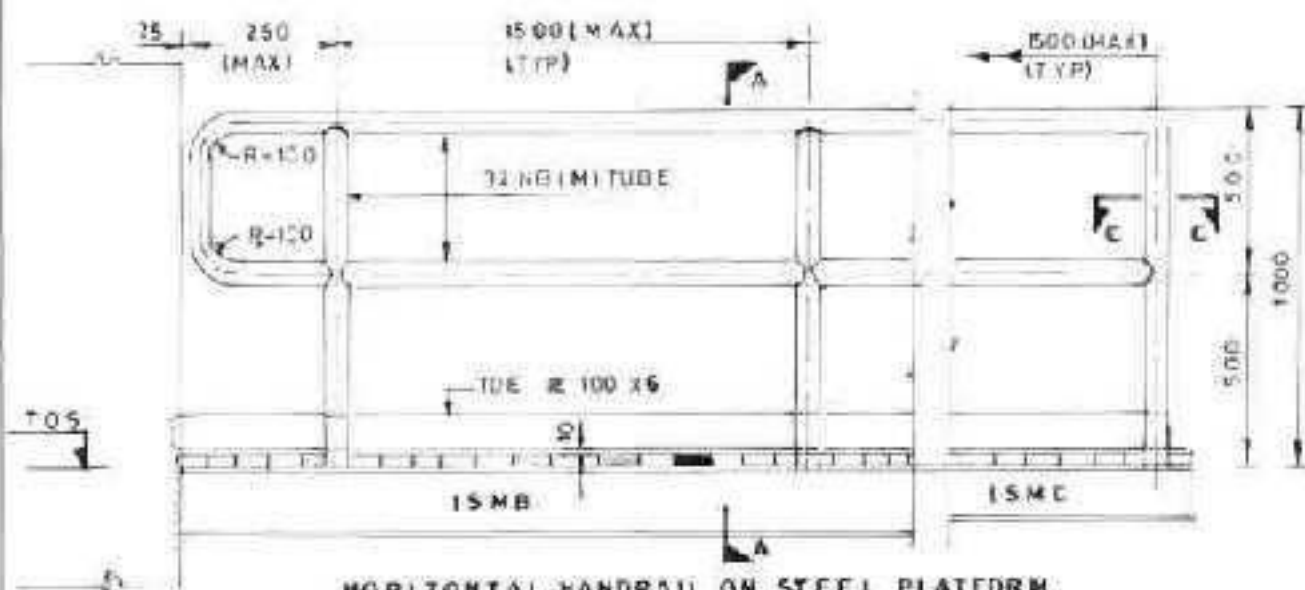
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05/02/93

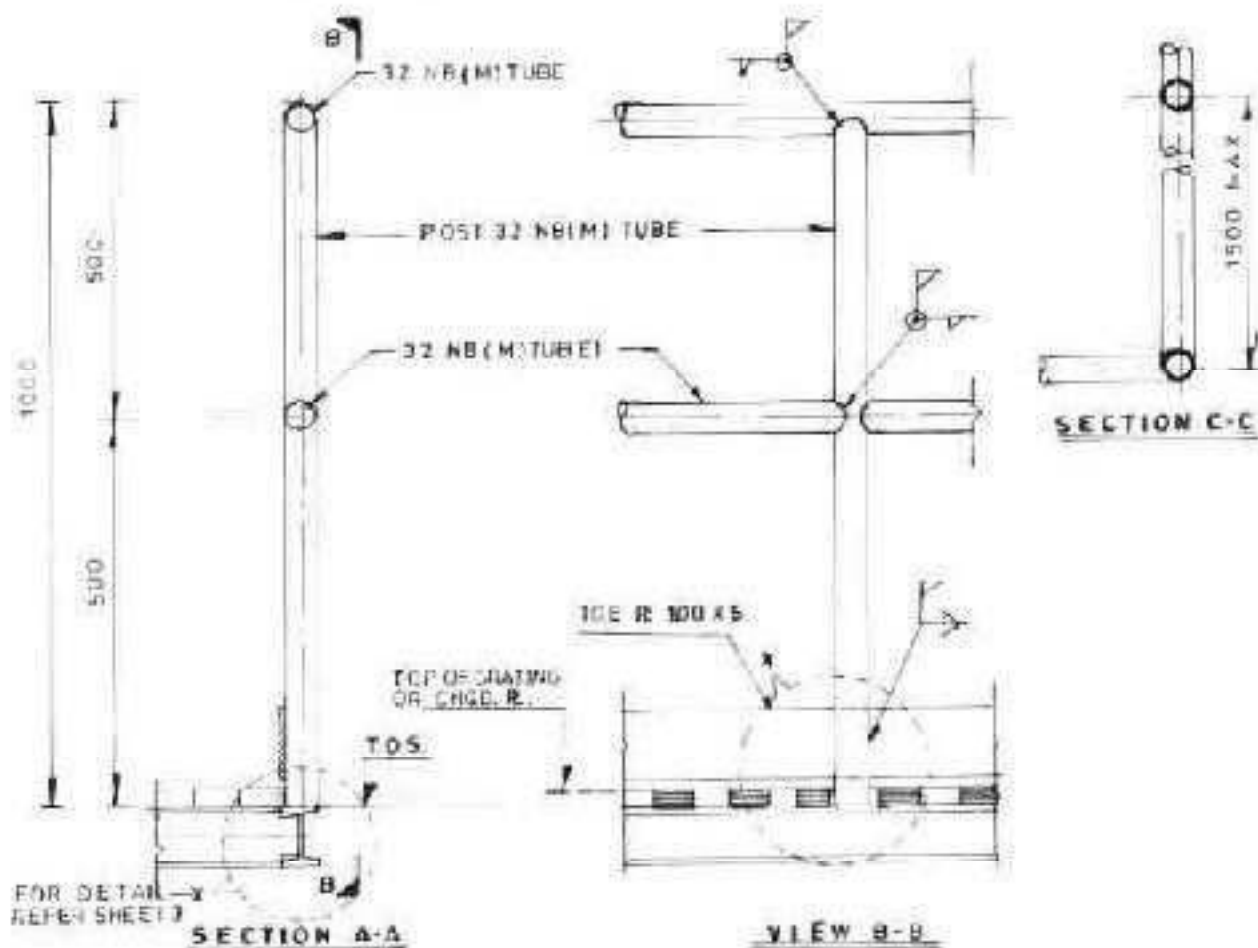
ISSUED AS STANDARD Q.E.S.

Plate

Plate



HORIZONTAL HANDRAIL ON STEEL PLATFORM



SECTION A-A

VIEW B-B

SHEET 1/7



PROJECT ENGINEERING
BHEL HYDERABAD

MS HAND RAIL DETAILS

DRAWING NO

4-38144-00005

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DATE
25/03/93

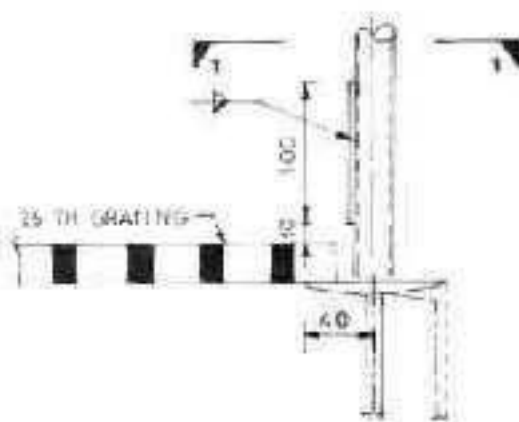
REVISIONS

ISSUED AS STANDARD

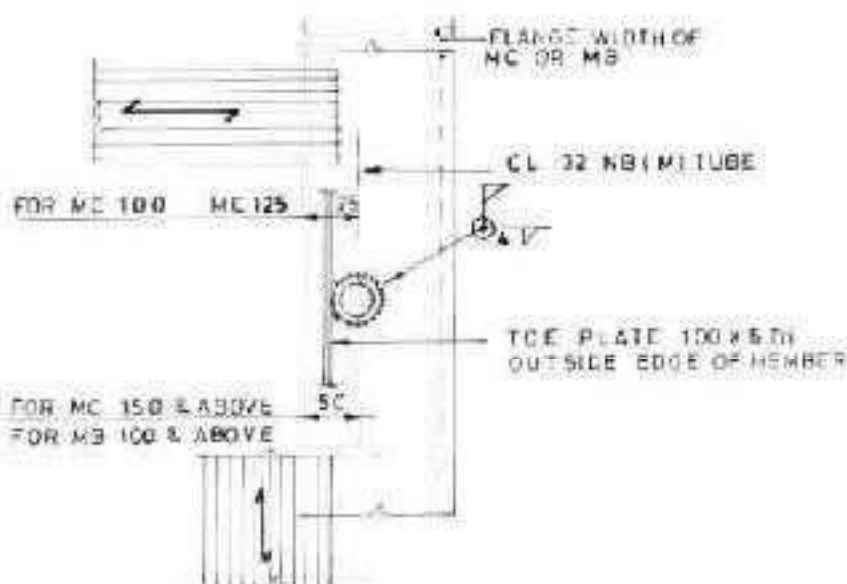
DRN
QES

CHD
P. S. S.

APPD
P. S. S.



DETAIL-X



PLAN 1-1

NOTES

1. CHB PLATES/GRATINGS SHALL BE SUITABLY NOTCHED TO ACCOMMODATE THE TUBE IN CASE OF BEAM MC-100 OR MC-125.

SHEET 3/7



PROJECT ENGINEERING
BHEL HYDERABAD

MS HAND RAIL
DETAILS

DRAWING NO

4-38144-00005

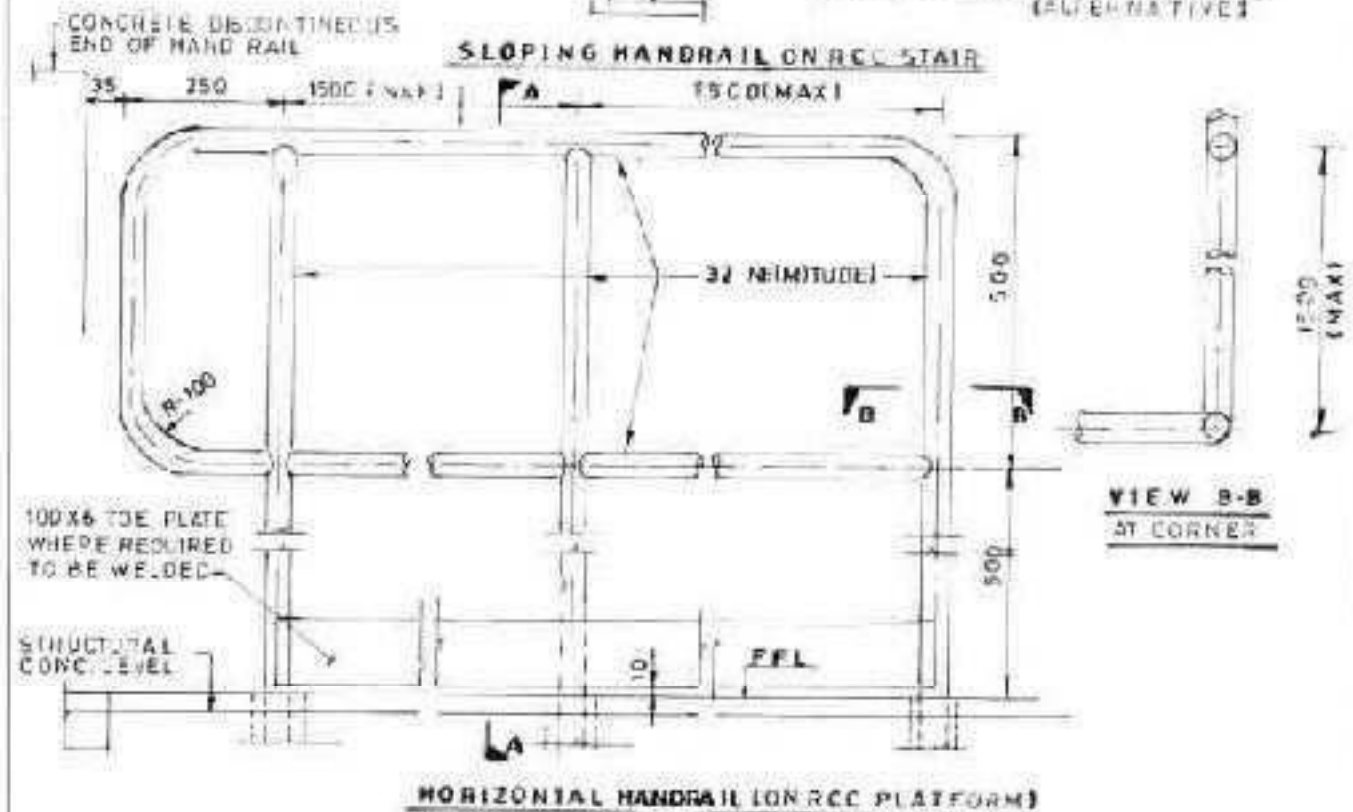
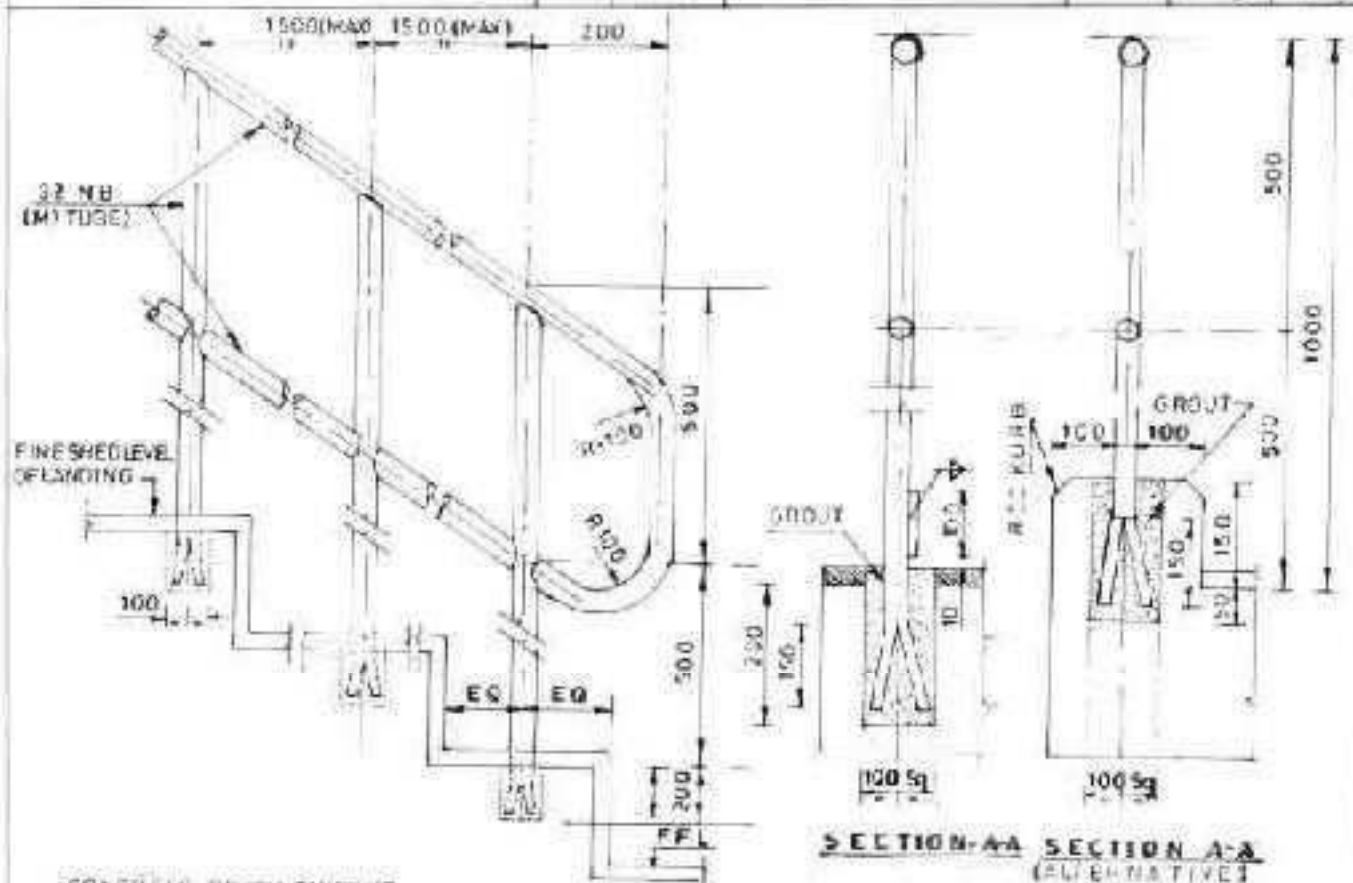
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0	06/02/93	ISSUED AS STANDARD	Q ES	Q ES	Q ES



SHEET 4/7



PROJECT ENGINEERING
BHEL HYDERABAD

MS HAND RAIL
DETAILS

DRAWING NO

4-38144-00005

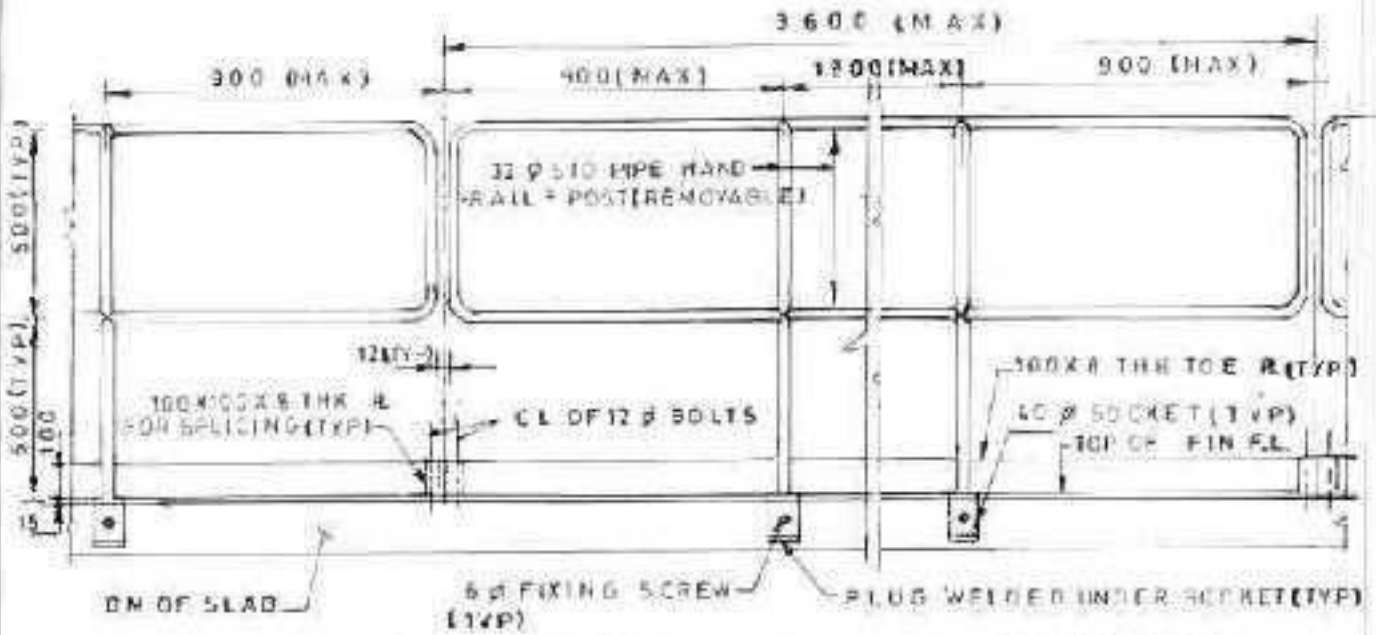
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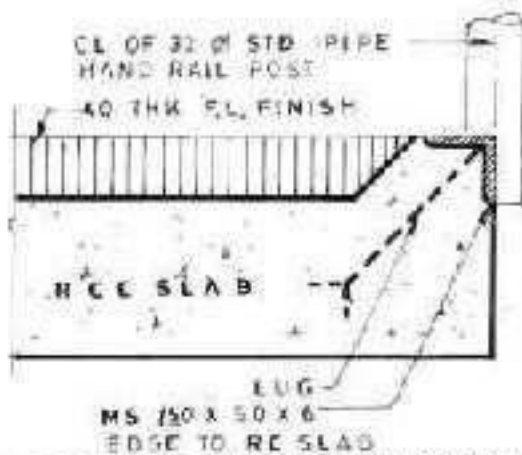
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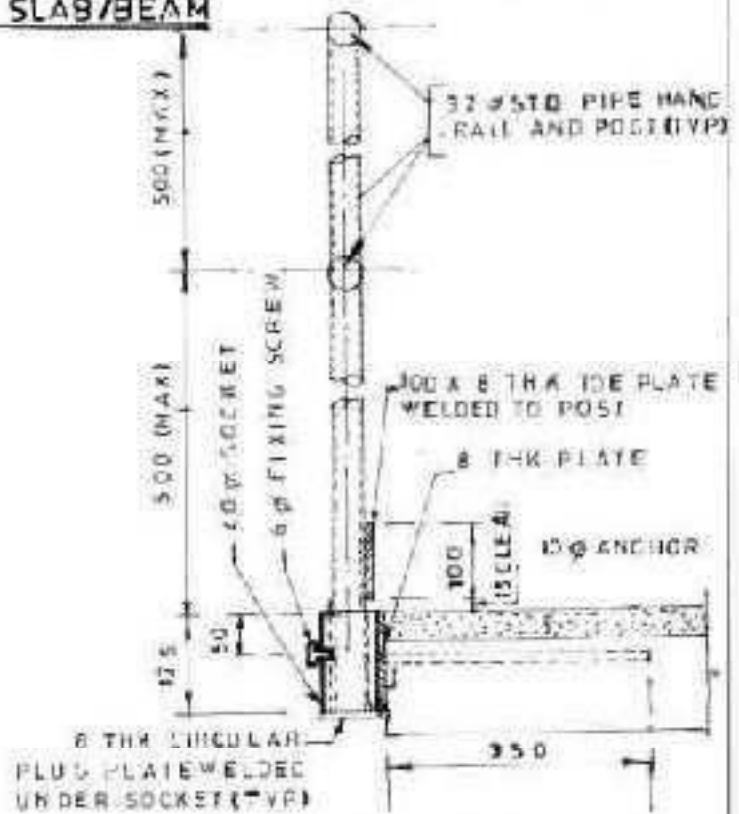
NO	DATE	REVISIONS	JRN	CHD	APFD
0	05/02/93	ISSUED AS STANDARD	<i>[Signature]</i>	<i>[Signature]</i>	<i>[Signature]</i>



ELEVATION OF HANDRAIL(REMOVABLE)
FIXED TO R C C SLAB/BAM



DETAIL OF FIXING HANDRAIL
POST TO RCC SLAB AS
ALTERNATIVE TO EMBEDMENT



**DETAIL OF FIXING HANDRAIL
TO RCC SLAB / BEAM
[REMOVABLE TYPE]**

SHEET 6 OF 7



PROJECT ENGINEERING
BHEL HYDERABAD

M.S. HANDRAILS DETAILS

DRAWING NO

REV

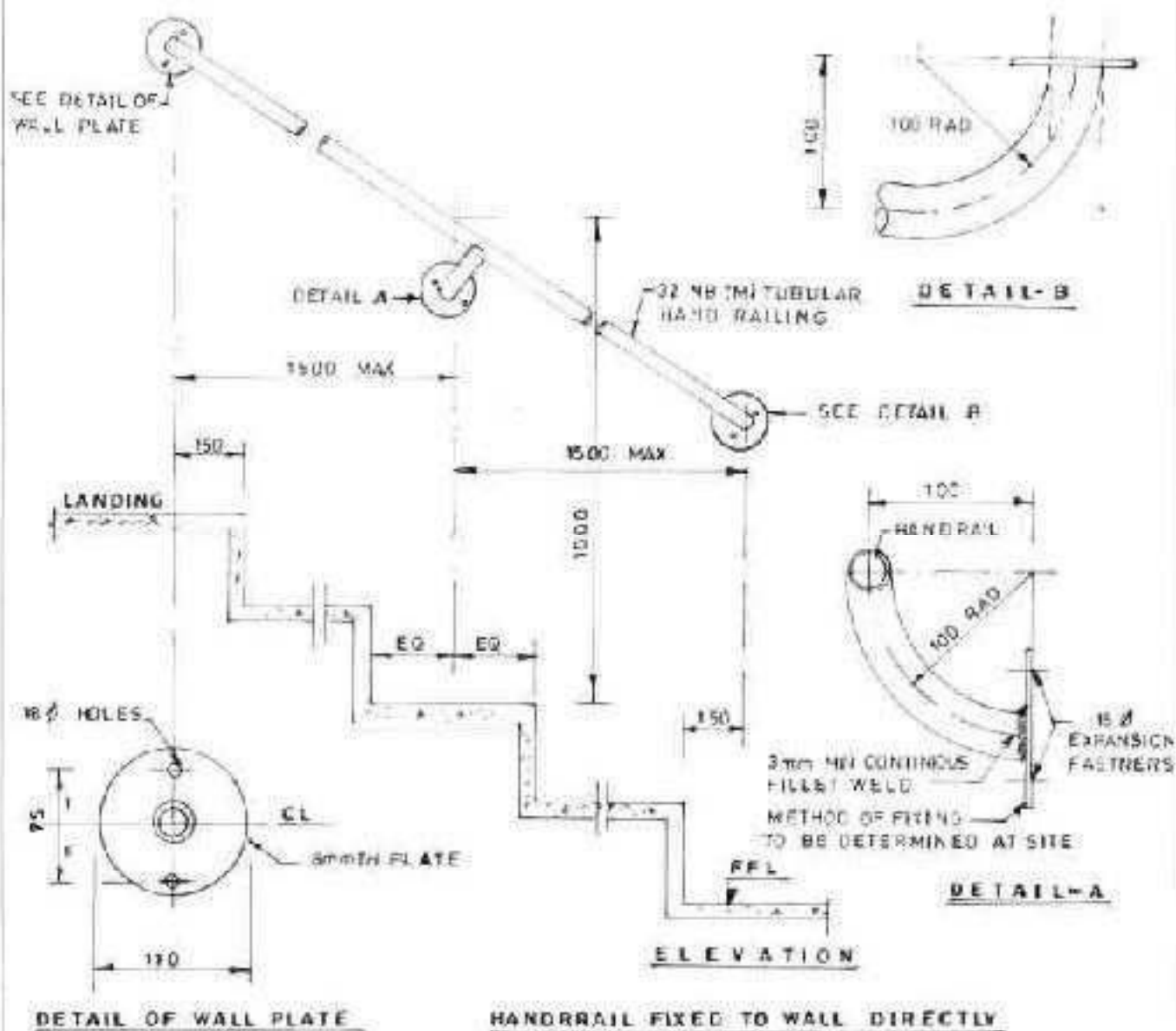
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NOTES

1. ALL HANDRAILS AND UPRIGHT SHALL BE 32 NB (M) MS TUBE FOR LIGHT AND MEDIUM DUTY AND 40 NB FOR HEAVY DUTY.
2. ALL FILLET WELDS SHALL BE 3mm MIN CONTINUOUS UNLESS NOTED OTHERWISE.
3. JOINTS IN HANDRAILS SHALL BE PROVIDED AT SUITABLE POINTS WELDED AND GROUND FLUSH OR WITH SCREWED COUPLINGS.
4. POCKETS FOR UPRIGHTS SHALL BE 100x100 DEEP TO BE GROUDED AFTER ERECTION AND ALIGNMENT.
5. BOTTOM 150 OF ALL UPRIGHTS EMBEDDED IN CONC SHALL BE CUT AND ENDS DISPLAYED OUT.
6. ALL MS TUBES AND FITTINGS SHALL CONFORM TO IS 1229.

SHEET 7/7



PROJECT ENGINEERING
BHEL HYDERABAD

MS HAND RAIL
DETAILS

DRAWING NO

438144 00005

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CIVIL ENGINEERING

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DATE

REVISION

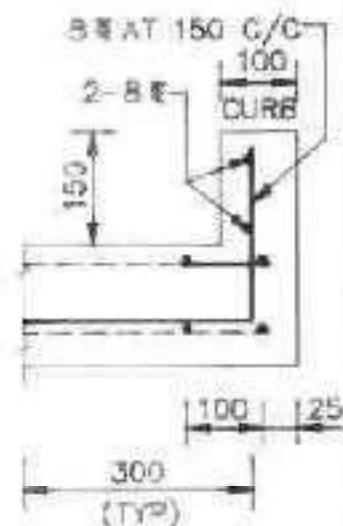
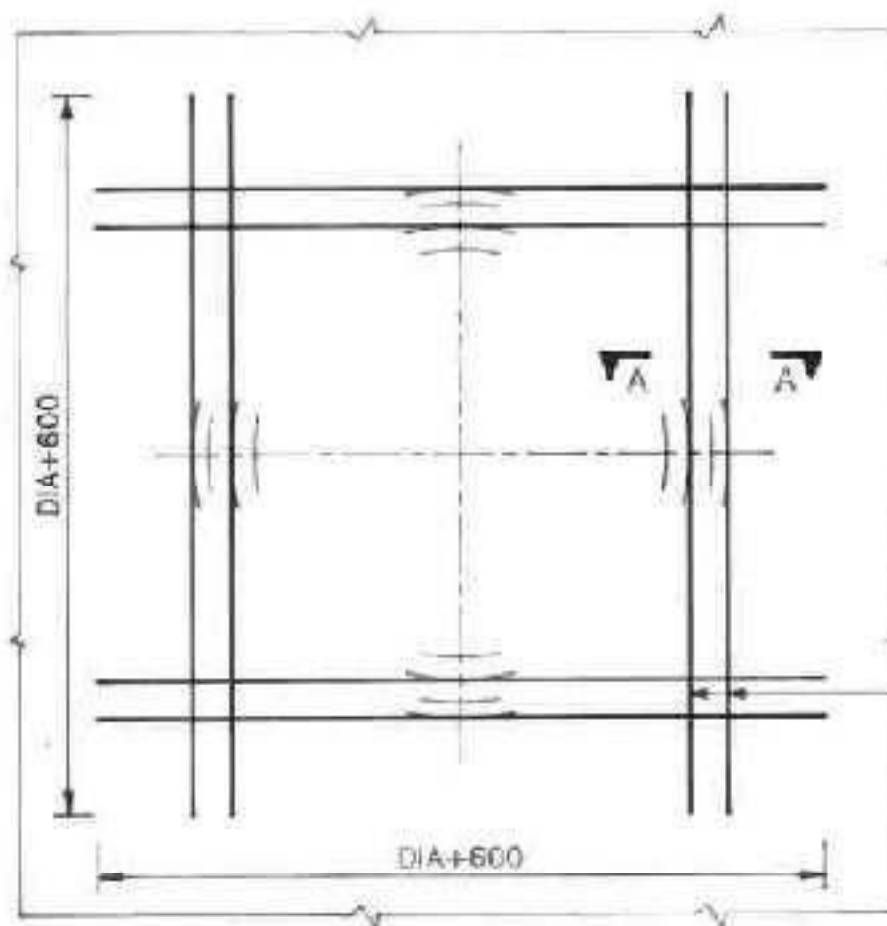
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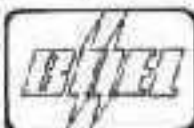
SECTION A-A

2Nos. 16 Φ BARS AT
T AND B BUT NOT LESS
THAN 50% OF STEEL CUT
AT OPENING (TYP)

NOTES :

1. ALL DIMENSIONS ARE IN MM.
2. ALL THESE BARS SHALL BE EFFECTIVELY TIED WITH THE MAIN REINFORCEMENT. BARS TO BE CUT OR SPLAYED NEAR THE OPENING AS PER THE DIRECTION OF THE ENGINEER-INCHARGE.
3. THIS DETAIL APPLIES TO SLABS UP TO 200 THICK FOR THICKER SLABS SEE DESIGN DRAWINGS.
4. OMIT CURB WHERE SPECIFICALLY STATED ON DRAWINGS.

FILE NAME 405 S9



PROJECT ENGINEERING
BHEL HYDERABAD

REINFORCEMENT
DETAILS AT CIRCULAR
CUT-OUT IN SLABS

DRAWING NO.

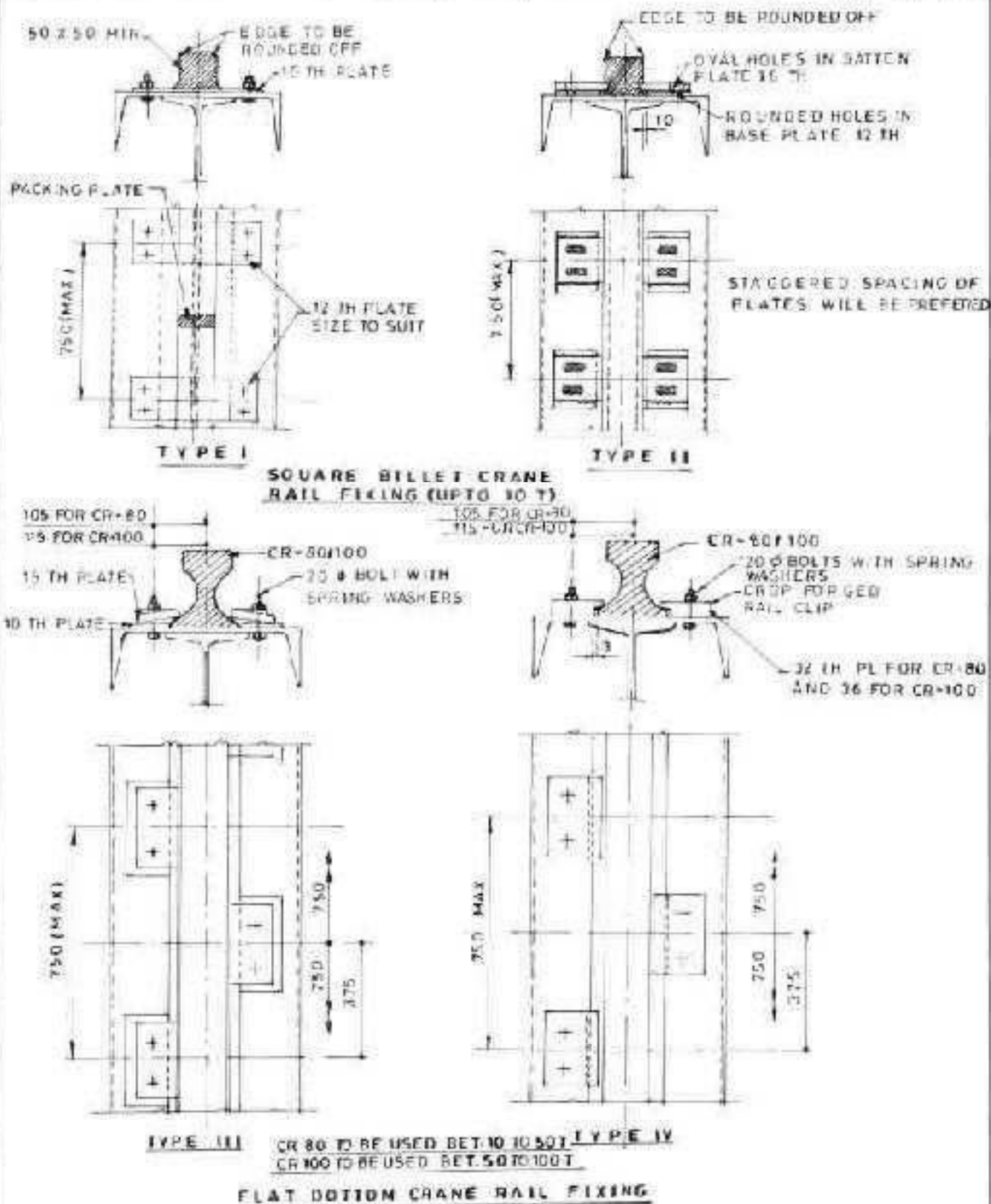
REV

4-38144-00009 00

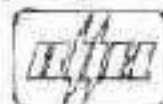
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SHEET 1 OF 2



PROJECT ENGINEERING
BHEL HYDERABAD

CRANE RAIL
FIXING DETAILS

DRAWING NO.
4-38144-00010

REV
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CIVIL ENGINEERING

NO	DATE	REVISION	DRN	CHD	APPD
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GENERAL NOTES:

1. ALL LUGS SHALL BE OF 12 Φ OR 16 Φ H.Y.D. BARS CONFORMING TO IS : 1786 AND SHALL BE CONNECTED TO METAL INSERT PLATES BY 6MM FILLET WELDS AS SHOWN IN SKETCHES.
2. METAL INSERT PLATES SHALL BE 12MM THICK OR 16MM THICK AS PER REQUIREMENT CONFORMING TO IS : 226.
3. MOMENT SHEAR AND TENSILE CAPACITIES IN TABLES ARE 3/4 OF THE VALUES CALCULATED BASED ON ALLOWABLE STRESSES AS PER IS : 458 (1978) AND IS : 800 (1962). THE EXTRA FACTOR OF SAFETY OF 1.33 IS TO ACCOUNT FOR THE NON - UNIFORM WELDING AND WORKMANSHIP AT SITE.
4. METAL INSERT PLATES SHALL BE MARKED ON DRAWING AS UNDER:-
IP-(A) @ (C)
IP = INSERT PLATE
A = TYPE OF INSERT PLATE
C = ELEVATION OF INSERT PLATE (TOP EDGE)
e.g. IP-R9a @ EL.110.300 MEANS INSERT PLATE TYPE R9a AT ELEVATION 110.300
5. METAL INSERT PLATES SHALL BE KEPT FLUSH WITH CONCRETE SURFACE
6. THE LONGER SIDE OF THE METAL INSERT PLATE SHALL BE KEPT VERTICAL UNLESS SHOWN OTHERWISE.
7. METAL INSERT PLATE ON COLUMN OR BEAM SHALL BE KEPT SYMMETRICAL ABOUT C OF COLUMN OR BEAM, UNLESS SHOWN OTHERWISE
8. WHERE REQUIRED LUGS SHALL BE BENT AS SHOWN IN SHT 04.

SHT 01 OF 13 FILE NAME 411 S1



**PROJECT ENGINEERING
BHEL HYDERABAD**

METAL INSERT PLATES

DRAWING NO.	REV
4-38144-00011	00

CIVIL ENGINEERING

NO	DATE	REVISION	DRN	CHD	APPD
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FORMULAE USED IN CALCULATION :-

(A) PURE SHEAR

SHEAR CAPACITY,

$$(i) \leq 3/4 \times (n \times AL \times Pq)$$

OR

$$(ii) \leq 3/4 \times (n \times 78.4 \times \phi^2 \times \sqrt{\sigma_{cu}})$$

WHICH EVER IS LESS

(A) COMBINED MOMENT AND SHEAR :-

$$1. T = \pi \times \phi \times L \times Tbd$$

OR $AL \times \sigma_{st}$

OR $\pi \times \phi \times \text{WELD SIZE} \times 0.7 \times 1100$

WHICH EVER IS LESS

$$2. M = T \times Z$$

$$3. \left(\frac{T}{AL \times \sigma_{st}} \right)^2 + \left(\frac{S}{AL \times Pq} \right)^2 \leq 1, \text{ HENCE } S \leq \left[\sqrt{1 - \left(\frac{T}{AL \times \sigma_{st}} \right)^2} \right] \times AL \times Pq$$

4. SHEAR CAPACITY

$$(i) \leq 3/4 \times n \times S$$

$$(ii) \leq 3/4 \times (n \times 78.4 \times \phi^2 \times \sqrt{\sigma_{cu}})$$

WHICH EVER IS LESS

$$5. \text{MOMENT CAPACITY} = 3/4 \times M$$

WHERE

1. Pq = ALLOWABLE SHEAR STRESS OF LUGS = 1600 Kg/Cm^2
2. σ_{st} = ALLOWABLE TENSILE STRESS IN LUGS = 2300 Kg/Cm^2
3. Tbd = BOND STRENGTH OF CONCRETE, Kg/Cm
4. σ_{cu} = 28 DAYS 150mm CUBE STRENGTH OF CONCRETE, Kg/Cm^2
5. ϕ = LUG DIAMETER, Cm
6. AL = SECTIONAL AREA OF A SINGLE LUG, Cm^2
7. n = NUMBER OF LUGS
8. Z = SECTION MODULUS OF LUG GROUP
9. L = EMBEDDED LENGTH
10. S = SHEAR STRENGTH OF SINGLE LUG, Kgs.
11. T = TENSILE STRENGTH OF SINGLE LUG, Kgs.

SHT 02 OF 13 | FILE NAME 411 S2



PROJECT ENGINEERING
BHEL HYDERABAD

METAL INSERT PLATES

DRAWING NO.

4-38144-00011

REV

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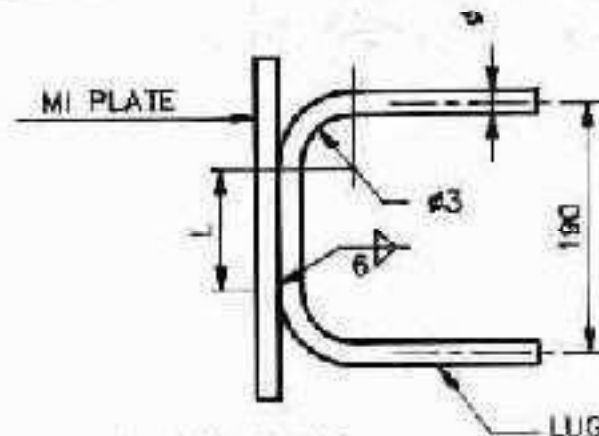
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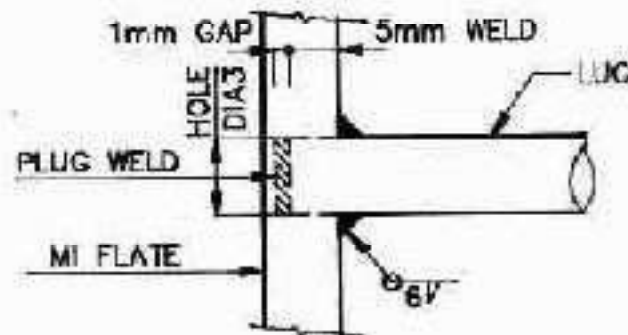


ϕ = DIA OF LUG

L = WELD LENGTH AVAILABLE $\leq (190 - 7\phi)$

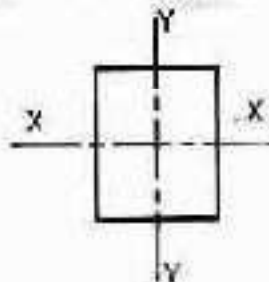
BENDING DIMENSION FOR 12φ & 16φ LUGS

(FOR SPACING OF LUGS ≥ 190)



WELD DET OF 12φ & 16φ LUGS WITH METAL INSERT PLATE

(FOR SPACING OF LUGS < 190)



TYP "X" AND "Y" DIRECTIONS

SHT 030F1E FILE NAME 41153



PROJECT ENGINEERING
BHEL HYDERABAD

METAL INSERT PLATES

DRAWING NO.

4-38144-00011

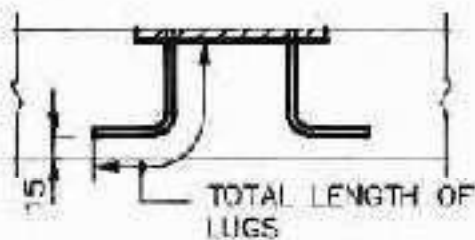
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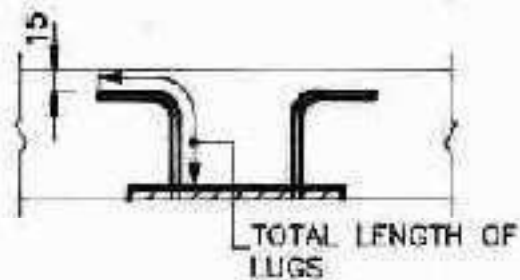
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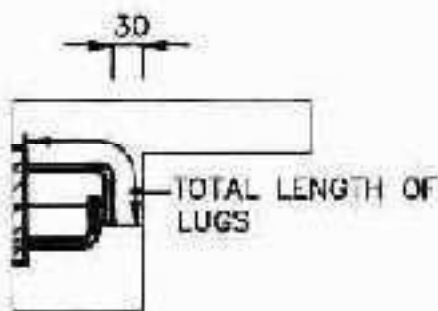
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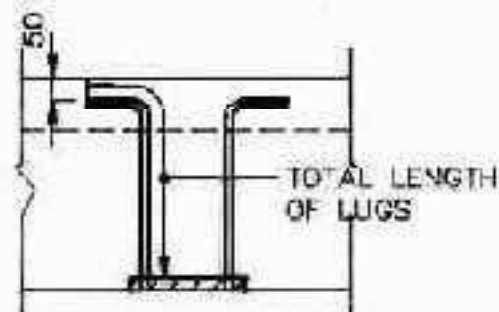
**TYP. METAL INSERT DETAIL
ON SIDE OF BEAM**



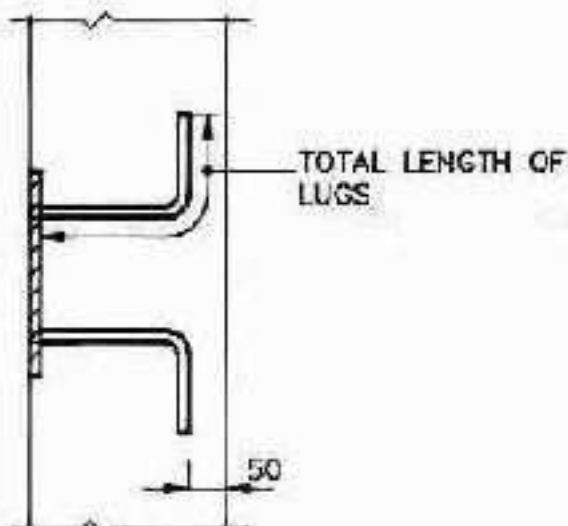
**TYP. METAL INSERT DETAIL
ON BOTTOM OF SLAB**



**TYP. METAL INSERT DETAIL
ON SIDE OF BEAM**

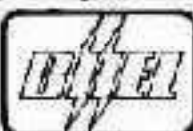


**TYP. METAL INSERT DETAIL
ON BOTTOM OF BEAM**



**TYP. METAL INSERT DETAIL
ON COLUMNS**

SHT 04 OF 13 FILE NAME 611 S 4



**PROJECT ENGINEERING
BHEL HYDERABAD**

**METAL INSERT PLATES
(LUG BENDING DETAIL)**

DRAWING NO:	REV
4-38144-00011	00



**PROJECT ENGINEERING
BHEL HYDERABAD**

METAL INSERT PLATES

METAL INSERT PLATES

DRAWING NO:

4-38144-00011 00

DRAWING NO:

4-38144-00011 00

DRAWING NO:	REV

4-38144-00011 00

DRAWING NO:	REV

METAL INSERT PLATES

SHT050F13	FILE NAME 41155

SH T 050 F 13

FILE NAME 47155

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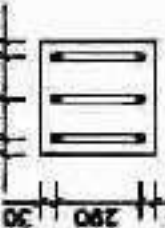
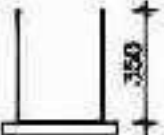
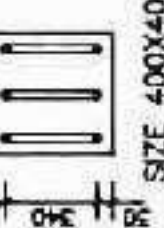
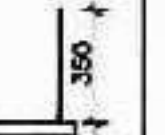
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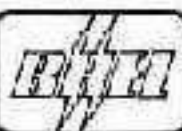
Handwritten signature

SQUARE M.I. PLATES FOR SHEAR & MOMENT, SHEAR & TENSION CAPACITIES

S. NO.	TYPE OF INSERT PLATE	DIA OF LUGS (mm)	THK OF INSERT PLATE (mm)	DETAILS OF INSERT PLATE		SHEAR AND MOMENT CAPACITY						SHEAR AND TENSION CAPACITY		UNIT WT (Kg)			
				PLAN	CROSS SECTION	M-20		M-25		M-20		M-25		M.I.P	LUGS		
						SHEAR (T)	MOMENT (TM)	SHEAR (T)	MOMENT (TM)	SHEAR (T)	MOMENT (TM)	SHEAR (T)	MOMENT (TM)				
1	S5a	12	12			6.70	0.95	0.60	6.25	1.05	0.70	6.70	8.85	6.25	9.95	11.55	2.65
	S5b	16	16			13.00	1.05	0.70	12.60	1.45	0.95	13.00	0.00	12.60	3.30	15.40	4.70
	S6a	12	12			8.70	1.10	0.75	6.25	1.30	0.85	8.70	8.85	6.25	9.95	15.00	2.75
2	S6b	16	16			13.00	1.30	0.85	12.60	1.70	1.10	13.00	0.00	12.60	3.30	20.00	4.95
	S7a	12	12			8.10	1.50	1.50	7.40	1.65	1.65	8.10	13.50	7.40	15.85	19.10	3.55
	S7b	16	16			16.70	1.95	1.95	16.00	2.20	2.20	16.70	18.00	16.00	20.25	25.40	6.30

FILE NAME 411

SHT 06 OF 13



PROJECT ENGINEERING
BHEL HYDERABAD

METAL INSERT PLATES

DRAWING NO:

REV

4-38144-00011

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DATE

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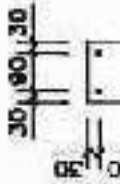
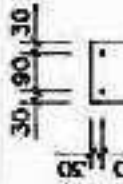
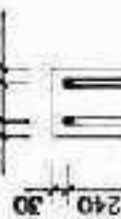
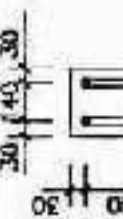
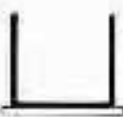
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ISSUED AS STANDARD

RECTANGULAR M.I. PLATE FOR SHEAR & MOMENT, SHEAR & TENSION CAPACITIES

TYPE OF INSERT PLATE	DIA OF LUGS	THK OF INSERT PLATE (mm)	DETAILS OF INSERT PLATE		SHEAR AND MOMENT CAPACITY				SHEAR AND TENSION CAPACITY				UNIT WT (Kg)			
			PLAN	CROSS SECTION	M-20		M-25		M-20		M-25					
					SHEAR (T)	MOMENT (TM)	Mx	My	(T)	(TM)	SHEAR (T)	MOMENT (TM)		SHEAR (T)	(TM)	
1	R1a	12			4.75	0.25	0.15	4.50	0.30	0.20	4.75	5.00	4.50	5.70	2.85	1.05
	R1b	16			8.95	0.30	0.20	8.70	0.40	0.25	8.95	8.50	8.70	7.60	3.75	1.90
2	R2a	12			4.75	0.45	0.15	4.50	0.80	0.20	4.75	5.00	4.50	5.70	4.25	1.50
	R2b	16			8.95	0.60	0.20	8.70	0.70	0.25	8.95	8.50	8.70	7.60	5.65	2.65
3	R3a	12			4.35	0.50	0.30	4.00	0.80	0.30	4.35	5.90	4.00	6.80	5.65	1.65
	R3b	16			8.85	0.80	0.35	8.40	0.80	0.45	8.85	8.65	8.40	8.85	7.55	3.00
4	R4a	12			4.35	0.75	0.30	4.00	0.80	0.30	4.35	5.90	4.00	6.80	7.55	1.85
	R4b	16			8.85	0.85	0.75	8.40	1.10	0.45	8.85	8.65	8.40	8.85	10.36	3.30

FILE NAME 411 | SHT 07 OF 13



PROJECT ENGINEERING
BHEL HYDERABAD

METAL INSERT PLATES

DRAWING NO:

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DATE

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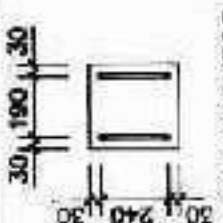
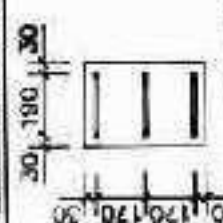
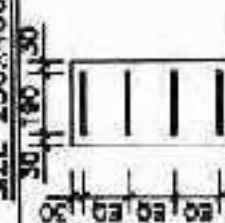
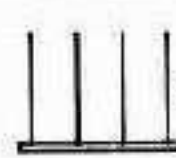
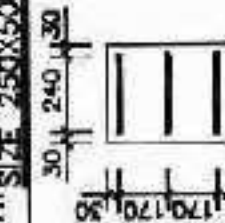
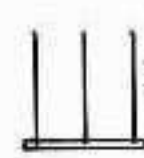
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RECTANGULAR M.I. PLATE FOR SHEAR & MOMENT, SHEAR & TENSION CAPACITIES

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				PLAN	CROSS SECTION	M-20		M-25		M-20		M-25			
						Mx	My	(T)	My (T)	SHEAR MOMENT (T)	SHEAR MOMENT (T)	SHEAR TENSILE (T)	TENSILE (T)		SHEAR TENSILE (T)
5	R5a	12	12			0.50	0.40	0.60	0.45	4.35	5.90	4.00	6.60	7.05	
	R5b	16	16			8.85	0.60	0.45	0.80	0.60	8.85	6.65	8.40	6.85	3.00
6	R6a	12	12			6.70	0.75	0.60	0.85	0.70	6.70	8.85	2.5	9.95	9.40
	R6b	16	16			13.00	0.85	0.70	1.10	0.95	13.00	10.00	12.60	13.30	2.55
7	R7a	12	12			8.10	1.30	1.00	1.40	1.00	8.10	13.50	7.40	15.63	8.0
	R7b	16	16								16.70	18.00	6.00	20.25	5.70
8	R8a	12	12			0.75				0.30	6.70	8.65	6.30	9.90	11.30
	R8b	16	16			0.85	0.75	1.10							16.05

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SHT 08 OF 13

PROJECT ENGINEERING
BHEL HYDERABAD

METAL INSERT PLATES

DRAWING NO.

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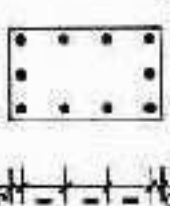
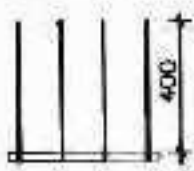
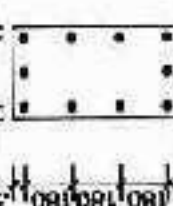
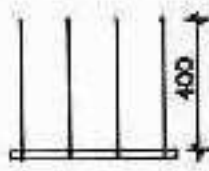
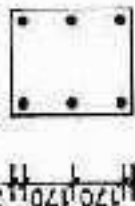
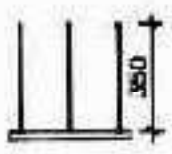
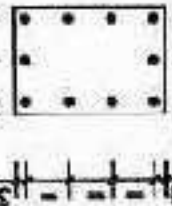
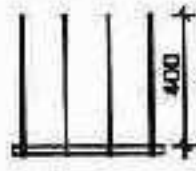
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CIVIL ENGINEERING

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0		ISSUED AS STANDARD			

RECTANGULAR M.I. PLATE FOR SHEAR & MOMENT, SHEAR & TENSION CAPACITIES

TYPE OF INSERT PLATE	DIA OF LUGS (mm)	THK OF INSERT PLATE (mm)	DETAILS OF INSERT PLATE		SHEAR AND MOMENT CAPACITY				TENSION CAPACITY				UNIT WT (Kg)				
			PLAN	CROSS SECTION	M-20		M-25		M-20		M-25						
					SHEAR (T)	MOMENT (TM)	SHEAR (T)	MOMENT (TM)	SHEAR (T)	MOMENT (TM)	SHEAR (T)	MOMENT (TM)					
9	R9a	12	12			10.30	1.80	1.20	9.25	1.40	10.30	6.65	9.25	19.00	4.10	3.60	
	R9b	16	16			20.80	2.40		20.00	2.65	1.80	20.80	2.50	20.00	25.30	8.85	6.30
10	R10a	12	12			10.30	2.10	1.20	9.25	2.40	1.40	10.30	6.65	9.25	19.00	16.95	3.60
	R10b	16	16			20.80	2.80	1.60	20.00	3.15	1.80	20.80	2.50	20.00	25.30	22.60	6.30
11	R11a	12	12			6.70	0.75	0.95	6.25	0.85	1.10	6.70	8.85	8.20	9.95	13.20	1.90
	R11b	16	16			13.00	0.85	1.10	12.60	1.15	1.50	13.00	0.00	2.60	5.30	7.60	3.30
12	R12a	12	12			10.30	1.80	1.45	9.25	2.00	1.70	10.30	6.65	9.25	19.00	16.45	3.60
	R12b	16	16			20.80	2.40		20.00		2.20	20.80	2.50	20.00	25.30	22.00	6.30

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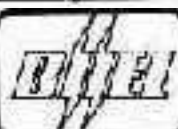
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6/2/2013

RECTANGULAR M.I. PLATE FOR SHEAR & MOMENT, SHEAR & TENSION CAPACITIES.

S NO.	TYPE OF INSERT PLATE	DIA OF INSERT PLATE (mm)	THK OF INSERT PLATE (mm)	DETAILS OF INSERT PLATE		SHEAR AND MOMENT CAPACITY				SHEAR AND TENSION CAPACITY				UNIT WT (Kg)			
				PLAN	CROSS SECTION	M-20		M-25		M-20		M-25					
						Mx	My	(T)	(T)	Mx	My	(T)	(T)		(T)	(T)	
14	R13a	12	12	 SIZE 350X800	 400	10.30	2.10	1.45	8.25	2.40	1.70	10.30	16.63	9.25	19.00	9.95	3.60
	R13b	16	16			20.80	2.80	1.95	20.00	3.15	2.20	20.80	22.50	20.00	25.30	26.40	6.30
15	R14a	12	12	 SIZE 400X500	 400	12.35	2.40	1.80	11.10	2.70	2.00	12.35	20.00	11.10	22.75	18.85	3.60
	R14b	16	16			25.00	3.10	2.50	24.80	3.50	2.75	25.00	27.00	24.80	30.35	25.10	6.30

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PROJECT ENGINEERING
BHEL HYDERABAD

METAL INSERT PLATES

DRAWING NO.

4-38144-00011

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CIVIL ENGINEERING

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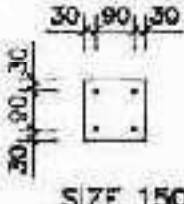
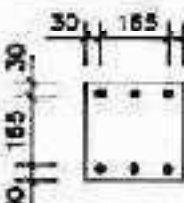
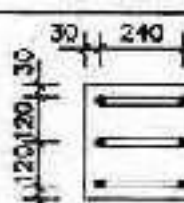
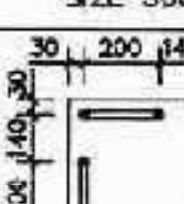
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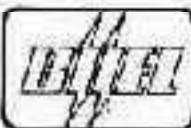
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DETAILS OF M.I. PLATE FOR PURE SHEAR CONNECTIONS ONLY

S NO	TYPE OF INSERT PLATE	DIA OF LUGS (mm)	THK OF INSERT PLATE (mm)	DETAILS OF INSERT PLATE		SHEAR CAPACITY (T)		UNIT WT (Kg)	
				PLAN	CROSS SECTION	M_20	M_25	M.I.P.	LUGS
1	PS1	12	12	 SIZE 150X150		4.75	5.35	2.10	0.90
	PS2	16	16			8.50		2.80	1.90
2	PS3	12	12	 SIZE 225X225		7.20	8.00	4.75	1.35
	PS4	16	16					6.35	2.85
3	PS5	12	12	 SIZE 300X300			8.00	8.50	2.00
	PS6	16	16			12.75	14.35	11.30	4.00
4	PS7	12	12	 SIZE 400X400		9.60	10.70	15.00	2.50
	PS8	16	16			17.00		20.00	5.00

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PROJECT ENGINEERING
BHEL HYDERABAD

METAL INSERT PLATES

DRAWING NO:

4-38144-00011

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CIVIL ENGINEERING

NO	DATE	REVISION	DRN	CHD	APPD
0		ISSUED AS STANDARD		<i>[Signature]</i>	<i>[Signature]</i>

DETAILS OF M.I. PLATE FOR PURE SHEAR CONNECTIONS ONLY

S NO	TYPE OF INSERT PLATE	DIA OF LUGS (mm)	THK OF INSERT PLATE (mm)	DETAILS OF INSERT PLATE		SHEAR CAPACITY (T)		UNIT WT (Kg)	
				PLAN	CROSS SECTION	M_20	M_25	M.I.P.	LUGS
5	PS9	12	12	 SIZE 450X450		9.60		19.10	2.60
	PS10	16	16			17.00	19.00	25.40	5.00
6	PS11	12	12	 SIZE 500X500		12.00	13.40	23.55	2.25
	PS12	16	16			21.30	23.80	31.40	4.75

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PROJECT ENGINEERING
BHEL HYDERABAD

METAL INSERT PLATES

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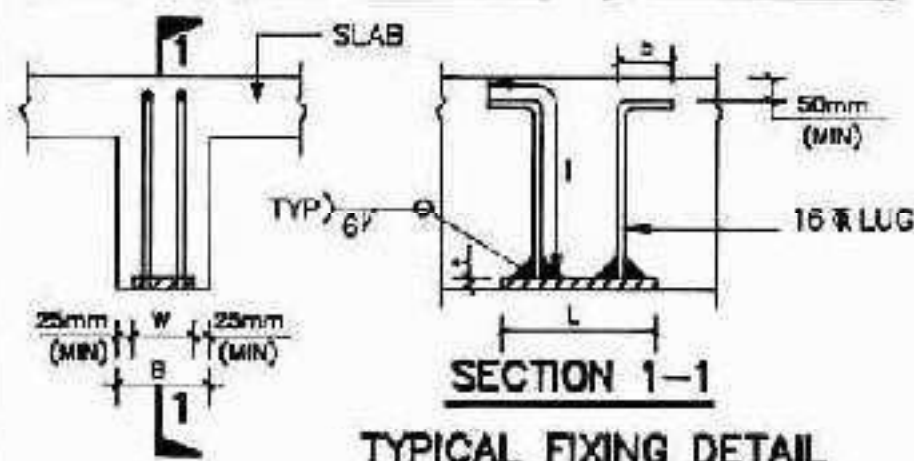
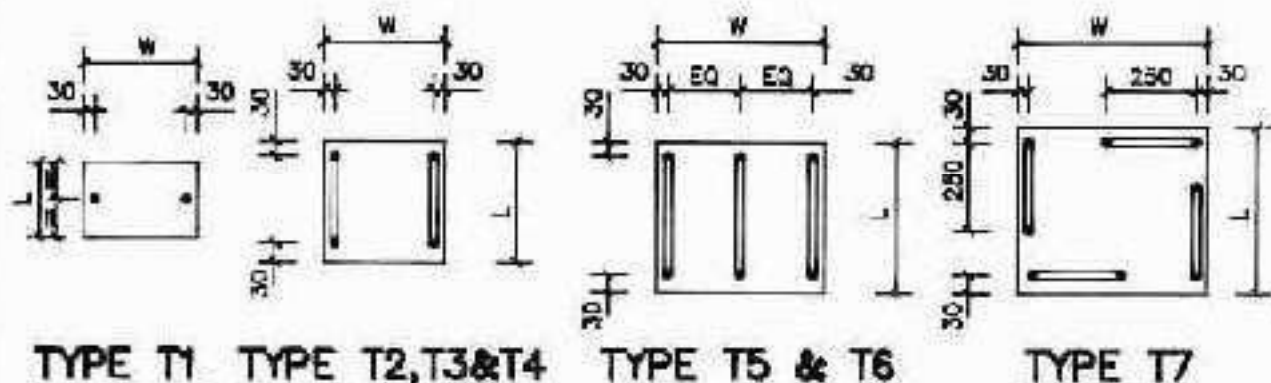
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DETAILS OF M I PLATE FOR TENSILE LOAD

S. NO.	TYPE OF INSERT PLATE	WIDTH OF BEAM 'B' (mm)	MAX. WIDTH OF PLATE 'W' (mm)	LENGTH OF PLATE 'L' (mm)	MAX. 'b' (mm)	THK. OF PLATE 't' (mm)	TOTAL ANCHORAGE LENGTH 'l' (mm)	UNIAXIAL TENSION CAPACITY (TONNES)		REMARKS
								M20	M25	
1	T1	230	180	180	110	16	350	3.90	4.40	
2	T2	300	220	250	110	20	350	7.90	8.80	
3	T3	350	270	250	110	20	350	7.90	8.80	
4	T4	400	320	250	110	20	350	7.90	8.80	
5	T5	450	370	300	110	32	350	11.80	13.30	
6	T6	500	420	300	110	32	350	11.80	13.30	
7	T7	500	420	400	110	32	350	15.75	17.70	FILE NAME #11 SHT 13 OF 13



PROJECT ENGINEERING
BHEL HYDERABAD

METAL INSERT PLATES

DRAWING NO

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GENERAL NOTES ON CONCRETE WORK1. GENERAL:

- a. All drawings shall be read in conjunction with the Contract Terms and Conditions, specifications & schedule of items.
- b. Appropriate Indian Standard Codes incorporated in the contract work specification shall be followed.
- c. All dimensions and local levels are in Millimetres and general co-ordinates and elevations in metres, unless mentioned otherwise.
- d. No dimensions shall be scaled off.
- e. Location and details of construction joints shall be decided by the Engineer-in-Charge of the site unless mentioned otherwise.
- f. For liquid retaining structures and structures in contact with earth and water, water - stop shall be provided along all construction joints as per the direction of the Engineer-in-Charge of the site, and as shown in drawings.
- g. Wherever water bars are provided as indicated in drawings, the ends of reinforcement bars shall be bent suitably.
- h. If any foundation rests on back filled soil the soil shall be well compacted (90% proctor density). If compaction is not possible, the back filled earth shall be removed and filled with P.C.C. 1:5:10 between the bottom of the foundation and bottom of the excavation.

2. CONCRETE:

- a. For all concrete works in general applicable requirements of IS: 456-1978 shall be met with.
- b. For extreme weather concreting suitable provisions of IS: 7861-1987 is to be followed.
- c. Ordinary Portland cement conforming to IS: 269 shall be used for all concrete works.
- d. All structural concrete shall be of grade M20 (in SI units) unless mentioned otherwise.
- e. The concrete mix proportioning shall be either designed or nominal as per Art 8 of IS: 456-1978 proportions for nominal mix concrete will be as per Table 3 of IS: 456-1978.
- f. Minimum cement content -
For M25 Concrete - 420 kg/cu.m.
For M20 Concrete - 360 kg/cu.m.
For M15 Concrete - 325 kg/cu.m.



PRODUCT STANDARD SWITCH GEAR

SG

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2. g. The slump of the concrete shall be as per Article 6 of IS: 456-1978.

h. Sampling and strength test of concrete shall be as per Art. 14 of IS: 456-1978, IS: 1199-1159, IS: 516-1959 and contract specifications.

i. All lean concrete shall be minimum 75 mm thick of grade 1:5:10 and shall extend 50 mm beyond foundation edge unless mentioned otherwise.

j. All pockets left in concrete for grouting later shall have rough finish surfaces.

3. REINFORCING STEEL:

a. All reinforcing steel shall be high yield strength deformed bars conforming to IS:1786 or IS:1139 above 6 mm dia., and conforming to IS: 432 grade I for 6 mm dia rods.

b. All splices and bends shall be as per IS: 456. Unless otherwise stated, the decision of the Engineer-in-Charge of the site shall be final.

c. All dowel bars and laps provided shall have a bond length of 50 times the diameter of the bar unless mentioned otherwise. Reinforcement may be welded using low hydrogen electrodes.

d. Suitable adjustment in reinforcement placing shall be made at site to clear pockets, anchor bolts, etc. with prior approval of the Engineer-in-Charge at the site.

4. COVER:

The minimum clear concrete cover to the main reinforcement shall be the greater of the dia of the main reinforcement and the figures given below unless mentioned otherwise.

	Top	Bottom	Sides
a. Foundations and footings	50	75	50
b. Base raft of basements, pits, Trenches	40	50	50
c. Top slab of cable tunnel	50	40	50
d. Walls of basements, pits, trenches			
i) Depth $\leq$ 2.0 M	40	-	40 outside 40 inside
ii) Depth $>$ 2.0 M	40	-	50 outside 40 inside

.....contd 3



PRODUCT STANDARD

SWITCH GEAR

SG

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OF

- 3 -

4.		Top	Bottom	Sides
e. Columns		40	-	40
f. Beams		25	25	25
g. Slabs		15	15	15

5. EMBEDMENTS:

a. Plates, angles and other sections used as embedments shall conform to IS: 226, unless mentioned otherwise.

b. Lugs used for anchoring embedments shall conform to IS: 226, IS: 1786, IS: 1139.

c. Welding on lugs to embedments shall be done as per IS: 816.

d. Exposed surfaces of embedded parts shall be coated with two coats of red oxide primer.

e. Tolerance for fixing embedments and penetrations shall be 6 mm in general unless mentioned otherwise.

f. Spacing of embedment lugs and reinforcement shall be suitably adjusted so as to avoid interference.

g. Whereas possible, embedment plates shall be cut from IS PLAT sections.



PRODUCT STANDARD

SWITCH GEAR

SG

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GENERAL NOTES ON STRUCTURAL STEEL WORK

1. GENERAL:

- a. This drawing shall be read in conjunction with the contract terms and conditions, specifications and schedule of items.
- b. Appropriate Indian Standard Codes incorporated in the contract work specifications shall be followed. In case of any controversy the decision of the Engineer-in-Charge shall be binding on the Contractor.
- c. Unless mentioned otherwise, all dimensions are in millimetres.

2. MATERIAL:

- a. Unless otherwise specified, steel for hot rolled structural shapes and plates shall conform to IS:226/2062.
- b. Steel tubes for structural purposes shall conform to IS:1161.
- c. High strength bolts shall conform to IS:3757.
- d. All mild steel bolts and nuts shall conform to black grade-8 specified in IS:1367, unless specified otherwise.
- e. All bolts, nuts and lock nuts shall conform to the requirements of IS:1367.

3. CONNECTIONS:

- a. All Shop & field connections shall be generally welded unless otherwise specified.
- b. Field connections shall be made with black bolts for ladders, handrail posts, stair stringers, removable members and floor plates, platform framing members 230mm and under in size, purlins, girts and minor pipe support members that require not more than three bolts per connection.
- c. Splices shall not be located closer than one metre. No splice in cantilevered beams shall be located closer to the support than one half the length. No splice shall be made in middle fourth or in one eighth of the span from support.
- d. All connections shall be designed for the full capacity of the connected members.
- e. Ends of members are to be cut at site to suit opposite profiles (if not already done)

..... contd 2



PRODUCT STANDARD SWITCH GEAR

SG

PAGE OF

- 2 -

4. WELDING:

a. All weld thickness to be equal to 0.8 times the thickness of the thinner member or plate connected unless specified otherwise. Ends of members to be welded around to opposite profiles at site are as follows wherever not indicated otherwise.

Sl.no.	Section	Size of weld
1.	I 600, L 130 x 130 x 12 L 150 x 150 x 12	10 A
2.	I 500, I 450, I 400, (I 400) L 100 x 100 x 10	8 A
3.	I 350, I 300, (L 300, L 250, I 250) L 80 x 80 x 8	6 A
4.	I 200, (L 200, L 150, L 75 x 75 x 6) L 65 x 65 x 6, L 50 x 50 x 6	5 A
5.	I 150, I 125	4 A

b. Length of fillet welds shall not be less than 4 times nominal size of the weld or 40 mm whichever is more.

c. Fillet welds terminating at ends must have returns around corners not less than twice the nominal size of the weld.

d. Welding should be done as per IS:816-1969 for electric arc welding wherever required.

e. Edge preparation for welding should be done as per IS:823-1964 and welding symbols shall conform to IS:813-1961 wherever required.

f. All butt welds shall be full penetration butt welds.

g. Materials conforming to IS: 226, IS: 2062, BS 4360, GR 43D, ASTM-A36 specifications and having thickness above 20mm are to be preheated to 100 to 120 deg C during welding.

5. BOLTING:

a. The minimum size of bolts shall be 16 mm unless limited by the size of the connected parts.

b. Holes for anchor bolts in base plates to be 5mm greater than the size of anchor bolts unless specified otherwise.

c. Holes for bolts shall not be formed by gas cutting process.

.....contd. 3



PRODUCT STANDARD SWITCH GEAR

SG

PAGE OF

- 3 -

5.d. Length of bolt threads to be limited by washers. Every bolt shall be provided with a steel washer (other than HSPG Bolts) under the nut so that no part of the threaded portion of the bolt is within the thickness of the parts bolted together.

e. No painting shall be done for a distance of 75 mm from a group of HSPG Bolts. Cement washing or any treatment provided on the surface of structural materials near HSPG Bolt connections are to be removed by wire brushing before the structural members are fastened.

f. High Strength Friction Grip Bolts to be tightened with wrenches by the Turn-of-the nut Method, as outlined in the specifications for structural joints, using BS:4395, Part 1 bolts. HSPG Bolts once tightened are not to be slackened, removed and reused.

6. SURFACE FINISH:

Out of flatness for flange shall not be more than (+) 1.0 mm and surface roughness shall not be more than 160 microns. Surface preparation holes is 12.5 Microns and edge preparations for welds is 25 Microns unless otherwise specified.

7. GENERAL:

a. Fabrication and erection of steel work shall conform to IS:800 and IS:906 as applicable.

b. Separator, diaphragms, filler plates, washers, tapered or plain shall be used wherever necessary or as required by the Engineer.

c. All gusset plates shall be 10 mm thick unless noted otherwise.

d. All fabricated structural steel, unless galvanized shall receive a shop coat of primer & painted as per Technical Specifications.

e. Column levels to be marked at every 5 metre level starting from the nearest whole number from top (if not done in shop).

f. Shim plates are to be provided below the flanges of columns under the base plate.

g. Before erection of columns on the foundations the top surface of base concrete shall be thoroughly cleaned with wire brushes and by chipping to remove all loose material to ensure proper bond between the grout and the base concrete.

h. Columns shall be erected plumb to a tolerance not exceeding 1 in 1000 with a maximum of 25 mm at the column centre line.

i. The symbol thus shown in the floor drawings indicates the direction of load bearing bars of the grill.



PRODUCT STANDARD SWITCH GEAR

SG

PAGE

OF

- 4 -

7.1. Floor grills are to be cut at site suitably wherever necessary. Where the edges of floor grills are to be cut at site to suit the openings, columns or other floor requirements, they shall be neatly cut and banded around all openings using edge strips 5 x 32 or 5 x 30 as the case may be.

k. Edges of all platforms are to be provided with guard plate.

l. If width of gap due to discontinuation of floors/platforms exceeds 150 mm ends of such floors/platforms shall be provided with hand railings. Handrailing shall not overhang more than 900 mm beyond the last handrail post.

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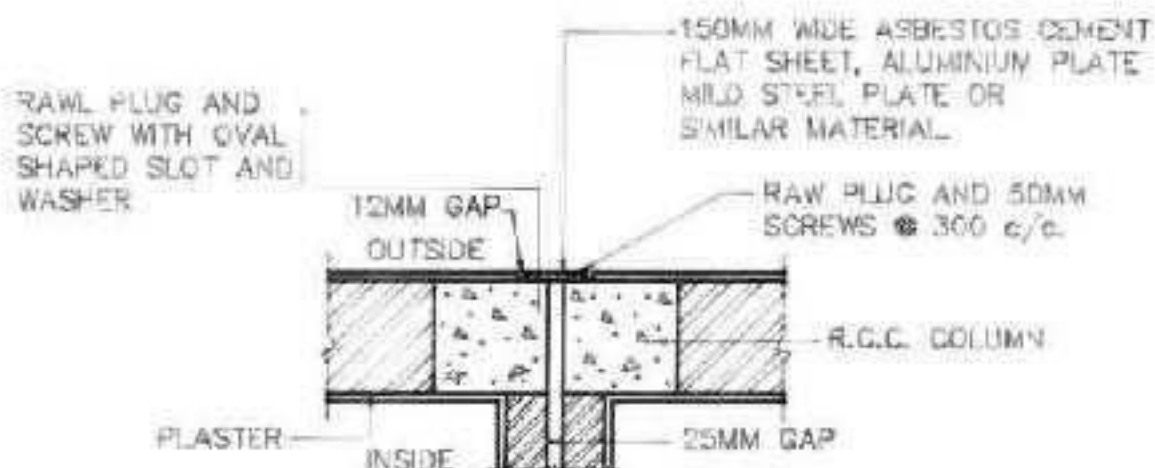
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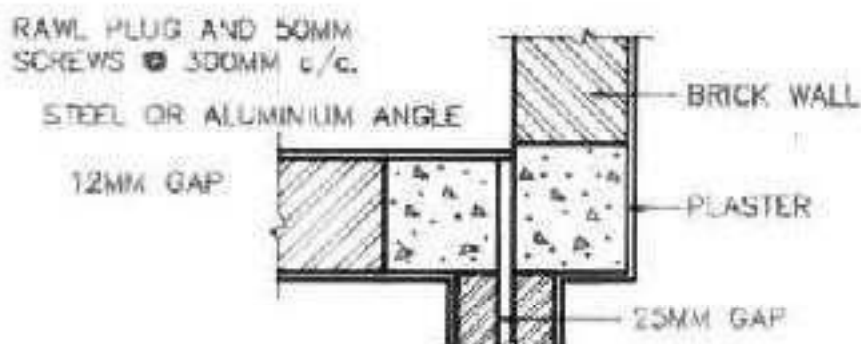
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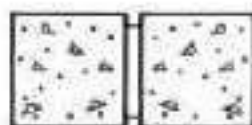
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TYPICAL DETAILS OF EXPANSION JOINT
ON OUTER FACE OF COLUMNS



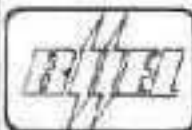
TYPICAL DETAILS OF EXPANSION JOINT
AT CORNER COLUMNS



COLUMNS SEALING COMPOUND

TYPICAL DETAILS OF EXPANSION JOINT
AT ISOLATED TWIN COLUMNS

FILE NAME 415



PROJECT ENGINEERING
BHEL HYDERABAD

COLUMN EXPANSION
JOINT DETAILS

DRAWING NO:

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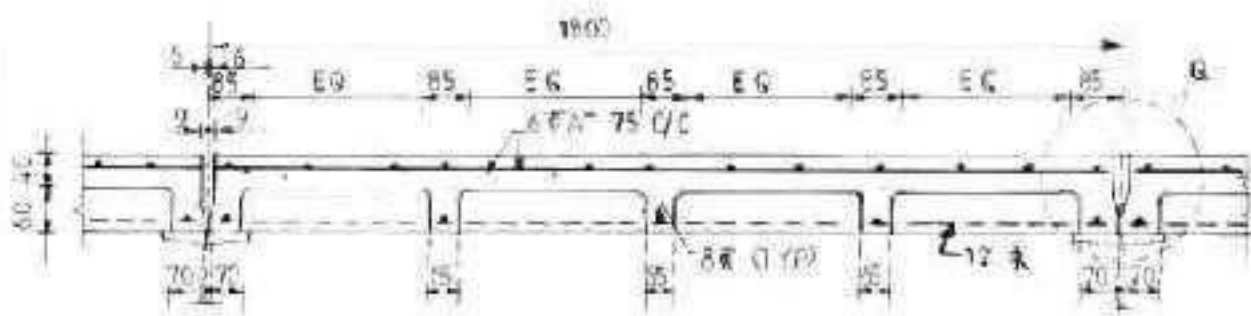
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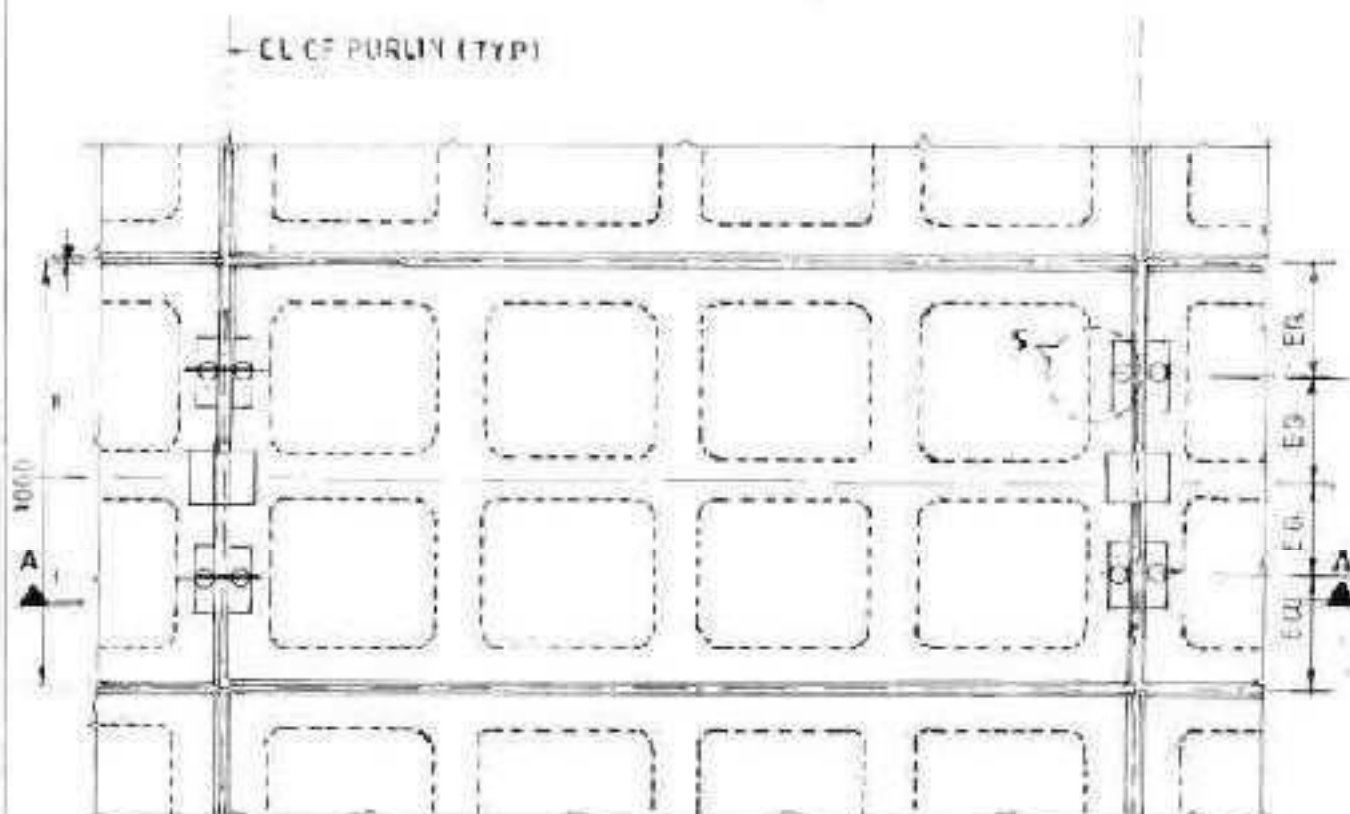
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SECTION A-A

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SHEET 1 OF 2

PROJECT ENGINEERING
BHEL HYDRAZAMPRE CAST ROOFING
UNITS (TYP)

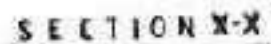
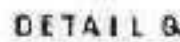
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PRECAST ROOFING
UNITS (TYP)

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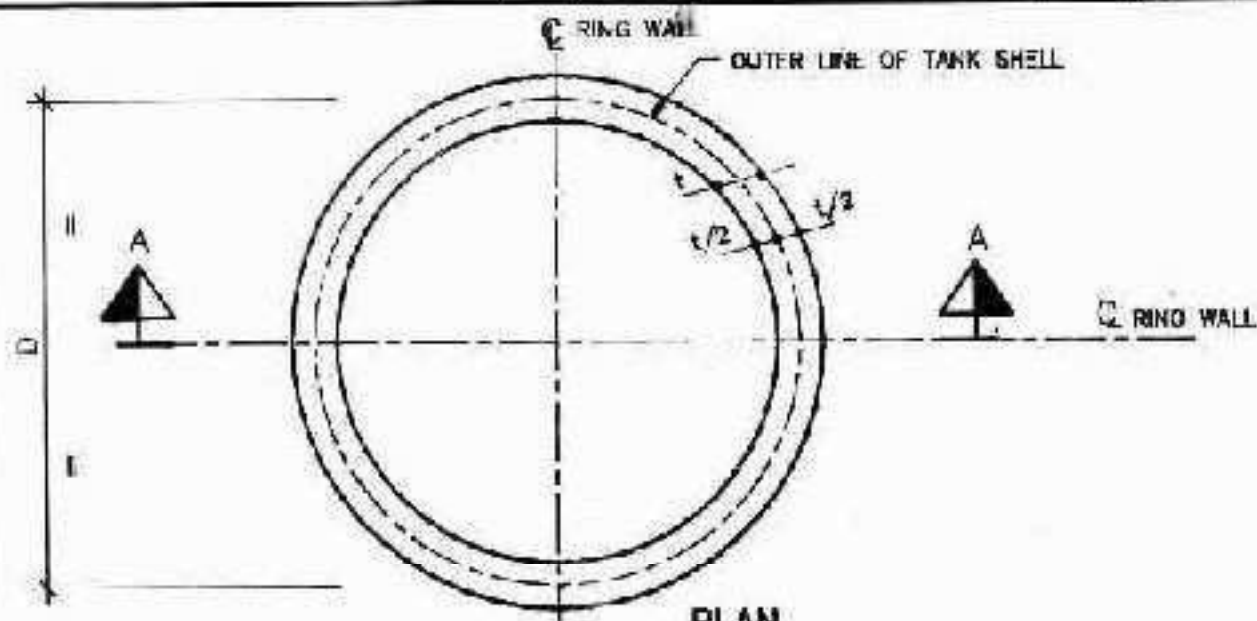
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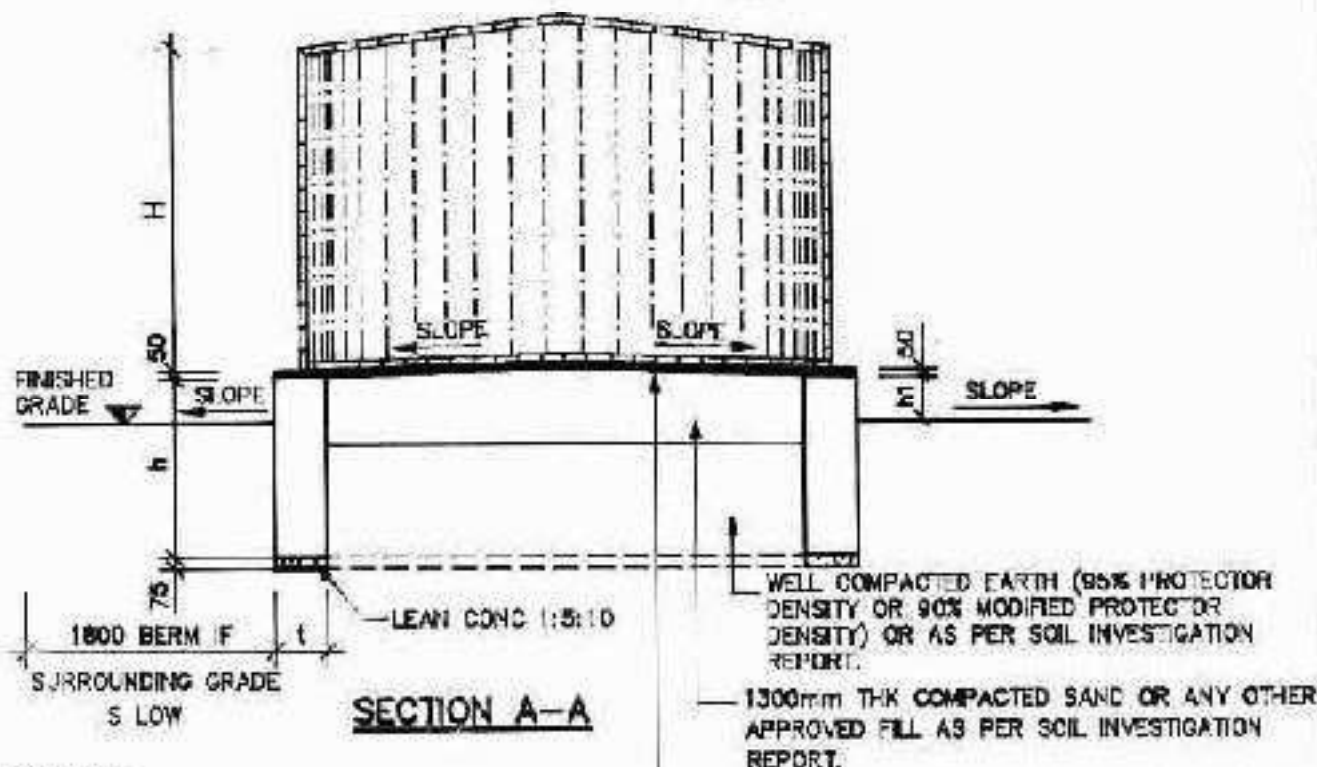
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PLAN



SECTION A-A

NOTES :

1. ALL DIMENSIONS ARE IN MM.
2. GRADE OF CONC. SHALL BE M20 CONFORMING TO IS:456
3. RE-BARS SHALL CONFORM TO IS : 1786.
4. SLOPE OF TOP OF ANTICORROSIVE LAYER SHALL SUIT TANK DATA
5. NECESSARY INSERT PLATES SHALL BE PROVIDED IN THE RING WALL TO SUIT SPIRAL STAIR REQUIREMENT
6. FOR DESIGN BASIS AND OTHER REQUIREMENTS REFER SHEET Nos. 7&8

WELL COMPACTED EARTH (95% PROCTOR DENSITY OR 90% MODIFIED PROCTOR DENSITY) OR AS PER SOIL INVESTIGATION REPORT.

1300mm THK COMPACTED SAND OR ANY OTHER APPROVED FILL AS PER SOIL INVESTIGATION REPORT.

50mm THK ANTI-CORROSIVE LAYER CONSISTING OF COARSE SAND MIXED WITH A90/S90 GRADE BITUMEN CONFORMING TO IS : 73(87)10% BY VOLUME)

FILE NAME : 43351 SHT. 1 OF 8



PROJECT ENGINEERING
BHEL HYDERABAD

RING WALL FOUNDATION
FOR STORAGE TANKS

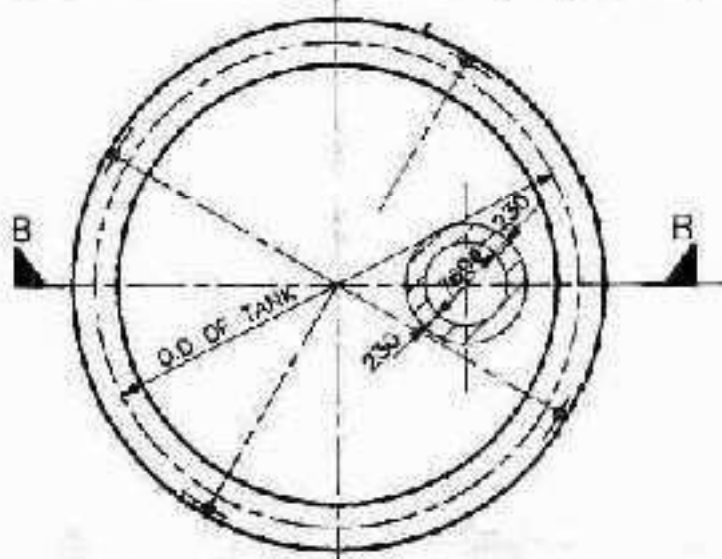
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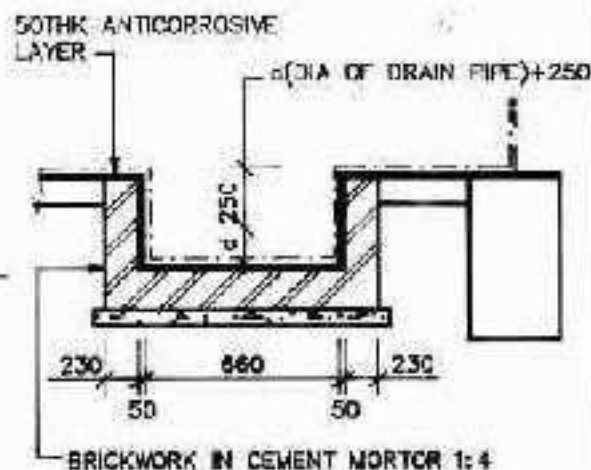
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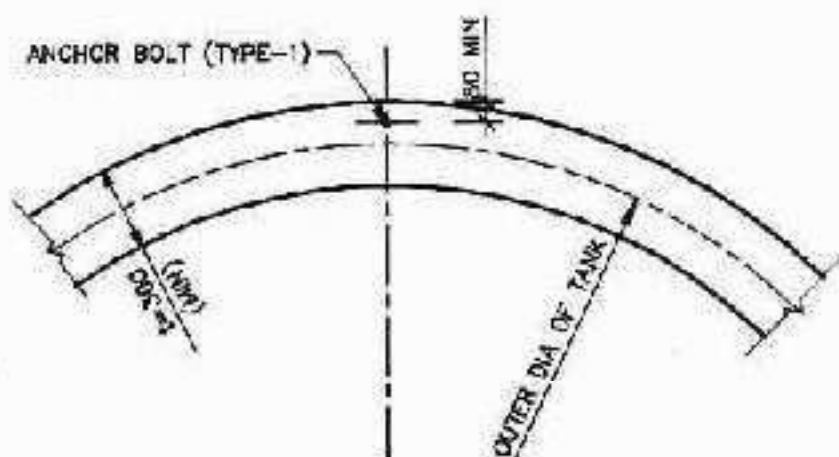
TYPICAL DETAIL FOR DRAIN PIT

FOR ORIENTATION AND LOCATION REFER TANK DATA

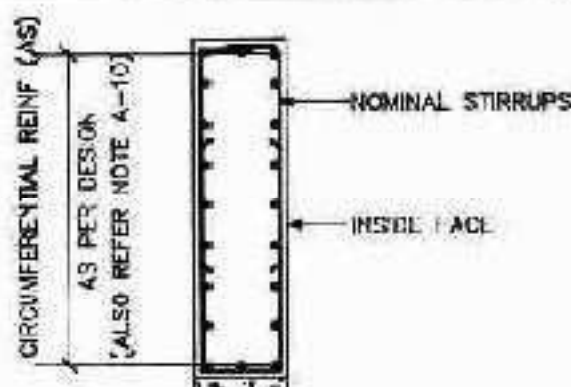


SECTION B-B

(ABOVE DIMENSIONS SHALL BE VERIFIED TO SUIT DRAIN OUTLET)



TYP. DET OF RING WALL AT ANCHOR BOLT LOCATION



TYP. DETAIL OF R/F

FILE NAME: 13652 SH. 2 OF 8



PROJECT ENGINEERING
BHEL HYDERABAD

RING WALL FOUNDATION
FOR STORAGE TANKS

DRAWING NO.

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4-38144-00035 00

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NO	DATE	REVISION	DRN	CHD	APPD
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TABLE-1: TYPICAL LOADS OF STEEL TANK SHELL AND ROOF (W) ON TOP OF RING WALL IN t/m OF THE PERIMETER

$\frac{H}{D}$	3.0	5.0	7.5	10.0	12.5	15.0
3.0	0.25	0.38				
5.0	0.28	0.41	0.57			
7.5		0.46	0.62	0.74		
10.0		0.52	0.68	0.83	1.00	
12.5			0.71	0.87	1.03	1.18
15.0			0.76	0.96	1.16	1.42
17.5			0.83	1.14	1.36	1.63
20.0			0.87	1.17	1.40	1.68

FILE NAME: 43693 SHT. 3 OF 8



PROJECT ENGINEERING
BHEL HYDERABAD

RING WALL FOUNDATION
FOR STORAGE TANKS

DRAWING NO.

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TABLE-2 : RING WALL FOUNDATION DESIGN

h = upto 2.5m

σ = upto 1.0 t/m^2

W = SP GRAVITY OF FLUID
X WT AS PER TABLE-1

H(m)	3.0			5.0			7.5			10.0			12.5			15.0		
D(m)	t	Pw	As	t	Pw	As	t	Pw	As	t	Pw	As	t	Pw	As	t	Pw	As
3.0	*		+	*		+												
	0.25	5.80	0.20	0.25	7.32	0.20												
5.0	*		+	*		+			+									
	0.25	5.92	0.20	0.25	7.44	0.20	0.30	8.96	0.20									
7.5						+			+									
				0.30	7.55	0.20	0.30	9.12	0.20	0.20	10.77	0.20						
10.0						+												
				0.30	7.50	0.20	0.30	9.32	0.21	0.20	11.07	0.26	0.30	12.88	0.32			
12.5																		
							0.30	9.42	0.26	0.30	11.20	0.33	0.30	12.95	0.40	0.30	14.73	0.48
15.0																		
							0.30	9.58	0.32	0.30	11.57	0.40	0.30	13.45	0.48	0.30	15.53	0.56
17.5																		
							0.30	9.71	0.32	0.30	12.10	0.46	0.30	14.08	0.55	0.30	16.25	0.65
20.0																		
							0.35	9.82	0.36	0.30	12.20	0.53	0.30	14.22	0.64	0.30	16.40	0.75
Pt (t/m ²)	4.8			6.8			9.3			11.5			14.3			16.8		
σ	7.5						10.0			12.5			15.0			17.5		

- H = HEIGHT OF TANK (m)
 D = D/A OF TANK (m)
 A_s = CIRCUMFERENTIAL REINFORCEMENT (HYD BARS) IN PERCENTAGE OF CROSS SECTIONAL AREA OF RING WALL
 h = HEIGHT OF RING WALL (m)
 t = THICKNESS OF RING WALL (m)
 σ = DENSITY OF FLUID INSIDE TANK (t/m^3)
 σ = MINIMUM THICKNESS OF WALL SHALL BE 300mm WHERE ANCHOR BOLTS ARE PROVIDED

- $+$ = BASED ON NOTE A-10 ON SHT. 8 OF 8
 p_w = NET SOIL PRESSURE UNDER RING WALL (t/m^2)
 P_t = NET SOIL PRESSURE UNDER TANK (t/m^2)
 P = NET ALLOWABLE BEARING PRESSURE OF SOIL (t/m^2)
 ALL NET PRESSURES ARE AT FOUNDING LEVEL OF RING WALL

FILE NAME: 43554 SHT. 4 OF 8



**PROJECT ENGINEERING
BHEL HYDERABAD**

**RING WALL FOUNDATION
FOR STORAGE TANKS**

DRAWING NO.

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CIVIL ENGINEERING

NO

D

DATE

03.08.93

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TABLE-3 : RING WALL FOUNDATION DESIGN

γ - upto 2.5m

ρ = upto 1.2 t/m³

W = SP GRAVITY OF FLUID
X WT AS PER TABLE-1

H(m)	3.0			5.0			7.5			10.0			12.5			15.0		
D(m)	t	Pw	As	t	Pw	As	t	Pw	As	t	Pw	As	t	Pw	As	t	Pw	As
3.0	*		+	*		+												
	0.25	5.30	0.20	0.25	8.12	0.20												
5.0	*		+	*		+			+									
	0.25	6.44	0.20	0.25	8.27	0.20	0.30	10.08	0.20									
7.5				*		+			+									
				0.25	8.51	0.20	0.30	10.28	0.20	0.30	12.28	0.23						
10.0				*														
				0.25	8.80	0.21	0.30	10.52	0.25	0.30	12.52	0.31	0.30	14.80	0.37			
12.5										0.30	10.64	0.30	0.30	12.78	0.38	0.30	14.82	0.46
																0.30	17.02	0.55
15.0										0.30	10.84	0.38	0.30	13.22	0.46	0.30	15.52	0.58
																0.30	17.95	0.68
17.5										0.30	11.62	0.43	0.30	13.88	0.54	0.30	16.24	0.65
																0.30	18.82	0.76
20.0										0.30	11.85	0.49	0.30	13.98	0.62	0.30	16.40	0.75
																0.30	19.02	0.87
$\frac{H^2}{D^2}$ (t/m ²)	5.4			7.8			10.8			13.8			16.8			19.8		
P	7.5			10.0			12.5			15.0			17.5			20.0		

H = HEIGHT OF TANK (m)

D = DIA OF TANK (m)

As = CIRCUMFERENTIAL REINFORCEMENT
(HYD BARS) IN PERCENTAGE OF CROSS
SECTIONAL AREA OF RING WALL

h = HEIGHT OF RING WALL (m)

t = THICKNESS OF RING WALL (m)

ρ = DENSITY OF FLUID INSIDE TANK (t/m³)

* = MINIMUM THICKNESS OF WALL SHALL BE
300mm WHERE ANCHOR BOLTS ARE PROVIDED

± = BASED ON NOTE A-10 ON SHT. 6 OF 8

Pw = NET SOIL PRESSURE UNDER RING WALL
(t/m²)

Pe = NET SOIL PRESSURE UNDER TANK (t/m²)

P = NET ALLOWABLE BEARING PRESSURE OF
SOIL (t/m²)

ALL NET PRESSURES ARE AT FOUNDING LEVEL
OF RING WALL

FILE NAME: 13565 SHT. 5 OF 8



PROJECT ENGINEERING
BHEL HYDERABAD

RING WALL FOUNDATION
FOR STORAGE TANKS

DRAWING NO.

4-38144-00035

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TAB E-3 : RING WALL FOUNDATION DESIGN

$h = \text{upto } 2.5\text{m}$ $\sigma = \text{upto } 1.4 \text{ t/m}^3$

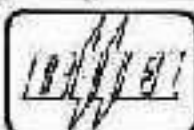
W = SP GRAVITY OF FLUID
X WT AS PER TABLE-1

H(m)	3.0			5.0			7.5			10.0			12.5			15.0		
D(m)	t	Pw	As	t	Pw	As	t	Pw	As	t	Pw	As	t	Pw	As	t	Pw	As
3.0	*	6.80	+	*	8.93	+												
5.0	*	8.97	+	*	9.10	+	0.30	11.2	0.20									
7.5				*	9.38	+	0.30	11.44	0.21	0.30	13.75	0.28						
10.0				*	9.71	0.24	0.30	11.72	0.27	0.30	14.17	0.35	0.30	16.72	0.43			
12.5							0.30	11.88	0.35	0.30	14.38	0.44	0.30	16.88	0.54	0.30	19.31	0.63
15.0							0.30	12.10	0.42	0.30	14.81	0.53	0.30	17.56	0.65	0.30	20.43	0.76
17.5							0.35	12.27	0.42	0.30	15.62	0.62	0.30	18.40	0.75	0.30	21.41	0.88
20.0							0.35	12.43	0.47	0.30	15.76	0.70	0.30	18.58	0.86	0.30	21.64	1.01
Pt (t/m ²)	6.0			8.8			12.3			15.8			19.3			22.8		
P	7.5			10.0			13.0			17.5			20.0			25.0		

H = HEIGHT OF TANK (m)
D = DIA OF TANK (m)
As = CIRCUMFERENTIAL REINFORCEMENT (HYD BARS) IN PERCENTAGE OF CROSS SECTIONAL AREA OF RING WALL
h = HEIGHT OF RING WALL (m)
t = THICKNESS OF RING WALL (m)
 σ = DENSITY OF FLUID INSIDE TANK (t/m³)
* = MINIMUM THICKNESS OF WALL SHALL BE 300mm WHERE ANCHOR BOLTS ARE PROVIDED

+ = BASED ON NOTE 4-10 ON SHT. 2 OF 8
pw = NET SOIL PRESSURE UNDER RING WALL (t/m²)
Pt = NET SOIL PRESSURE UNDER TANK (t/m²)
P = NET ALLOWABLE BEARING PRESSURE OF SOIL (t/m²)
ALL NET PRESSURES ARE AT FOUNDING LEVEL OF RING WALL

FILE NAME: 13556 SHT. 6 OF 8



PROJECT ENGINEERING
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RING WALL FOUNDATION
FOR STORAGE TANKS

DRAWING NO.
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A-PROCEDURE FOR DESIGN OF RING WALL FDN. FOR STORAGE TANKS.

1. WHERE STORAGE TANKS ARE REQUIRED TO BE SUPPORTED ON RING WALL FOUNDATION, THIS STANDARD SHALL BE FOLLOWED.
2. THIS STANDARD INCLUDES DESIGN BASIS AND GENERAL REQUIREMENT OF CONCRETE RING WALL FOUNDATION FOR STORAGE TANKS.
3. THE RING WALL SHALL BE FOUNDED IN THE FIRM STRATUM. THE EMBEDMENT DEPTH SHALL BE MINIMUM 300mm INSIDE THE FIRM STRATUM OR AS PER SOIL INVESTIGATION REPORT.
4. TABLES 2 TO 4 GIVE THICKNESS OF RING WALL (t) AND PERCENTAGE OF TOTAL REINFORCEMENT (As) REQUIRED IN A SECTION OF THE WALL FOR STORAGE TANKS UPTO D=20m AND H=15m. FOR STORAGE TANKS HAVING 'D' AND 'H' GREATER THAN THESE VALUES, THE DESIGN BASIS GIVEN HERE UNDER SHALL BE FOLLOWED.
5. ALTHOUGH THE TABLES SHOW RING WALL FDN. DETAIL FOR TANKS UPTO DIA. 20 AND HEIGHT 15m, IT DOES NOT NECESSARILY MEAN THAT ALL SUCH TANKS SHALL BE FOUNDED ON RING WALLS. THE REQUIREMENT OF RING WALL SHALL BE DECIDED JOINTLY WITH GENERAL CIVIL, GEO-TECH. AND PIPING DEPARTMENTS.
6. THE THICKNESS OF RING WALL (t) IS SO ASSUMED THAT PRESSURE UNDER RING WALL (p_w) AT FOUNDING LEVEL DOES NOT EXCEED THE NEXT ALLOWABLE PRESSURE OF THE SOIL (p). THE EXPRESSIONS USED FOR WORKING OUT NET PRESSURE UNDER TANK AND RING WALL AT THE FOUNDING LEVEL OF RING WALL ARE GIVEN BELOW :

$$p_t = \sigma H + 1.8 h_1$$

$$p_w = \frac{w}{t} + \frac{\sigma H}{2} + 0.6h + 1.8h_1$$

WHERE w = WEIGHT OF SHELL AND ROOF IN t/m OF CIRCUMFERENCE.
ABOVE EXPRESSIONS ARE BASED ON FOLLOWING ASSUMPTIONS.

DENSITY OF CONCRETE = 2.4 t/m³

DENSITY OF EARTH = 1.8 t/m³

h_1 = ELEVATION OF TANK BOTTOM ABOVE FGL (m)

= 1.0m (FOR TABULATION OF VALUES)

NGL = FGL

σ = DENSITY OF FLUID (t/m³)

H = HEIGHT OF STEEL TANK (m)

7. THE REINFORCEMENT IS WORKED OUT TO RESIST HOOP STRESS RESULTING FROM LATERAL PRESSURE OF CONFINED EARTH. THE COEFFICIENT OF ACTIVE EARTH PRESSURE IS TAKEN AS 0.3 IN THESE CALCULATIONS.

FILE NAME: 43057 SH: 7 OF 8



PROJECT ENGINEERING
BHEL HYDERABAD

RING WALL FOUNDATION
FOR STORAGE TANKS

DRAWING NO.

REV

4-38144-00035 00

CIVIL ENGINEERING

NO	DATE	REVISION	DRN	CHD	APPD
0	03.08.93	ISSUED AS STANDARD		<i>[Signature]</i>	<i>[Signature]</i>

8. THE PERCENTAGE OF TOTAL CIRCUMFERENTIAL REINFORCEMENT SHALL BE WORKED OUT FROM FOLLOWING FORMULA

$$A_s (\%) = \frac{(0.30H + 0.27h)R}{230t}$$

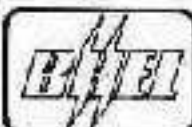
WHERE R=RADIUS OF THE RING WALL CENTER LINE IN m. AND ASSUMED ALLOWABLE STRESS IN REBARS = $2300 \times 10 \text{ t/m}^2$

9. MINIMUM VERTICAL STEEL SHALL BE 0.12% OF THE GROSS CONCRETE AREA EQUALLY DIVIDED ON BOTH FACES IN THE FORM OF STIRRUPS. THE MINIMUM DIAMETER OF VERTICAL STEEL SHALL BE 10mm AND MAXIMUM SPACING OF THESE STIRRUPS SHALL NOT BE MORE THAN THREE TIMES THE WALL THICKNESS OR 450mm WHICHEVER IS LESS.
10. MINIMUM CIRCUMFERENTIAL STEEL SHALL BE 0.2% OF THE CROSS SECTIONAL AREA OF RING WALL DISTRIBUTED ON BOTH FACES.
11. FOLLOWING LOADS HAVE NOT BEEN CONSIDERED IN THE DESIGN AS THEIR EFFECT IS NEGLIGIBLE OR ON THE SAFER SIDE.
- (I) ECCENTRICITY OF LOAD DUE TO FLUID COLUMN INSIDE TANK DIRECTLY COMING OVER RING WALL.
 - (II) SUBMERGED WEIGHT OF RING WALL DUE TO WATER TABLE IN DETERMINING p.w.

B-NOTES TO BE INCLUDED ON CONSTRUCTION DRAWINGS.

- TOP OF RING WALL SHALL BE MADE LEVEL TO AVOID LARGE DEFORMATIONS THAT CAN ARISE FROM RELATIVELY SMALL DIFFERENCES IN RING WALL ELEVATION.
- THE RING WALL SHALL BE LEVEL WITHIN 6mm (± 3 mm) IN A PERIMETER OF 10m AND THAT NO TWO POINTS ON THE WALL SHALL DIFFER IN ELEVATION BY MORE THAN 12mm (± 6 mm).
- IF POSSIBLE AVOID SITUATIONS, WHERE TANK RESTS PARTLY ON CUT AND PARTLY IN FILL. IF THIS IS UNAVOIDABLE, ENSURE THAT FILL IS OF A READILY COMPACTIBLE MATERIAL AND THAT IT IS WELL COMPACTED.

FILE NAME: 43558 SH. 3 OF 8



PROJECT ENGINEERING
BHEL HYDERABAD

RING WALL FOUNDATION
FOR STORAGE TANKS

DRAWING NO.

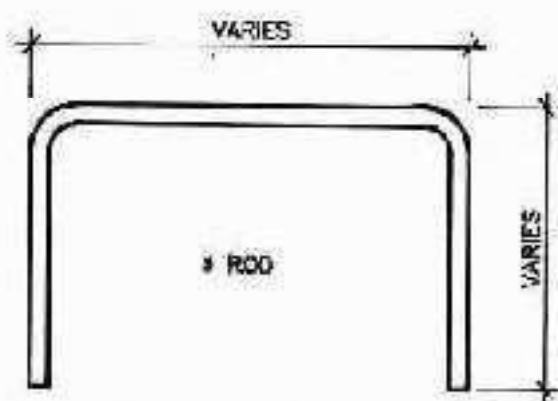
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4-38144-00035 00

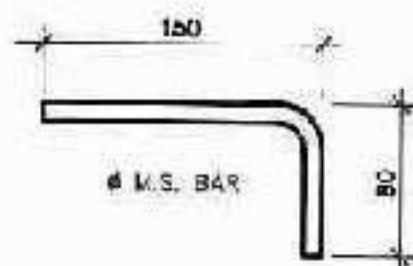
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CIVIL ENGINEERING

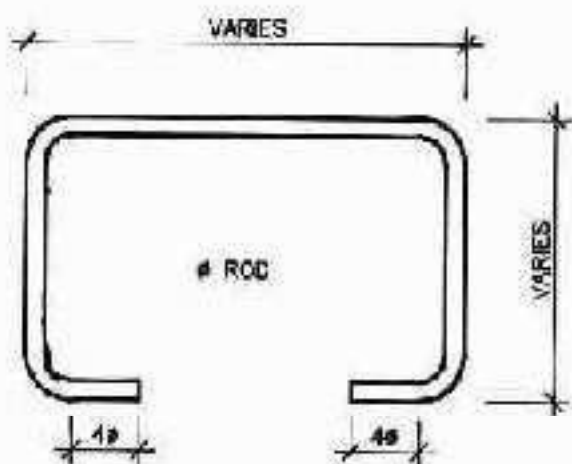
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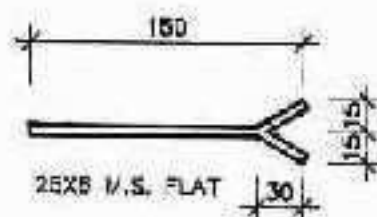
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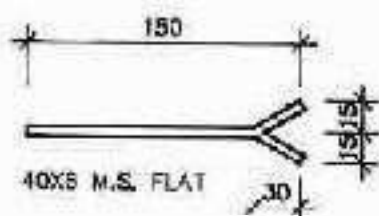
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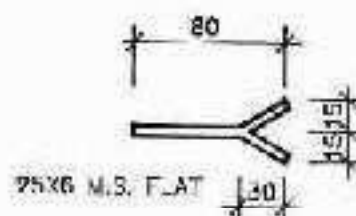
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TYPE - 'C1'



TYPE - 'C2'



TYPE - 'C3'

FILE NAME: 436



PROJECT ENGINEERING
BHEL HYDERABAD

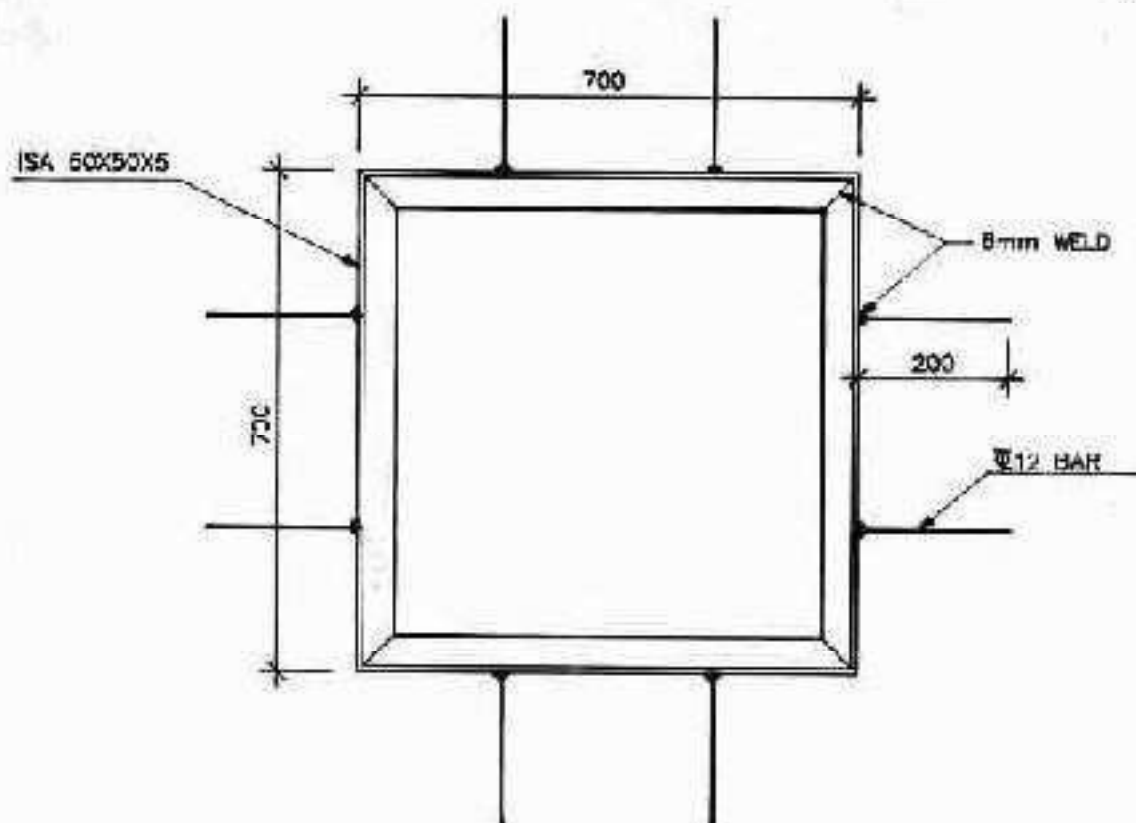
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DRAWING NO.	REV
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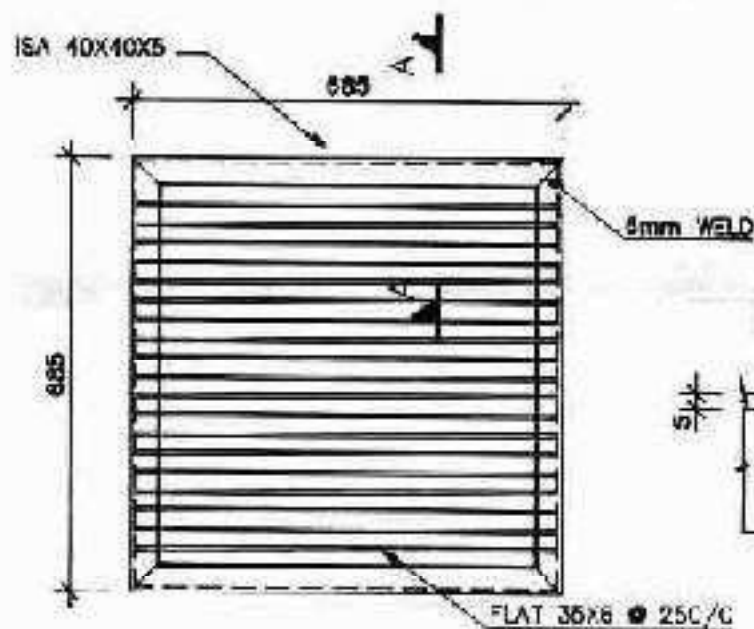
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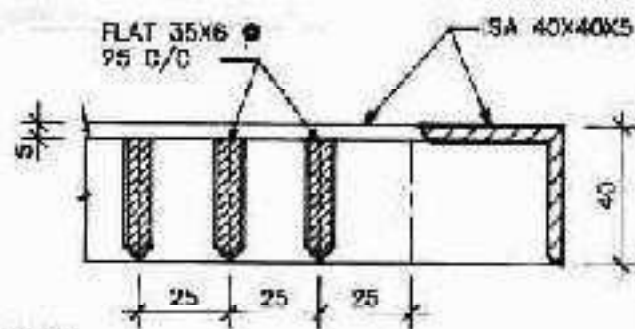
NO	DATE	REVISION	DRN	CHD	APPD
0	03.08.93	ISSUED AS STANDARD			



DETAIL OF FRAME



DETAIL OF GRATING



SECTION A A

FILE NAME 437 SHT. 1 OF 1



PROJECT ENGINEERING
BHEL HYDERABAD

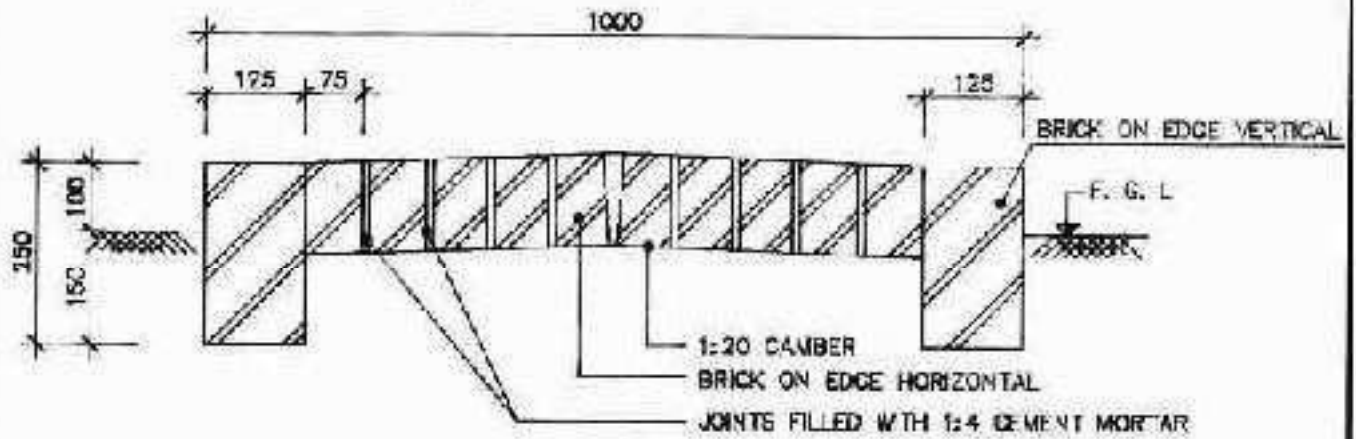
GRATING DETAIL FOR
CATCH BASIN

DRAWING NO.	REV
4-38144-00037	00

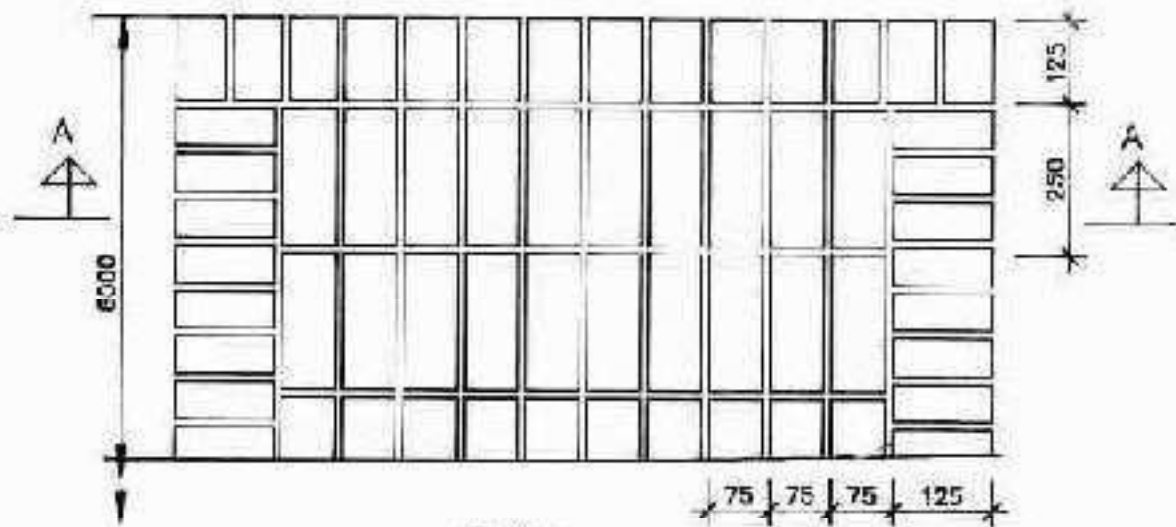
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0	03.08.06	ISSUED AS STANDARD			



SECTION A-A

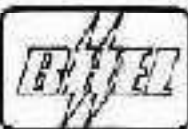


PLAN

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETERS.
2. AFTER EVERY 6000 LENGTH OF FOOTPATH A BREAK OF 100mm WIDTH SHALL BE LEFT UNPAVED TO ALLOW THE SURFACE DRAINAGE

FILE NAME 435 SHT. 1 OF 1



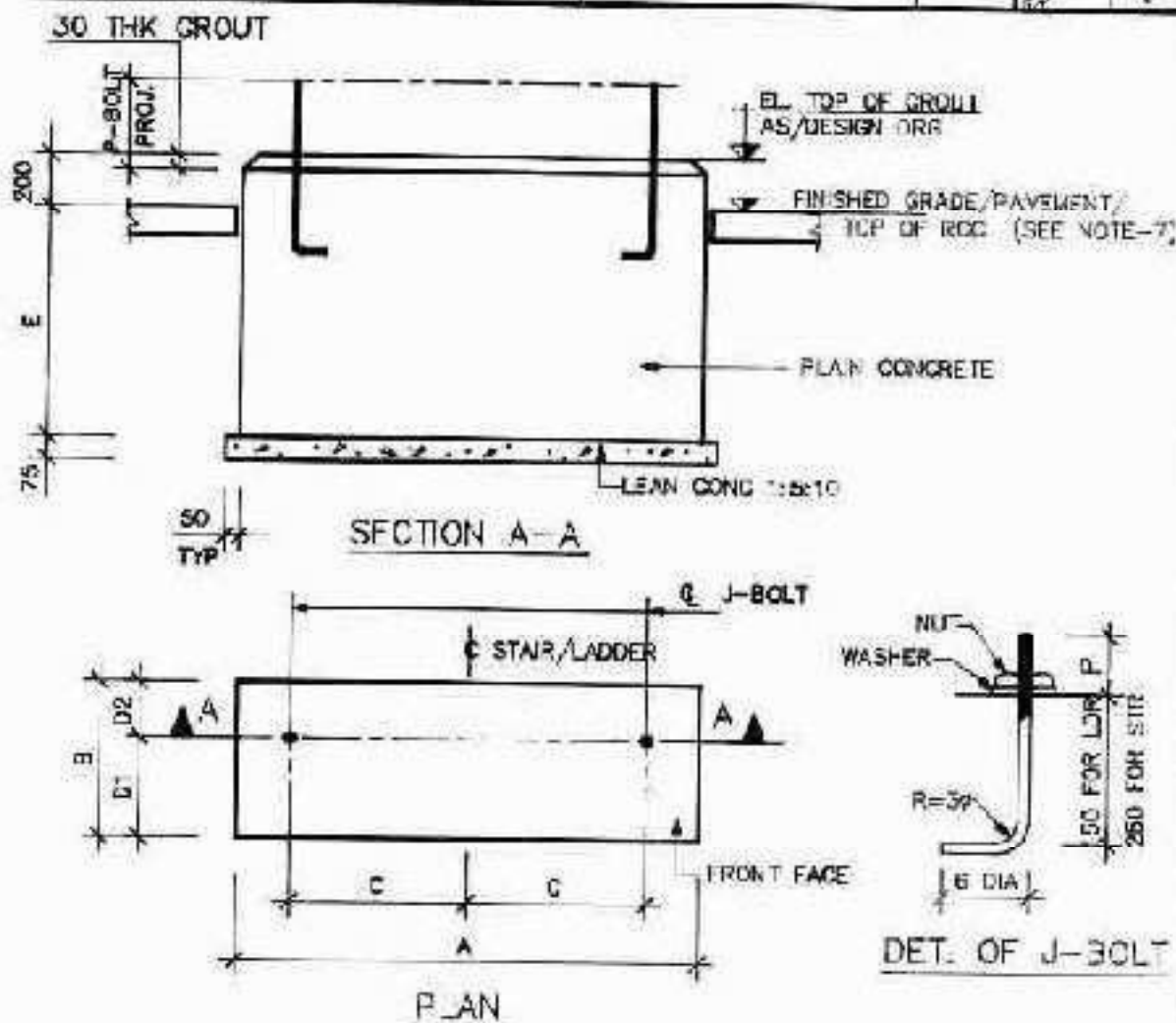
PROJECT ENGINEERING
BHEL HYDERABAD

FOOTPATHS

DRAWING NO.	REV
4-38144-00038	00

CIVIL ENGINEERING

NO	DATE	REVISION	DRN	CHD	APPD
0	08.08.93	ISSUED AS STANDARD			



S.NO	ITEM	WIDTH	A	B	C	D1	D2	P	E	NUT	REMARKS
1	LADDER	450	750	300	280	200	100	70	500	SINGLE	
2	STAIR	750	1100	310	440	210	100	100	600	DOUBLE	FOR STRINGER BEAM
3	STAIR	750	1100	355	440	255	100	100	600	DOUBLE	FOR STRINGER BEAM

NOTES :

- IN CASE OF PEDESTAL OVER PILE CAP DIMENSION L TO SUIT ACCORDINGLY BUT NOT TO EXCEED VALUES GIVEN IN ABOVE
- CONCRETE SHALL BE OF GRADE M-15 /M20
- PROVIDE J-BOLT OF $\phi 12$ FOR LADDERS AND $\phi 20$ FOR STAIRS AS/DETAIL GIVEN ABOVE
- BOLTS SHALL BE TURNED FROM MILD STEEL BARS CONFORMING TO IS:226 OR IS:432 GR-1
- HEXAGONAL NUTS AND WASHERS SHALL CONFORM TO IS:1365 AND IS:3178
- THREADING SHALL BE COARSE AND CONFORM TO IS:1367 AND IS: 4218
- THE PEDESTAL ON RCC FLOOR SLAB SHALL BE MADE MONOLITHIC WITH RCC SLAB TO SUIT THE ABOVE WITH DIMENSION E-O ; IN SUCH CASES THE PEDESTAL PORTION SHALL BE REINFORCED WITH 8 ϕ BARS AT 150 (INVERTED U-SHAPE) BOTH WAYS.

FILE NAME 439 SHT. 1 OF 1



PROJECT ENGINEERING
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PEDESTAL FOR
STAIR / LADDER

DRAWING NO. REV
4-38144-00039 00

CIVIL ENGINEERING

NO	DATE	REVISION	DRN	CHD	APPD
0	03.08.98	ISSUED AS STANDARD		<i>[Signature]</i>	<i>[Signature]</i>

INTRODUCTION :

THIS STANDARD ON WELDING SYMBOLS HAS BEEN MADE TO INCORPORATE THE REQUIREMENTS OF THE REVISED IS (INDIAN STANDARD) CODE ON 'SCHEME OF SYMBOLS FOR WELDING' (IS : 813-1986).

WITH A VIEW TO FACILITATE ITS USAGE, AND TO MINIMIZE THE CHANCES OF ERROR IN THE TRANSITION PERIOD, THE STANDARD GIVES THE REQUIREMENTS OF BOTH THE EARLIER IS : 813-(1961) AS WELL AS THE REVISED IS : 813-(1986).

THIS STANDARD ON WELDING SYMBOLS SHALL BE USED ON DRAWINGS FOR ALL JOBS. SPECIFIC MENTION SHALL BE MADE ON DRAWING GIVING REFERENCE TO USE OF THE REVISED IS : 813-(1986).
SYMBOLS FOR WELDING.

FILE NAME : 44CSI SHT. 1 OF 6



PROJECT ENGINEERING
BHEL HYDERABAD

WELDING SYMBOLS

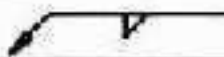
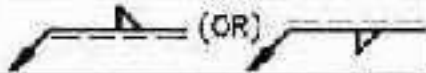
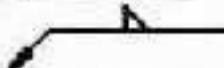
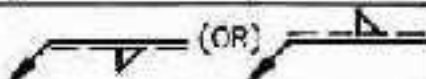
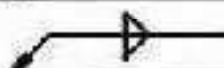
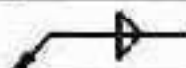
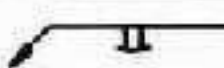
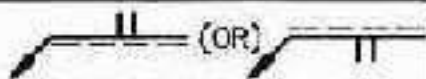
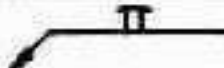
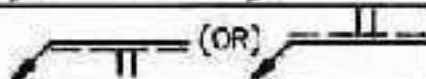
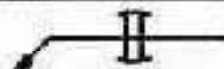
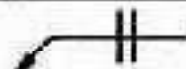
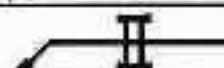
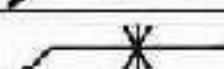
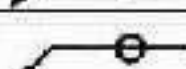
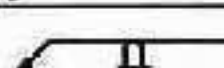
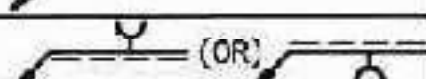
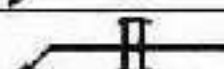
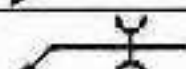
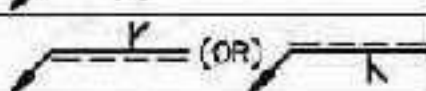
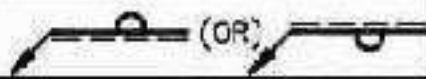
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4-38144-00040	00

CIVIL ENGINEERING

NO	DATE	REVISION	DRN	CHD	APPD
0	03.08.93	ISSUED AS STANDARD			

STANDARD BASIC SYMBOLS FOR WELDING

REF. IS : 813-1961/1986

S.NO	INSTRUCTIONS	DRG REPRESENTATION IS : 813-1961	DRG REPRESENTATION S : 813-1986
1.	NEAR SIDE FILLET WELD		
2.	FAR SIDE FILLET WELD		
3.	BOTH SIDE FILLET WELD		
4.	WELD ALL ROUND		
5.	SITE WELD		
6.	SQUARE BUTT NEAR SIDE		
7.	SQUARE BUTT FAR SIDE		
8.	SQUARE BUTT BOTH SIDE		
9.	SQUARE BUTT BOTH SIDE GRINDING FINISH		
10.	SPOT WELD		
11.	SINGLE U BUTT (NEAR SIDE)		
12.	DOUBLE -U BUTT.		
13.	SINGLE BEVEL BUTT WELD WITH BROAD ROOT FACE (NEAR SIDE)		
14.	BACKING RUN, BACK RUN BACKING WELD (NEAR SIDE).		

FILE NAME : 44052 SFT. 2 OF 6



PROJECT ENGINEERING
BHEL HYDERABAD

WELDING SYMBOLS

DRAWING NO.

REV

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0	03.08.93	ISSUED AS STANDARD			

STANDARD BASIC SYMBOLS FOR WELDING

REF. IS : B13-1981/1986

S.NO	INSTRUCTIONS	DRG REPRESENTATION IS : B13-1981	DRG REPRESENTATION S : B13-1986
15	SINGLE-V BUTT NEAR SIDE		
16	SINGLE-V BUTT FAR SIDE		
17	DOUBLE-V BUTT		
18	DOUBLE-V BUTT GRINDING FINISH		
19	SINGLE BEVEL-BUTT NEAR SIDE		
20	SINGLE BEVEL-BUTT FAR SIDE		
21	DOUBLE BEVEL-BUTT		
22	DOUBLE BEVEL-BUTT GRINDING FINISH		
23	STITCH WELD		
24	PLUG OR SLOT WELD (NEAR SIDE)		
25	SINGLE J-BUTT FAR SIDE		
26	DOUBLE J-BUTT		
27	BUTT WELD BETWEEN PLATES WITH RAISED EDGES (NEAR SIDE)		
28	SINGLE-V BUTT WELD WITH BOARD ROOT FACE (NEAR SIDE)		
29	SEAM WELD		

FILE NAME : 11063 SHT. 3 OF 6



PROJECT ENGINEERING
BHEL HYDERABAD

WELDING SYMBOLS

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4-38144-00040	00

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NO	DATE	REVISION	DRN	CHD	APPD
0	03.08.86	ISSUED AS STANDARD			

SUPPLEMENTARY SYMBOLS (IS : 813-1986)

SHAPE OF WELD SURFACE	SYMBOL
(a) FLAT (USUALLY FINISHED FLUSH)	—
(b) CONVEX	⌒
(c) CONCAVE	⌒

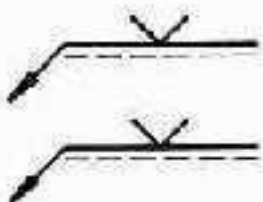
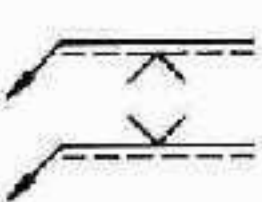
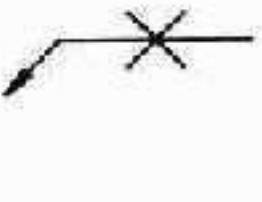
EXAMPLE OF APPLICATION OF SUPPLEMENTARY SYMBOLS

IS : 813-1986

DESIGNATION	SYMBOL
FLAT (FLUSH) SINGLE-V BUTT WELD	∇
CONVEX DOUBLE-V BUTT WELD	⋈
CONCAVE FILLET WELD	⌒
FLAT (FLUSH) SINGLE-V BUTT WELD WITH FLAT (FLUSH) BACKING RUN	∇ —

POSITION OF SYMBOL ACCORDING TO THE REFERENCE LINE

IS : 813-1986

 a) TO BE WELDED ON ARROW SIDE.	 b) TO BE WELDED ON OTHER SIDE	 c) FOR SYMMETRICAL WELDS ONLY

FILE NAME : 44054 SHT. 4 OF 6



PROJECT ENGINEERING
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WELDING SYMBOLS

DRAWING NO. REV

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0	03.04.83	ISSUED AS STANDARD			

METHOD OF INDICATING DIMENSIONS OF WELDS: (IS: 813-'886)

S. NO	DESIGNATION OF WELDS	DEFINITION	INSCRIPTION
1	BUTT WELD		$\begin{array}{c} \text{a} \sqrt{\quad} \\ \text{||} \\ \text{Y} \end{array}$
2	BUTT WELD BETWEEN PLATES WITH RAISED EDGES		$\begin{array}{c} \text{a} || \end{array}$
3	CONTINUOUS FILLET WELD		$\begin{array}{c} \text{a} \triangle \\ \text{(OR)} \times \triangle \end{array}$
4	INTERMITTENT FILLET WELD		$\begin{array}{c} \text{a} \triangle n \times l \text{ (a)} \\ \text{(OR)} \times \triangle n \times l \text{ (a)} \end{array}$
5	STAGGERED INTERMITTENT FILLET WELD		$\begin{array}{c} \frac{\text{a}}{2} \triangle n \times l \text{ (a)} \\ \frac{\text{a}}{2} \triangle n \times l \text{ (a)} \\ \text{(OR)} \times \frac{\text{a}}{2} \triangle n \times l \text{ (a)} \\ \times \frac{\text{a}}{2} \triangle n \times l \text{ (a)} \end{array}$
6	PLUG OR SLOT WELD		$\text{a} \text{---} n \times l \text{ (a)}$
7	SEAM WELD		$\text{c} \text{---} n \times l \text{ (a)}$
8	PLUG WELD		$\text{d} \text{---} n \times \text{a}$
9	SPOT WELD		$\text{d} \text{---} n \times \text{a}$

NOTE: 'n' INDICATES NUMBER OF WELD ELEMENTS

"l" INDICATES LENGTH OF WELD (WITHOUT END CRATERS)

FILE NAME : 44055 SHT. 5 OF 6



PROJECT ENGINEERING
BHEL HYDERABAD

WELDING SYMBOLS

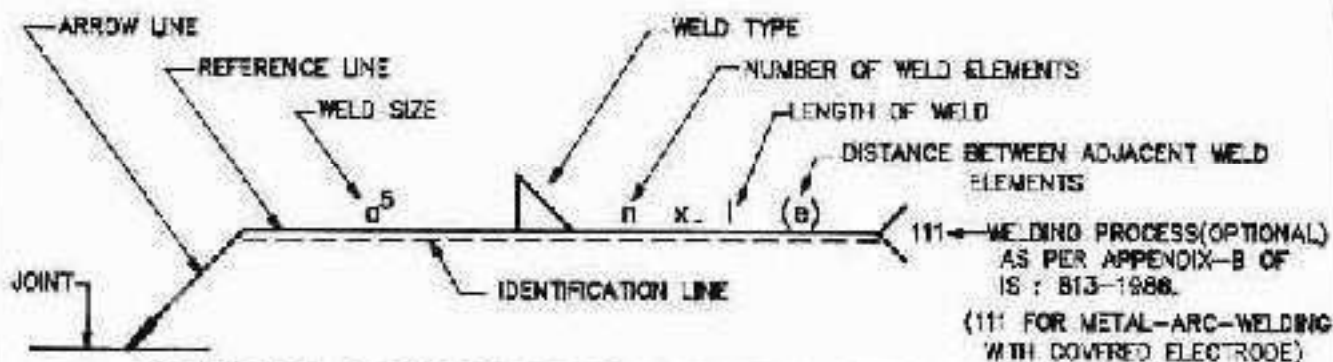
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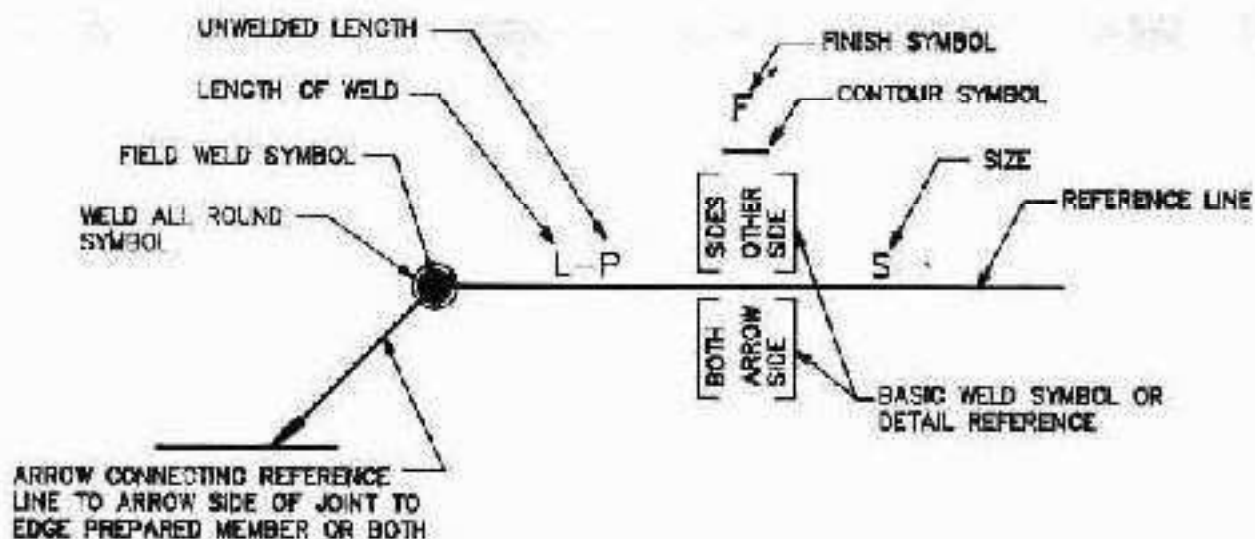
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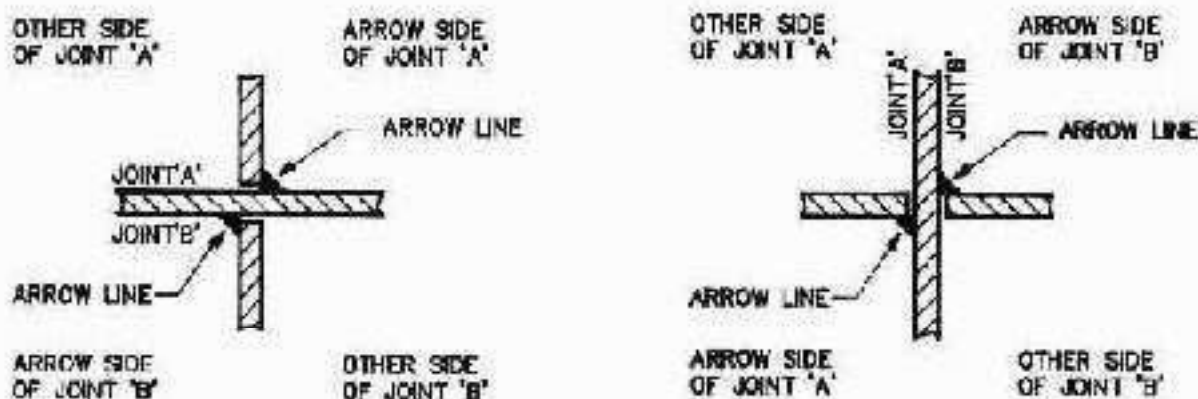
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0	03.08.80	ISSUED AS STANDARD			



STANDARD REPRESENTATION OF WELDS IN DRAWINGS IS : 813-1988



STANDARD REPRESENTATION OF WELDS IN DRAWINGS IS : 813-1981



POSITION OF WELDING SYMBOL ACCORDING TO THE REFERENCE LINE

FILE NAME : 44058 SHT. 6 OF 6



PROJECT ENGINEERING
BHEL HYDERABAD

WELDING SYMBOLS

DRAWING NO. REV

4-38144-00040 00

CIVIL ENGINEERING

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0	03.08.83	ISSUED AS STANDARD		<i>b...</i>	<i>...</i>

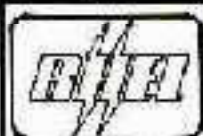
LAP LENGTH FOR H.Y.D. BARS (IN mm)

BAR DIA (mm)	LAP LENGTH OF BARS			
	GRADE OF CONCRETE			
	M-15	M-20	M-25	M-30
6	410	310	270	250
8	550	410	370	330
10	600	510	450	410
12	820	620	550	490
16	1100	820	730	660
18	1230	920	820	740
20	1370	1030	910	820
22	1510	1130	1000	900
25	1710	1280	1140	1030
28	1820	1440	1280	1150
32	2190	1640	1450	1310
36	2450	1850	1640	1480

NOTES :

1. BASED ON SP : 16 (S & T) - 1980, DESIGNS TO BS : 456-1978 AND APPLICABLE TO WORKING STRESS METHOD OF DESIGN.
2. THIS TABLE SHALL BE USED FOR WATER RETAINING STRUCTURES : CIRCULAR DKS & CHIMNEYS

FILE NAME: 44151 SHEET 1 OF 2



**PROJECT ENGINEERING
BHEL HYDERABAD**

**STANDARD LAPS & HOOKS
FOR REINFORCEMENT**

DRAWING NO.

REV

4-38144-00041 00

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NO DATE

0 03.08.88

REVISION

ISSUED AS STANDARD

DRN

CIID

APPD

6/8/88 2/8/88

LAP LENGTH FOR H.Y.D. BARS IN mm

BAR DIA (mm)	LAP LENGTH OF BARS			
	GRADE OF CONCRETE			
	M-5	M-20	M-25	M-30
6	340	280	340	230
8	400	380	320	300
10	580	470	400	380
12	680	580	480	400
16	900	760	650	600
18	1020	850	730	680
20	1130	940	810	750
22	1240	1030	890	830
25	1410	1180	1010	910
28	1580	1320	1130	1050
32	1810	1500	1280	1200
36	2030	1690	1450	1350

NOTES :

1. THE LAP LENGTHS GIVEN ABOVE ARE FOR LIMIT STATE / ULTIMATE STRESS METHOD OF DESIGN, BASED ON SP - 16 (S & T) - 1980 IN CONJUNCTION WITH IS : 456-1978.
2. THIS TABLE SHALL BE FOLLOWED FOR ALL R.C.C STRUCTURES EXCEPT FOR WATER RETAINING STRUCTURES, CIRCULAR BINS & CHIMNEYS.

FILE NAME 44/52

SH. 2 OF 5



PROJECT ENGINEERING
BHEL HYDERABAD

STANDARD LAPS & HOOKS
FOR REINFORCEMENT

DRAWING NO.

REV

4-38144-00041

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CIVIL ENGINEERING

NO	DATE	REVISION	DRN	CHD	APPD
0	03.08.88	ISSUED AS STANDARD			

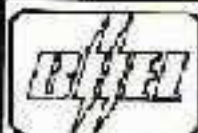
LAP LENGTH FOR PLAIN ROUND BARS (IN mm)

BAR DIA (mm)	LAP LENGTH OF BARS			
	GRADE OF CONCRETE			
	M-15	M-20	M-25	M-30
6	350	280	230	210
8	420	350	310	280
10	580	410	390	350
12	700	530	470	420
16	930	700	620	580
18	1050	790	700	640
20	1170	880	780	700
22	1190	890	790	720
25	1350	1020	900	810
28	1520	1140	1010	910
32	1730	1300	1180	1040
36	1950	1480	1300	1170

NOTES :

1. BASED ON SP : 16 (S & T) - 1980, DESIGNS TO IS : 456-1978 AND APPLICABLE TO WORKING STRESS METHOD OF DESIGN.
2. THIS TABLE SHALL BE USED FOR WATER RETAINING STRUCTURES ; CIRCULAR MANS & CHIMNEYS

FILE NAME 44153 SHT. 3 OF 5



PROJECT ENGINEERING
BHEL HYDERABAD

STANDARD LAPS & HOOKS
FOR REINFORCEMENT

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LAP LENGTH FOR PLAIN ROUND BARS (IN mm)

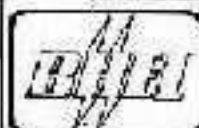
BAR DIA (mm)	LAP LENGTH OF BARS			
	GRADE OF CONCR. II			
	M-15	M-20	M-25	M-30
6	330	270	250	270
8	440	360	310	290
10	540	450	390	360
12	650	540	470	440
16	870	730	620	580
18	980	820	700	650
20	1080	910	780	730
22	1150	960	820	770
25	1310	1080	930	870
28	1460	1220	1040	970
32	1670	1390	1180	1110
36	1820	1570	1340	1250

NOTES :

1. THE LAP LENGTHS GIVEN ABOVE ARE FOR LIMIT STATE / ULTIMATE STRESS METHOD OF DESIGN BASED ON SP : 34 (S & I) - 1983 DESIGN AIDS TO IS : 456-1978.
2. THIS TABLE SHALL BE FOLLOWED FOR ALL R.C.C STRUCTURES EXCEPT FOR WATER RETAINING STRUCTURES, CIRCULAR BINS & CHIMNEYS.

FILE NAME : 44154

SHT. 4 OF 5



PROJECT ENGINEERING
BHEL HYDERABAD

STANDARD LAPS & HOOKS
FOR REINFORCEMENT

DRAWING NO.

REV

4-38144-00041

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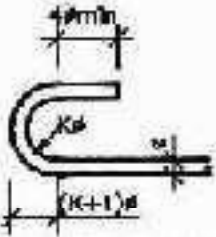
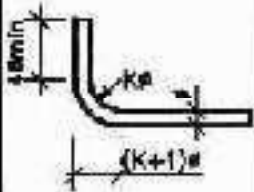
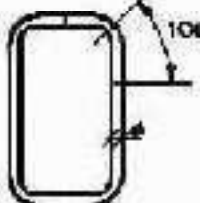
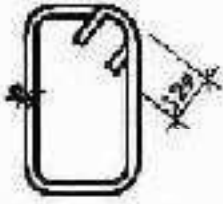
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02.08.93

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ANCHORAGE VALUE OF HOOKS & BENDS (IN mm)

SHAPE	BAR #	6	8	10	12	16	18	20	22	25	28	32	36
 STANDARD HOOK		95	130	160	190	255	290	320	350	400	450	510	575
 STANDARD 90° BEND		60	85	80	95	130	145	160	175	200	225	265	290
 FOR HYD. BARS		120	180	200	240	320	360	400	440	500	580	640	720
 FOR PLAIN BARS		145	180	210	260	385	430	480	530	600	670	770	865

MIN. K VALUE FOR MILD STEEL = 2

MIN K VALUE FOR HIGH YIELD DEFORMED BARS = 4

- ABOVE TABLE IS APPLICABLE TO ALL GRADES OF RE-BARS UNLESS NOTED.
- HOOKS & BENDS SHALL CONFORM TO THE DETAILS AS SHOWN.
- HOOKS & BENDS ARE BASED ON SP : 16(S & T) -1980, DESIGN AIDS TO IS: 156-'878

FILE NAME 44155

SHT. 5 OF 5



PROJECT ENGINEERING
BHEL HYDERABAD

STANDARD LAPS & HOOKS
FOR REINFORCEMENT

DRAWING NO.

4-38144-00041

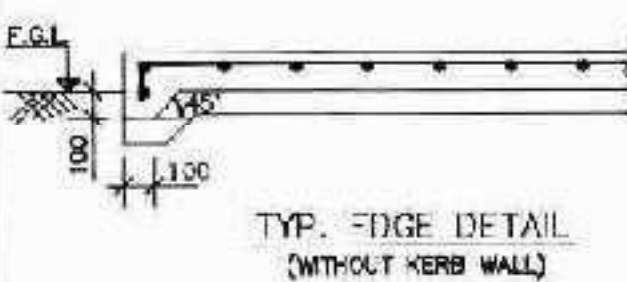
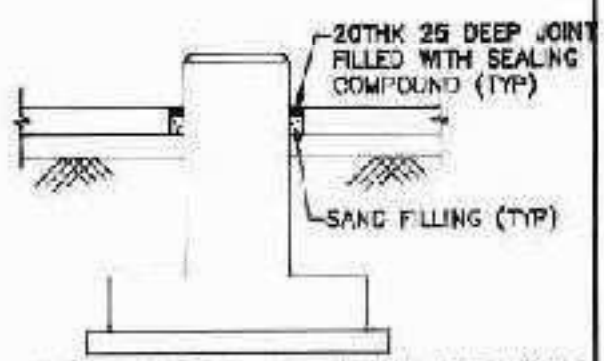
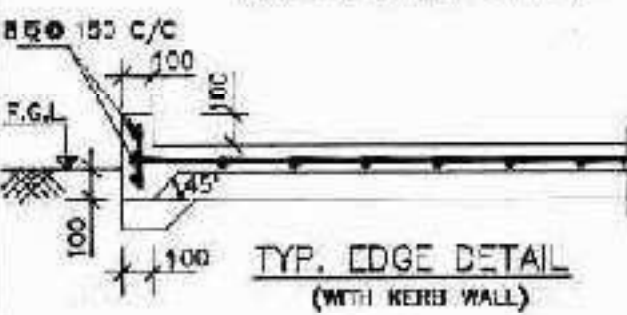
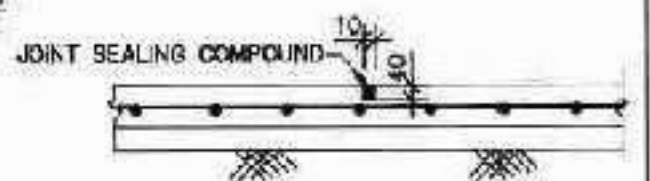
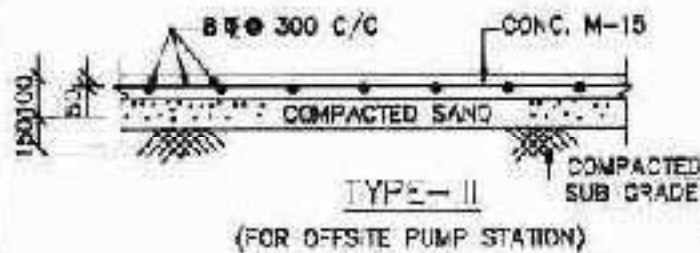
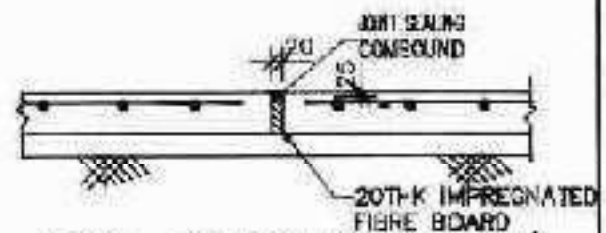
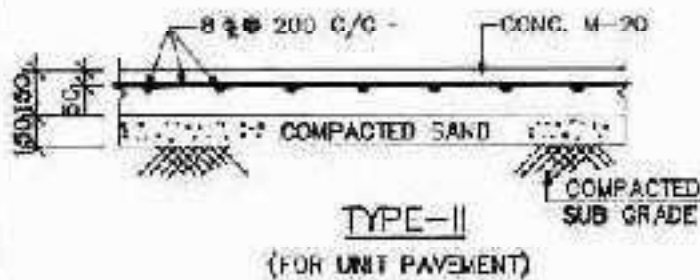
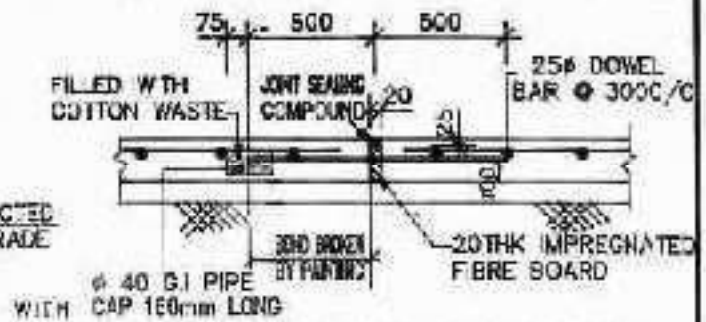
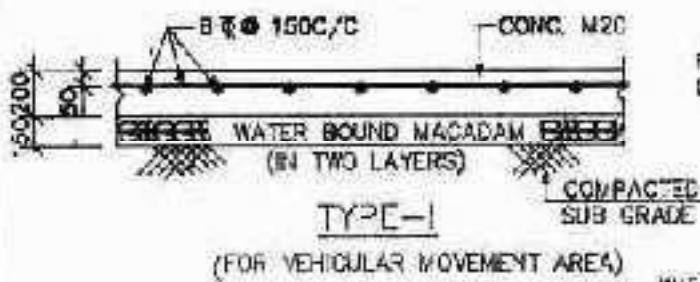
REV

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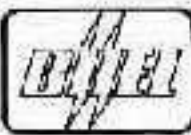
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CIVIL ENGINEERING

NO	DATE	REVISION	DRN	CHD	APPD
0	08.08.93	ISSUED AS STANDARD			



FILE NAME 44251 SHT. 1 OF 2



PROJECT ENGINEERING
BHEL HYDERABAD

R.C.C. PAVEMENT
DETAILS

DRAWING NO.	REV
4-38144-00042	00

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CIVIL ENGINEERING	NO	DATE	REVISION	DRN	CHD	APPD
	0	03.08.83	ISSUED AS STANDARD			

NOTES :

1. ALL DIMENSIONS ARE IN MILLIMETRES.
2. CONC. SHALL CONFORM TO IS : 456.
3. Φ DENOTES HIGH YIELD DEFORMED BARS CONFORMING TO IS : 1786
4. JOINT SEALING COMPOUND IN PAVING & AROUND EQUIPMENT FOUNDATIONS SHALL CONFORM TO IS : 1834 TYPE B.
5. EXPANSION JOINT FILLER MATERIAL SHALL BE PREMCULDED FIBRE IMPREGNATED FELT CONFORMING TO IS : 1838.
6. CONC. PAVING SHALL BE SLOPED TO 1:100 UNLESS OTHERWISE SHOWN IN DETAIL ENGINEERING DRG.
7. SUB GRADE SHALL BE THOROUGHLY COMPACTED TO PROPER SLOPE & GRADE BEFORE LAYING WBM/COMPACTED SAND FILLING.
8. SAND SHALL BE COMPACTED TO 90% LAB MAX. DRY DENSITY THE COMPACTED SAND FILLING TO BE SATURATED WITH WATER BEFORE CONCRETING.
9. CONC. PAVEMENT SHALL BE LAID IN ALTERNATE CAST IN SITU PANELS OF 3.0Mx3.0M SIZE, PANEL SIZE SHALL BE ADJUSTED AROUND COLUMNS & FOUNDATIONS.
10. EXPANSION JOINTS SHALL BE SPACED AT 15.0M C/C.

FILE NAME 442S2 | SHT. 2 OF 2



**PROJECT ENGINEERING
BHEL HYDERABAD**

**R.C.C. PAVEMENT
DETAILS**

DRAWING NO.	REV
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REVISION

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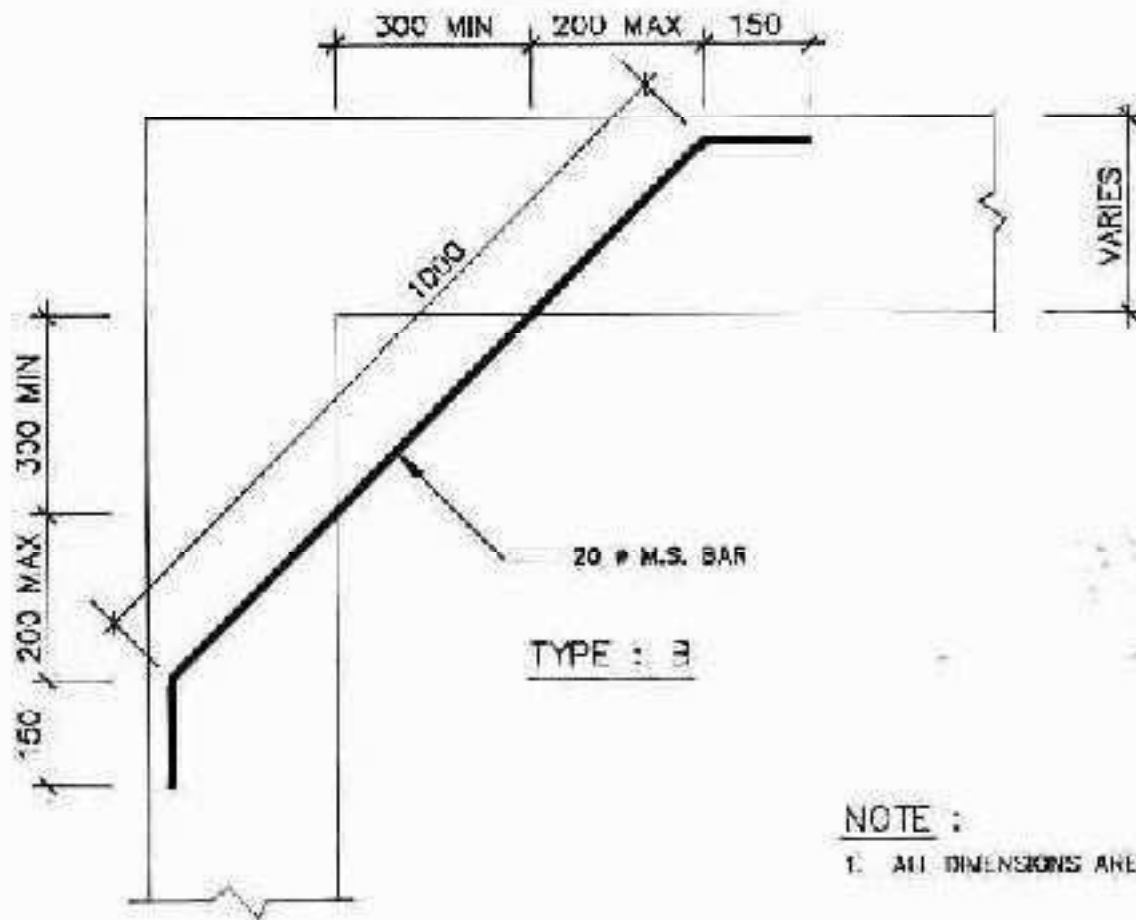
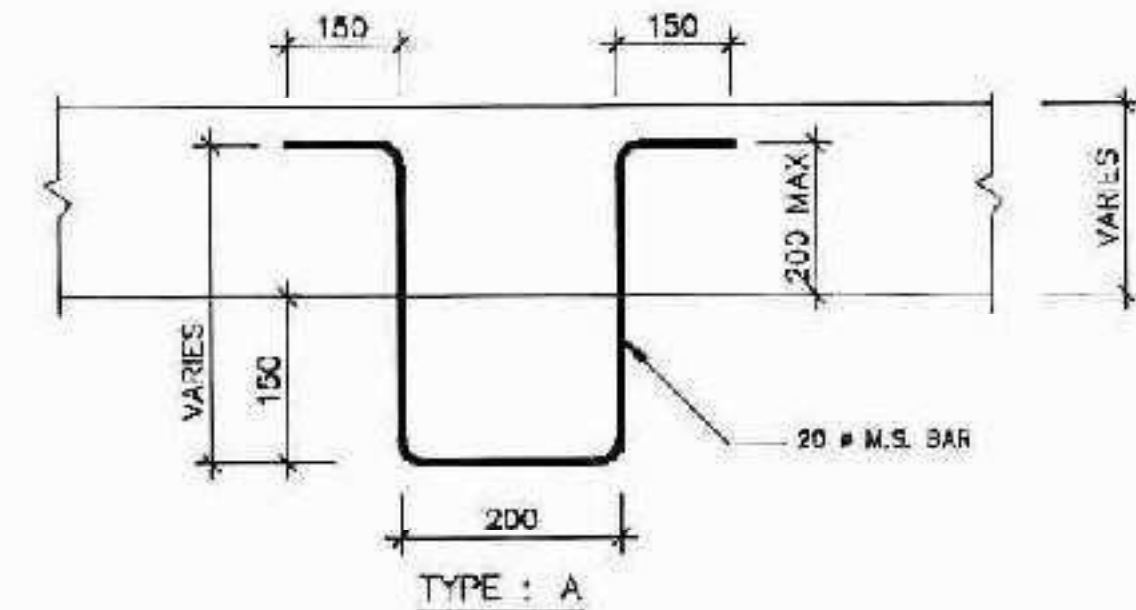
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03.04.88

ISSUED AS STANDARD



NOTE :

1. ALL DIMENSIONS ARE IN MM.

FILE NAME 113

SPT. 1 OF 1

PROJECT ENGINEERING
BHEL HYDERABAD

DETAILS OF M.S. RUNGS

DRAWING NO.

REV

4-38144-00043

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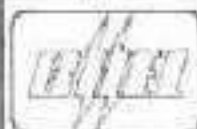
CIVIL ENGINEERING

NO	DATE	REVISION	DRN	CHD	APPR
0	03.08.99	ISSUED AS STANDARD			flr

NOTES:

- THIS STANDARD IS BASED ON FOLLOWING PRINCIPLE OF LAYING CABLES IN THE PLANT AREA
 - UNIT AREA - CABLES IN RCC TRENCH/BRICK MASONRY TO BE FILLED WITH SAND AND COVERED WITH PRECAST RCC SLABS.
 - INSIDE BUILDING - CABLES IN RCC TRENCH TO BE COVERED WITH CHEQUERED PLATE/RCC PRECAST COVERS
 - OFFSITE AREA - NO TRENCH TO BE LAID UNDER GROUND OR OVERHEAD.
- ELECTRICAL DEPTT. WILL PROVIDE FOLLOWING INFORMATION ON THEIR DRAWINGS WHICH WILL BE ISSUED FOR CONSTRUCTION:
 - LAYOUT AND SIZE OF THE CABLE TRENCH.
 - TYPE OF COVER REQUIRED I.e. PRECAST RCC / CHEQR. PLATE.
 - LIVE LOAD ON THE COVERS IF MORE THAN AS DEFINED IN TABLE 1 & 2.
 - INSERT PLATE REQUIREMENT AND ITS SPACING.
 - LAYOUT AND SIZE OF OPENING FOR PANELS (SHEET 16 OF 17)
- GRADE OF CONCRETE FOR PRECAST COVER SHALL BE M-20 AND FOR CABLE TRENCH M-15 AS PER IS : 456 U.O.S IN THE DRAWING.
- CABLE TRENCH AS PER S.NO 14 TO 16 OF TABLE 5 & 6 SHALL NORMALLY BE IN BRICK MASONRY. IN CASE IT IS REQUIRED TO BE CONSTRUCTED IN RCC REBAR AND OTHER DETAILS SHALL BE SIMILAR TO S.NO 13 OF TABLE 5 & 6.
- SPECIAL PRECAST COVERS AT THE JUNCTION OF THE CABLE TRENCH SHALL PREFERABLY BE IN CAST-IN-SITU (REFER SHEET 9 OF 17 AND 10 OF 17)
- EVERY FIFTH COVER SHALL HAVE LIFTING HOOK AS PER TYPE A OR TYPE B (REFER SHEET 3 OF 17 & 15 OF 17)
- THIS STANDARD IS NOT APPLICABLE FOR CABLE TRENCH / COVERS AT ROAD CROSSING.

FILE NAME : 44851 | SHT. 1 OF 17

PROJECT ENGINEERING
BHEL HYDERABAD

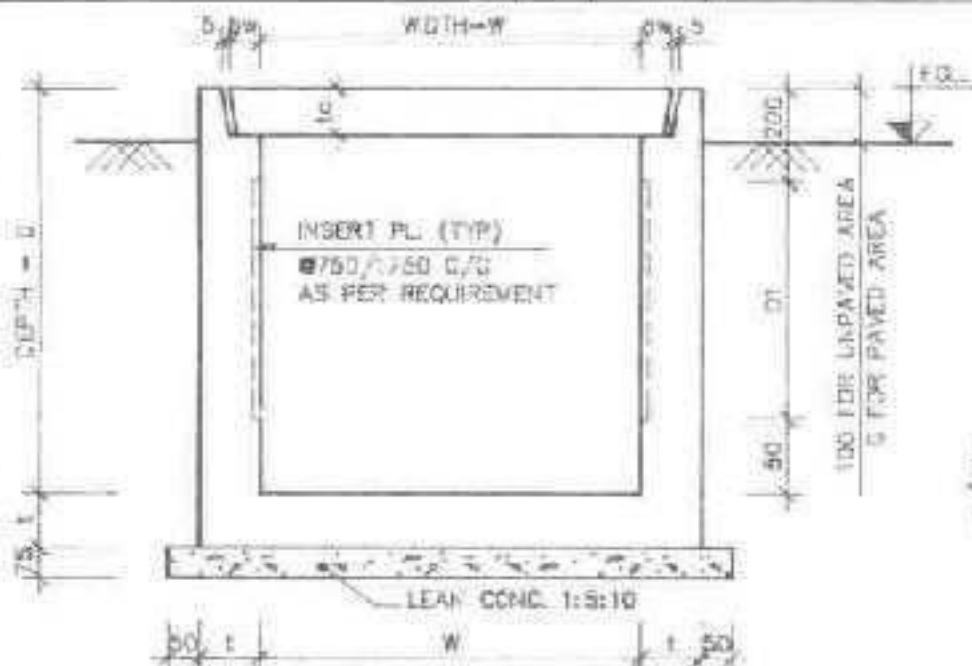
CABLE TRENCH

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4-38144-00046 00

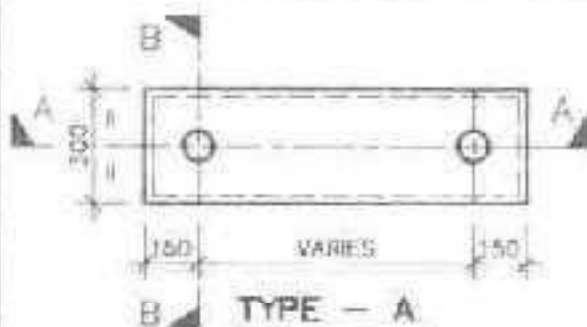
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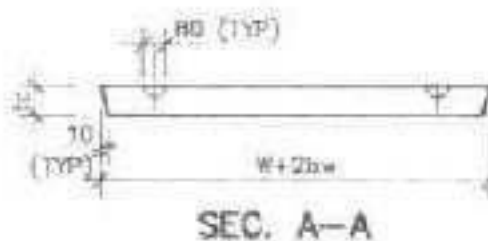
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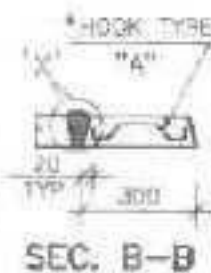
TYP. SECTION OF CABLE TRENCH



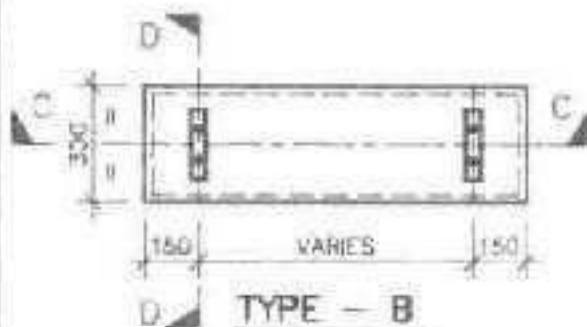
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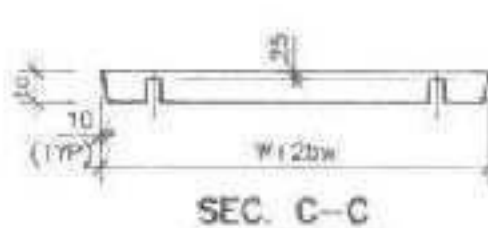
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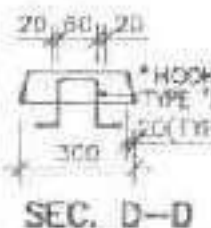
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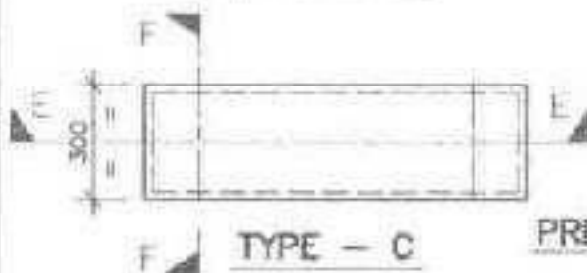
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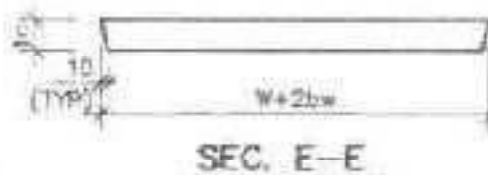
SEC. C-C



SEC. D-D



TYPE - C



SEC. E-E



SEC. F-F

* ONE HOOK FOR SPAN UP TO 500
TWO HOOKS FOR SPAN ABOVE 500

PRECAST R.C.C. COVERS

FILE NAME : 44852 SHL 2 OF 17



PROJECT ENGINEERING
BHEL HYDERABAD

CABLE TRENCH

DRAWING NO.

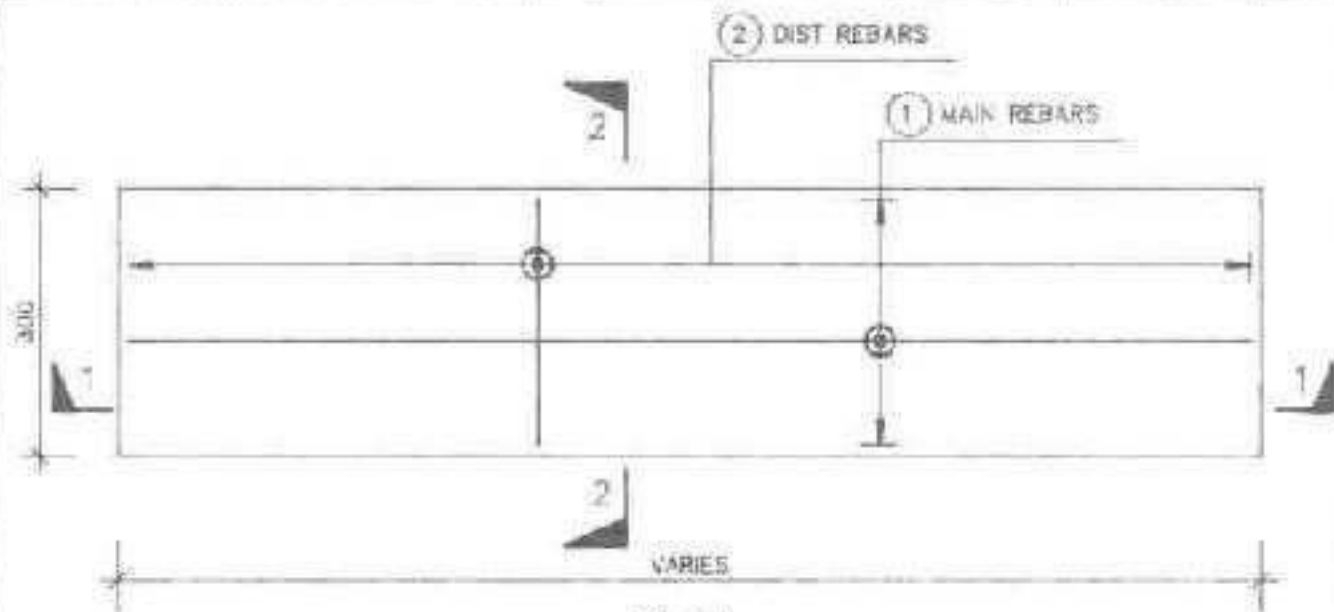
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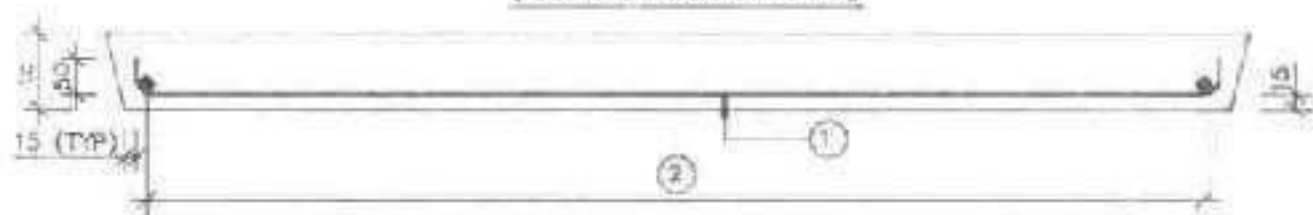
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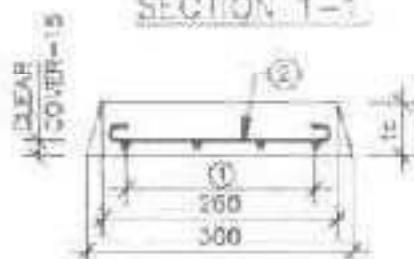
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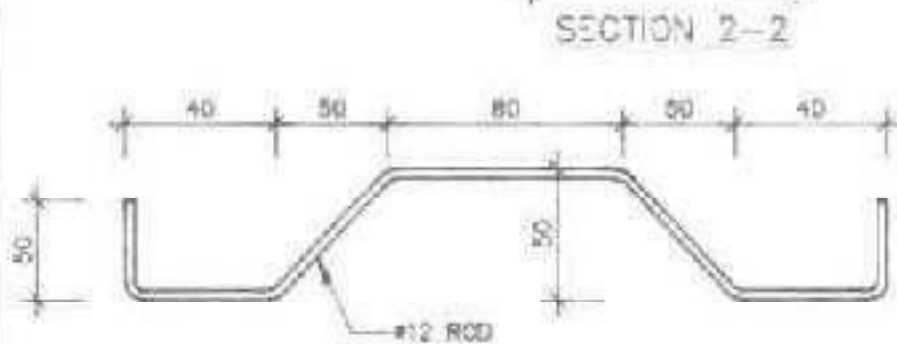
PLAN
(STANDARD PRECAST COVER)



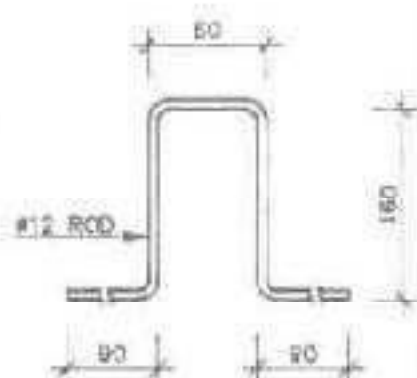
SECTION 1-1



SECTION 2-2



HOOK TYPE 'A'
(REF. SHT. 2)



HOOK TYPE 'B'
(REF. SHT. 2)

FILE NAME: 1446S3 SHT. 3 OF 17



PROJECT ENGINEERING
BHEL HYDERABAD

CABLE TRENCH

DRAWING NO. REV
4-38144-00046 00

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DATE
03.08.93

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TABLE - 1
DETAIL OF STANDARD PRECAST COVERS

DETAIL OF STANDARD PRECAST COVERS

TABLE

NO.

S.NO. TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	REINFORCEMENT DETAILS AS/ IS: 1286	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)	CONCRETE (M ³)	APPROX. QUANTITIES	SELF WEIGHT (kgs)
S.NO.	TYPE	WORKING DIMENSIONS	DESIGN LOAD ON EACH COVER	EQUIV. CONCENTRE OF SPAN LOAD AT CENTRE OF SPAN (kgs)			

NOTES :

- FOR LOCATION OF BARS MKD. 1 AND 2 REFER SHT. 3 OF 17.
- ALL PRECAST COVERS SHALL BE MARKED (T) ON THE TOP FOR PROPER PLACEMENT.
- THE QUANTITIES GIVEN ON THIS TABLE ARE FOR ESTIMATION PURPOSE ONLY.
- DESIGN S FOR EITHER TOTAL UDL OR EQUIV. POINT LOAD.



PROJECT ENGINEERING
BHEL HYDERABAD

CABLE TRENCH

FILE NAME : 446S4 SHT. 4 OF 17

DRAWING NO.

REV

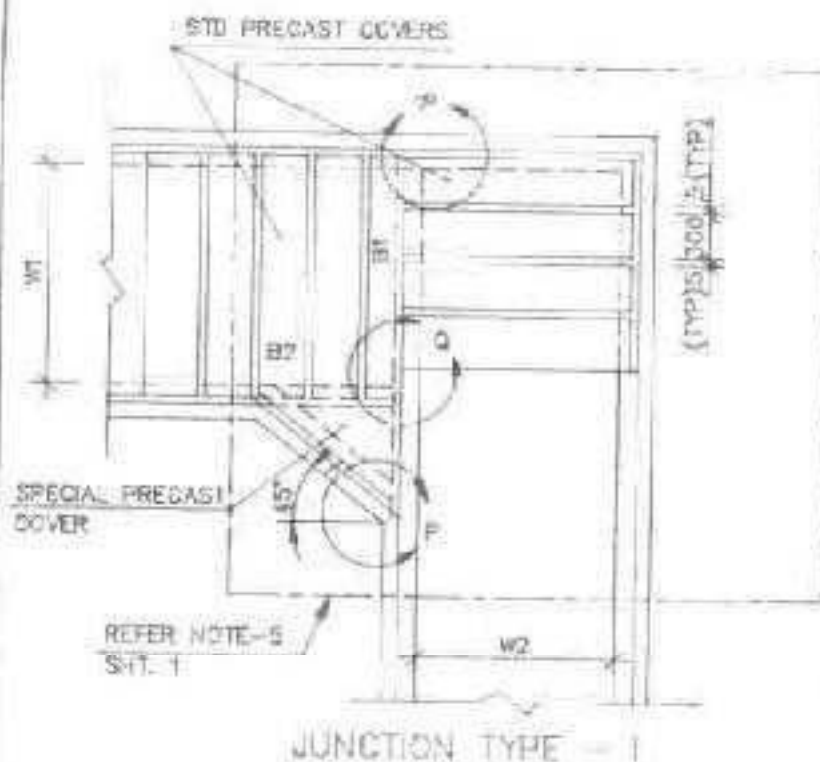
4-38144-00046 00

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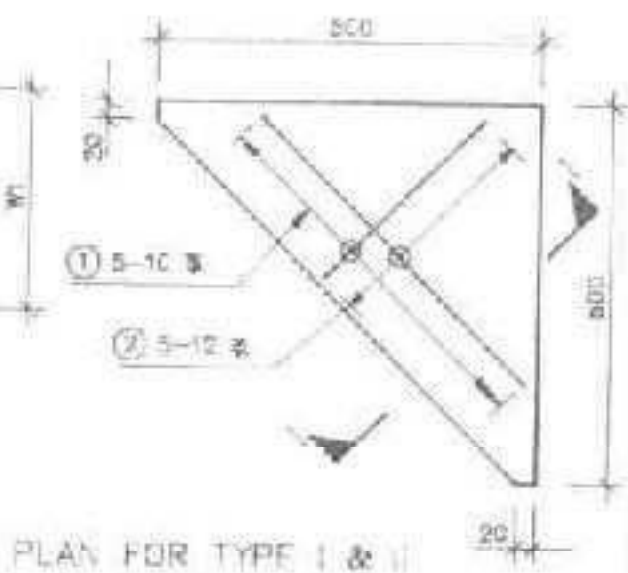
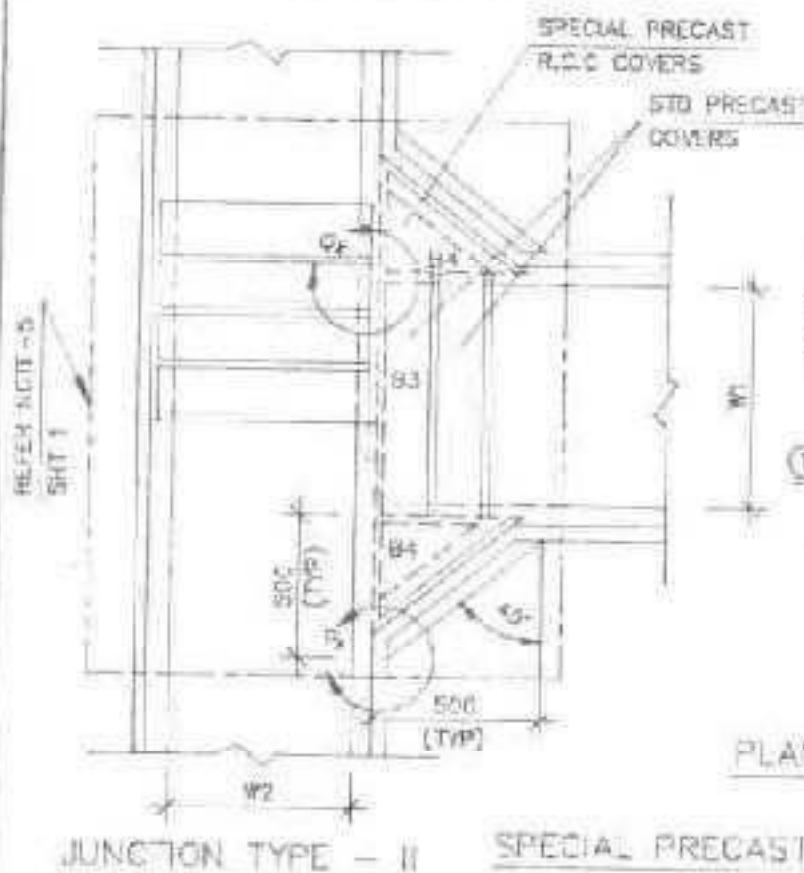
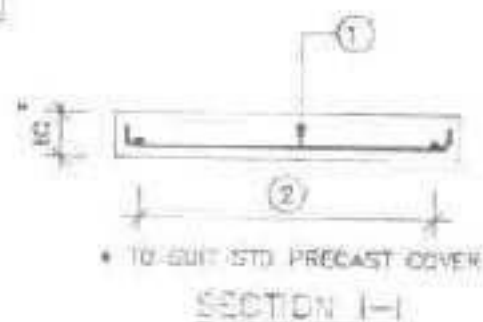
CIVIL ENGINEERING

NO	DATE	REVISION	DRN	CHD	APPD
0	03.08.93	ISSUED AS STANDARD			



NOTES :

1. FOR DETAILS P.Q. & R REFER SHT. 6 OF 17
2. FOR DETAIL OF BEAMS B1 TO B4 REFER TABLE 2



FILE NAME : 44055 SHT. 5 OF 17



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BHEL HYDERABAD

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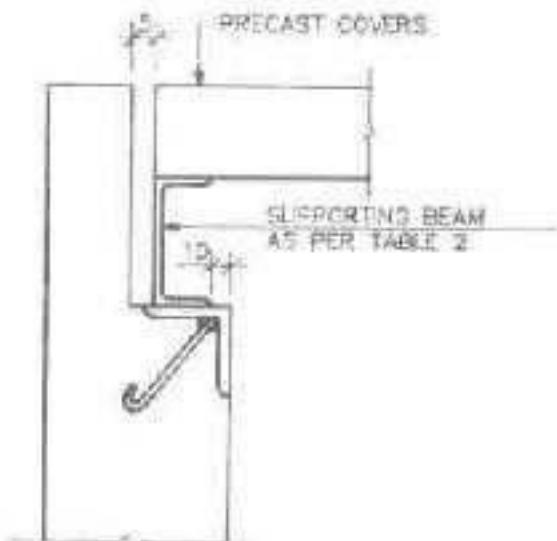
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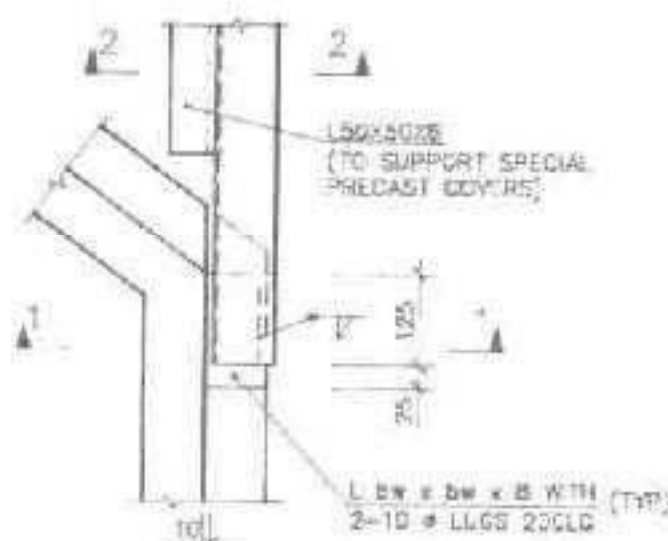
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SEC. 2-2

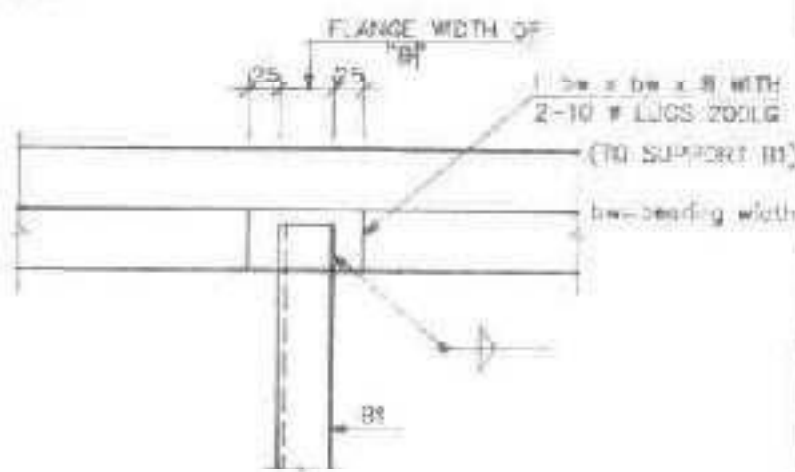


SEC. 1-1

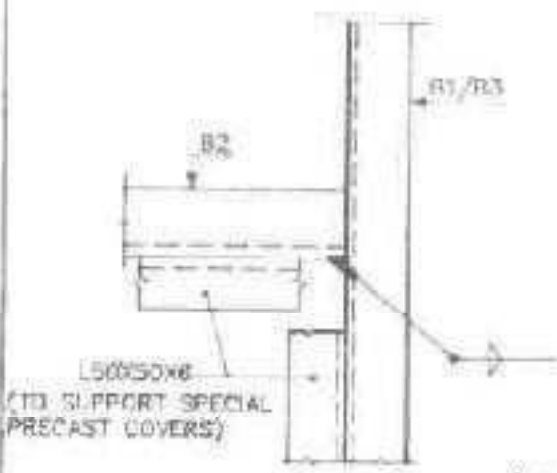


DETAIL 'P'

DETAIL 'P'-MIRROR IMAGE



DETAIL 'R'



DETAIL 'Q'

DETAIL 'Q'-MIRROR IMAGE

(FOR LOCATION OF DET. P, Q & R REF. SH. 5)

SUPPORTING MEMBERS

FILE NAME : 44056 SH. 6 OF 17



PROJECT ENGINEERING
BHEL HYDERABAD

CABLE TRENCH

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CHD

APPD

DETAIL OF SUPPORTING MEMBERS AT JUNCTIONS

TABLE - 2

S.NO	WIDTH OF MAIN TRENCH MM	JUNCTION TYPE - I				JUNCTION TYPE - I				REMARKS
		SUPPORTING MEMBER B1		SUPPORTING MEMBER B2		SUPPORTING MEMBER B3		SUPPORTING MEMBER B4		
		SIZE	LENGTH	SIZE	LENGTH	SIZE	LENGTH	SIZE	LENGTH	
1.	300	MC 100	1020	MC 100	825	MC 100	1650	MC 100	625	
2.	500	MC 100	1220	MC 100	825	MC 125	1850	MC 100	625	
3.	750	MC 100	1470	MC 100	825	MC 125	2100	MC 100	625	
4.	1000	MC 100	1770	MC 100	825	MC 125	2350	MC 100	625	
5.	1250	MC 100	1970	MC 100	825	MC 150	2600	MC 100	625	
6.	1500	MC 125	2270	MC 100	825	MC 150	2800	MC 100	625	
7.	2000	MC 125	2270	MC 100	825	MC 200	3400	MC 100	625	

NOTE : THE SUPPORTING MEMBERS ARE DESIGNED FOR COVER WT. PLUS A POINT LOAD
OF 1000 kg. AT MID SPAN.

FILE NAME : 448S7 SHEET 7 OF 12



PROJECT ENGINEERING
BHEL HYDERABAD

CABLE TRENCH

DRAWING NO.

4-38144-00048

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CIVIL ENGINEERING

NO DATE

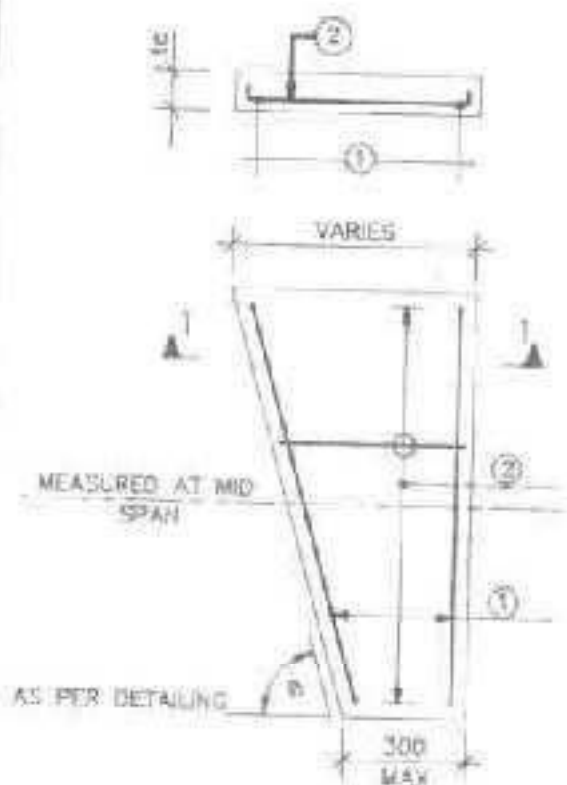
REVISION

DRN CHD APPD

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03.08.83

ISSUED AS STANDARD



PLAN OF SPECIAL COVER

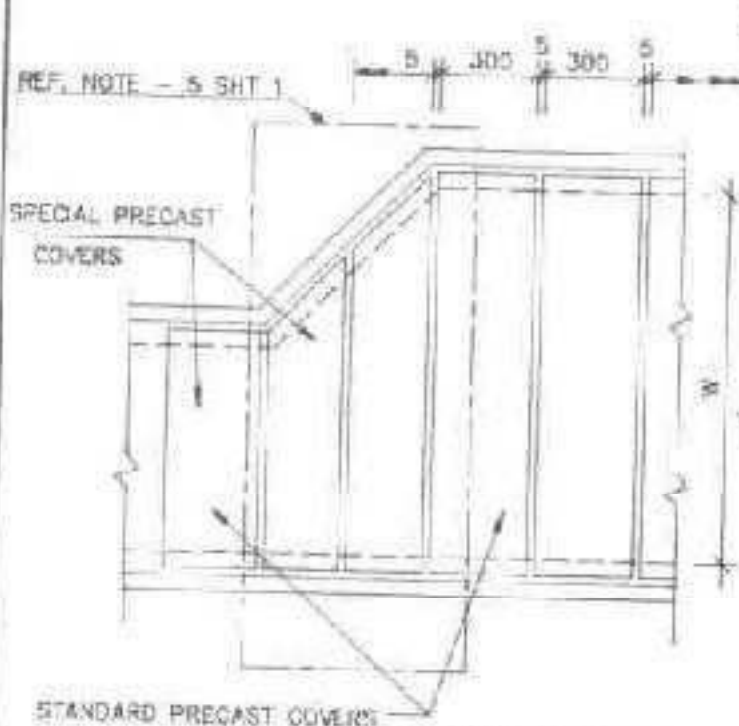
(FOR TYPE-II & IV)

TABLE - 3

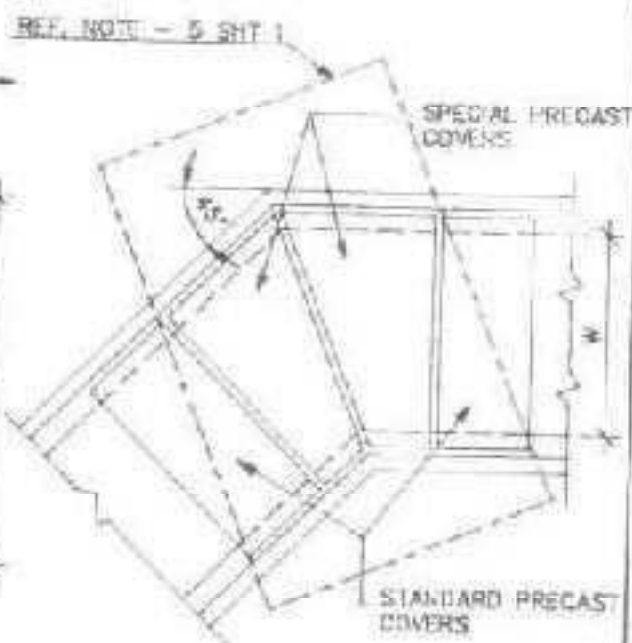
SPAN W(mm)	BAR MARK ①	BAR MARK ②	REMARKS
300	8 Φ 100 c/c	3-8 Φ	
500	8 Φ 100 c/c	3-8 Φ	
750	8 Φ 100 c/c	4-8 Φ	
1000	8 Φ 75 c/c	5-8 Φ	
1250	10 Φ 75 c/c	5-8 Φ	
1500	10 Φ 75 c/c	6-8 Φ	
2000	12 Φ 75 c/c	7-8 Φ	

NOTE :

FOR THICKNESS 1c - REFER TABLE - 1



JUNCTION TYPE - III



JUNCTION TYPE - IV

FILE NAME : 448521 SFT. B OF 17

PROJECT ENGINEERING
BHEL HYDERABAD

CABLE TRENCH

DRAWING NO.

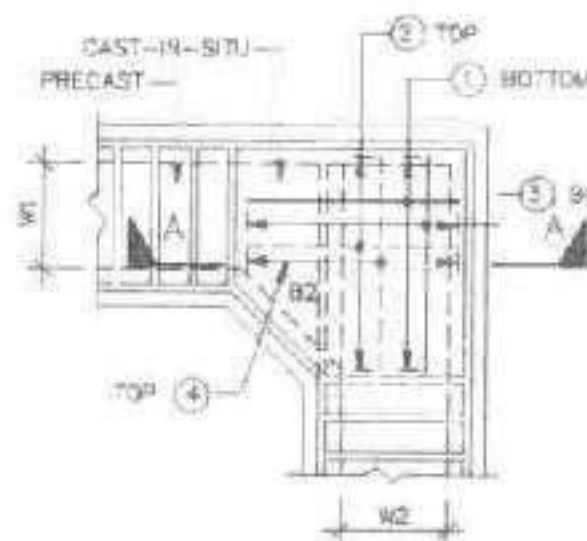
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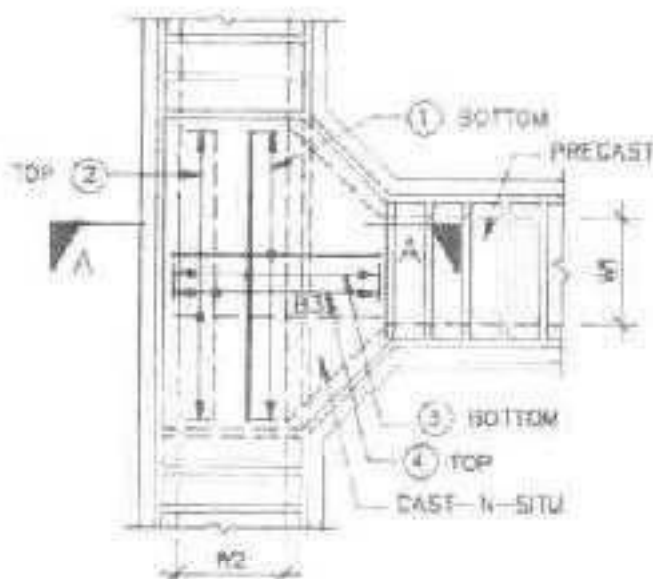
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CIVIL ENGINEERING

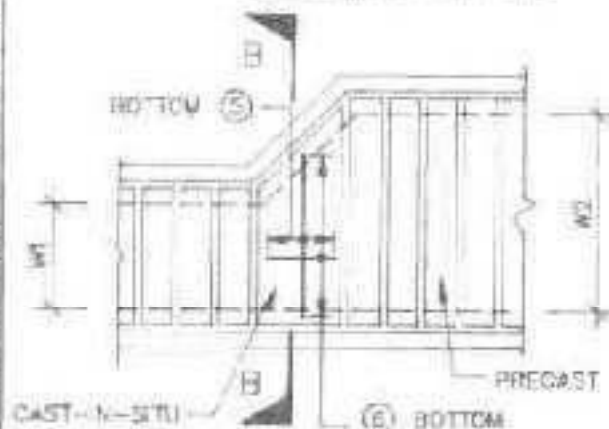
NO	DATE	REVISION	DRN	CHD	APPD
0	03.08.93	ISSUED AS STANDARD			



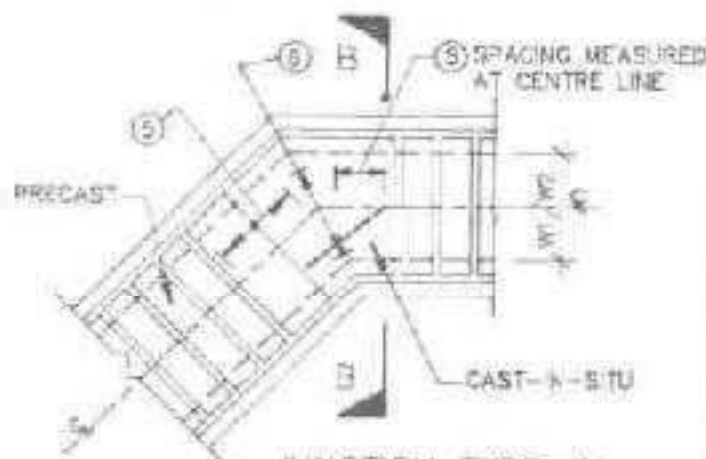
JUNCTION TYPE-I



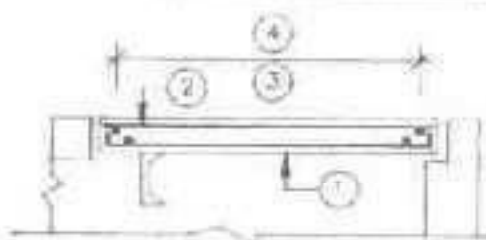
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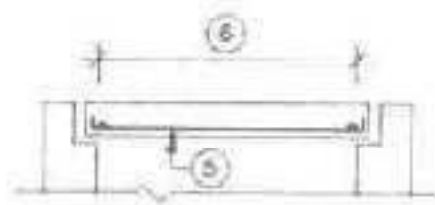
JUNCTION TYPE-III



JUNCTION TYPE-IV



SECTION A-A



SECTION B-B

DETAILS OF CAST-IN-SITU COVERS

FILE NAME : 44539 SHT. B OF 17

PROJECT ENGINEERING
BHEL HYDERABAD

CABLE TRENCH

DRAWING NO. REV

4-38144-00048 00

CIVIL ENGINEERING

NO	DATE	REVISION	DRN	CHD	APPD
0	03.08.99	ISSUED AS STANDARD			

TABLE - 4

S.No	W2 (mm)	tc (mm)	REINFORCEMENT DETAIL FOR CAST-IN-SITU COVERS						REMARKS
			JUNCTION TYPE I & II				JUNCTION TYPE III&V		
			BAR MARK ①	BAR MARK ②	BAR MARK ③	BAR MARK ④	BAR MARK ⑤	BAR MARK ⑥	
1	300	80	8# 120c/c	—	8# 150c/c	—	8# 150c/c	8# 200c/c	
2	300	85	8# 120c/c	—	8# 150c/c	—	8# 150c/c	8# 200c/c	
3	750	80	8# 120c/c	8# 200c/c	8# 200c/c	8# 200c/c	8# 150c/c	8# 200c/c	
4	1000	100	8# 120c/c	8# 200c/c	8# 300c/c	8# 300c/c	8# 150c/c	8# 300c/c	
5	1250	100	10# 120c/c	8# 200c/c	8# 300c/c	8# 300c/c	10# 150c/c	8# 300c/c	
6	1500	110	10# 120c/c	8# 200c/c	8# 300c/c	8# 300c/c	10# 150c/c	8# 300c/c	
7	2000	120	12# 120c/c	8# 200c/c	8# 300c/c	8# 300c/c	12# 150c/c	8# 300c/c	

NOTES :

1. THE CAST-IN-SITU COVERS ARE DESIGNED FOR TOTAL UDL OF 2000 kg OR AN EQUIVALENT POINT LOAD OF 1000 kg ACTING AT MID SPAN.
2. FOR CONNECTION DETAIL AND SIZES OF B1 & B3 REFER SHT. 6 & 7.
3. REINFORCEMENT BARS SHALL BE AS PER IS:1785
4. GRADE OF CONC. SHALL BE M-20 AS PER IS:456.
5. FOR LOCATION OF BAR MARKS ① TO ⑥ REF. SHT. 9 OF 17.

T.E. NAME : 446310 SHT. 10 OF 17

**PROJECT ENGINEERING
BHEL HYDERABAD**

CABLE TRENCH

DRAWING NO.

REV

4-38144-00045 00

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DETAIL OF CABLE TRENCH REINFORCEMENT

TABLE - 5 CASE A : WATER TABLE UPTO 300mm BELOW F.F.L

WORKING DIMENSIONS			REINFORCEMENT DETAIL (AS PER IS : 1786)						QUANTITIES FOR 1 M. LENGTH (APPROXIMATE)				
S.NO	DEPTH (mm)	WIDTH (mm)	THICKNESS (mm)	CLEAR COVER (mm)	BAR MARK (REF. SHT. 11 OF 17)					LEAN CONCL. 1:2:10 M ³	CONC. REBAR SPLITTING M-15 M ³	REBAR SPLITTING M ²	
					1	2	3	4	5				
1	1500	2000	200	25	10# 200 c/c	10# 175 c/c	8# 200 c/c	8# 300 c/c	8# 300 c/c	0.18	1.02	43.0	5.4
2		1500	200	25	10# 200 c/c	10# 300 c/c	8# 200 c/c	-	-	0.15	0.98	35.0	6.4
3		1250	200	25	10# 200 c/c	8# 200 c/c	8# 200 c/c	-	-	0.13	0.93	33.0	6.4
4		1000	200	25	10# 200 c/c	8# 200 c/c	8# 200 c/c	-	-	0.11	0.88	30.0	6.4
5	1250	2000	150	25	10# 150 c/c	12# 150 c/c	8# 250 c/c	-	-	0.13	0.72	52.0	5.3
6		1500	150	25	10# 150 c/c	12# 150 c/c	8# 250 c/c	-	-	0.14	0.85	45.0	5.3
7		1250	150	25	10# 150 c/c	10# 150 c/c	8# 250 c/c	-	-	0.12	0.81	38.0	5.3
8		1000	150	25	10# 150 c/c	10# 200 c/c	8# 250 c/c	-	-	0.11	0.57	34.0	5.3
9	1000	2000	150	25	10# 200 c/c	10# 150 c/c	8# 250 c/c	-	-	0.18	1.65	43.0	4.3
10		1500	125	25	10# 200 c/c	10# 150 c/c	8# 300 c/c	-	-	0.14	0.47	35.0	4.25
11		1250	100	25	10# 150 c/c	8# 150 c/c	8# 300 c/c	-	-	0.12	0.35	30.0	4.2
12		1000	100	25	10# 150 c/c	8# 200 c/c	8# 300 c/c	-	-	0.10	0.32	27.0	4.2
13	750	750	100	25	8# 200 c/c	8# 150 c/c	8# 300 c/c	-	-	0.08	0.25	18.0	3.2
14	500	500											
15	300	300											
16	300	300											

IN BRICK MASONRY WHEREVER SPECIFIED

IN BRICK MASONRY WHEREVER SPECIFIED

NOTES :

1. ALL CABLE TRENCHES ARE DESIGNED FOR A SURCHARGE LOAD OF 1 T/M²
2. THE QUANTITIES GIVEN IN THIS TABLE ARE FOR ESTIMATION PURPOSE ONLY
3. PREFERABLY THE DEPTH OF CABLE TRENCH SHALL NOT BE MORE THAN THE WIDTH

FILE NAME : 1446512 SHT. 12 OF 17



PROJECT ENGINEERING
BHEL HYDERABAD

CABLE TRENCH

DRAWING NO. 4-38144-00046
REV 00

23

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CIVIL ENGINEERING	NO	DATE	REVISION	DRN	CHD	APPD
	0	03.08.93	ISSUED AS STANDARD			

DETAIL OF CABLE TRENCH REINFORCEMENT

TABLE - 6 CASE B : WATER TABLE BELOW TRENCH BOTTOM

S.NO	WORKING DIMENSIONS		CLEAR COVER (mm)	REINFORCEMENT DETAIL (AS PER IS : 1786)					QUANTITIES FOR 1 M LENGTH (APPROXIMATE)		
	DEPTH D (mm)	WIDTH W (mm)	THICKNESS T (mm)	BAR MARK (REF. SHT. NO. OF 17)					LEAN CONC. 1:1.5:10	CONC. M-15	REINFORCING
				(1)	(2)	(3)	(4)	(5)			
1		2000	150	25	12 Φ 200 c/c	12 Φ 175 c/c	8 Φ 250 c/c	8 Φ 300 c/c	0.18	0.80	36.0
2		1500	150	25	12 Φ 200 c/c	10 Φ 175 c/c	8 Φ 250 c/c	*	0.143	0.72	44.0
3	1500	1250	150	25	12 Φ 200 c/c	8 Φ 175 c/c	8 Φ 250 c/c	*	0.124	0.65	40.0
4		1000	150	25	12 Φ 200 c/c	8 Φ 250 c/c	8 Φ 250 c/c	*	0.105	0.65	36.0
5		2500	150	25	10 Φ 175 c/c	12 Φ 150 c/c	8 Φ 250 c/c	*	0.180	0.72	49.0
6		1500	150	25	10 Φ 150 c/c	12 Φ 150 c/c	8 Φ 300 c/c	*	0.139	0.50	43.0
7	1250	1250	150	25	10 Φ 150 c/c	10 Φ 150 c/c	8 Φ 300 c/c	*	0.17	0.60	37.0
8		1000	150	25	10 Φ 150 c/c	10 Φ 150 c/c	8 Φ 300 c/c	*	0.101	0.47	32.0
9		2000	150	25	10 Φ 200 c/c	12 Φ 150 c/c	8 Φ 250 c/c	*	0.180	0.65	46.0
10		1500	150	25	10 Φ 200 c/c	12 Φ 150 c/c	8 Φ 300 c/c	*	0.139	0.47	36.0
11	1000	1250	150	25	10 Φ 150 c/c	8 Φ 150 c/c	8 Φ 300 c/c	*	0.116	0.36	29.0
12		1000	150	25	10 Φ 150 c/c	8 Φ 200 c/c	8 Φ 300 c/c	*	0.098	0.32	25.0
13	750	750	150	25	8 Φ 200 c/c	10 Φ 150 c/c	8 Φ 300 c/c	*	0.079	0.25	18.0
14	500	500									
15	300	300									
16	300	300									

IN BRICK MASONRY WHEREVER SPECIFIED

NOTES :

1. R.C.C CABLE TRENCHES ARE DESIGNED FOR A SURCHARGE LOAD OF 1 T/M²
2. THE QUANTITIES GIVEN IN THIS TABLE ARE FOR ESTIMATION PURPOSE ONLY
3. PROBABLY THE DEPTH OF CABLE TRENCH SHALL NOT BE MORE THAN THE WIDTH

FILE NAME : 448913 SHT. 13 OF 17



PROJECT ENGINEERING
BHEL HYDERABAD

CABLE TRENCH

DRAWING NO.	REV
4-38144-00043	00

CIVIL ENGINEERING

NO

DATE

REVISION

DRN

CHD

APPD

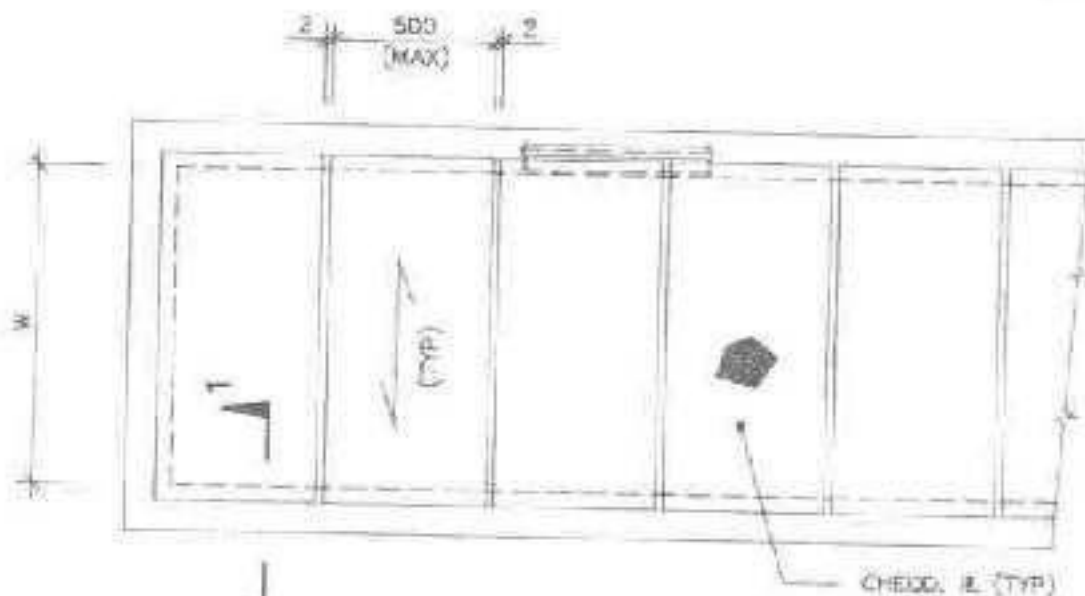
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03.08.93

ISSUED AS STANDARD

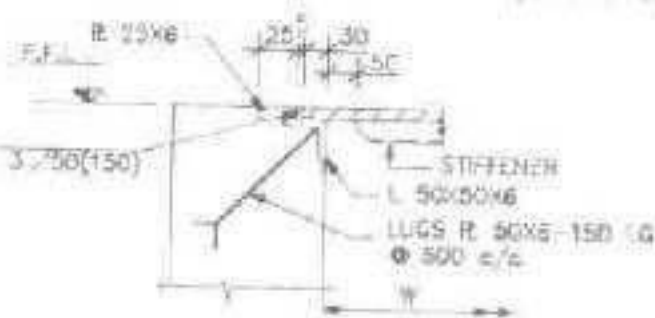
W. S. S.

P. S. S.

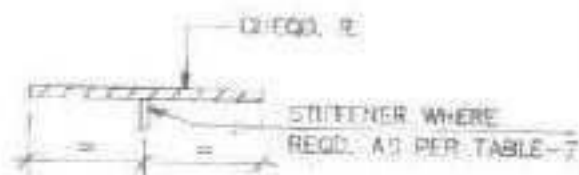


TYPICAL TRENCH PLAN

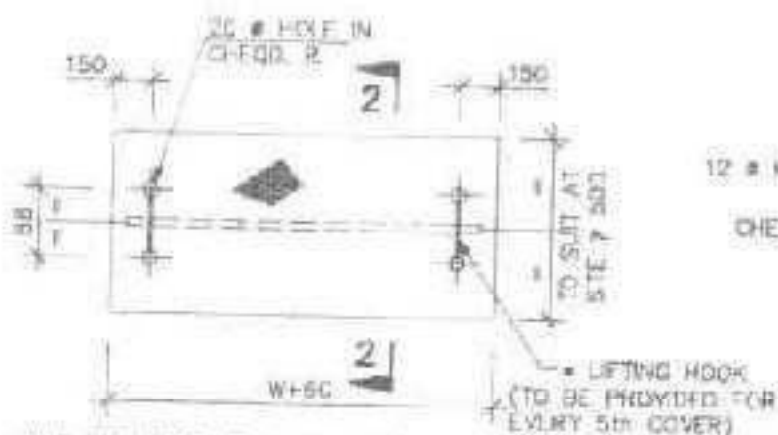
(SHOWING CHECKED. E.)



SEC. 1-1

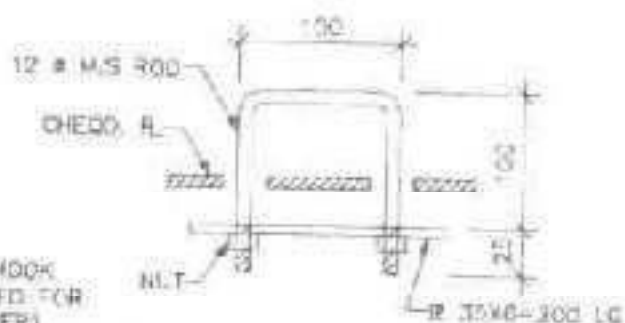


SEC. 2-2



- ONE HOOK FOR SPAN UP TO 500
- TWO HOOKS FOR SPAN ABOVE 500

TYP. CHECKED. PLATE DETAIL



TYP. LIFTING HOOK DETAIL

FILE NAME: 446310 SHT. 15 OF 17

PROJECT ENGINEERING
BHIL HYDERABAD

CABLE TRENCH

DRAWING NO.

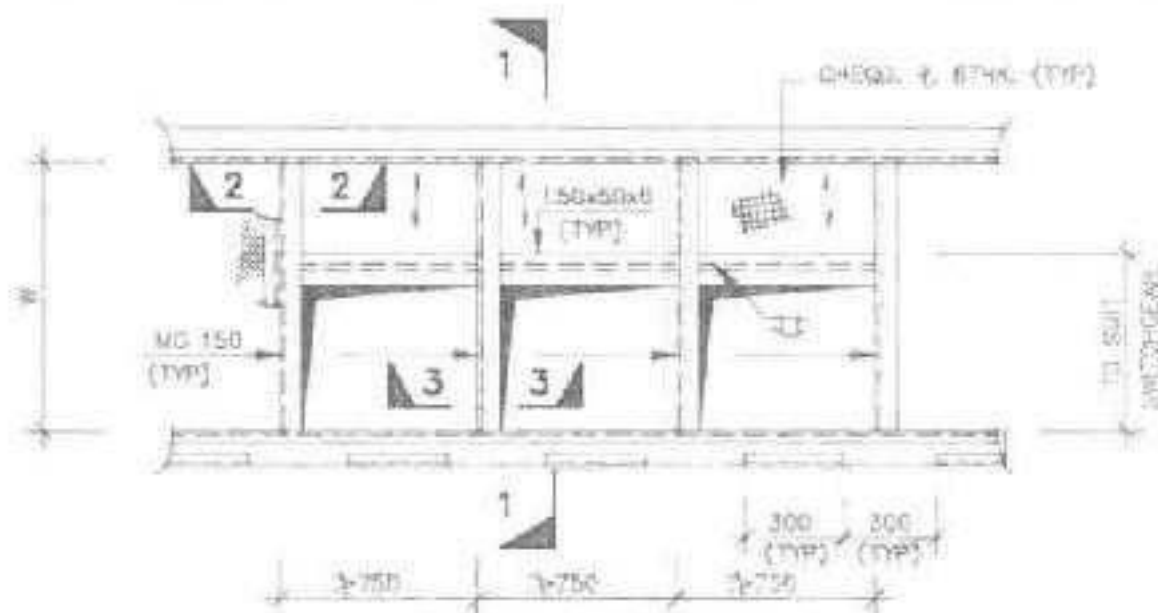
REV

4-38144-00046 00

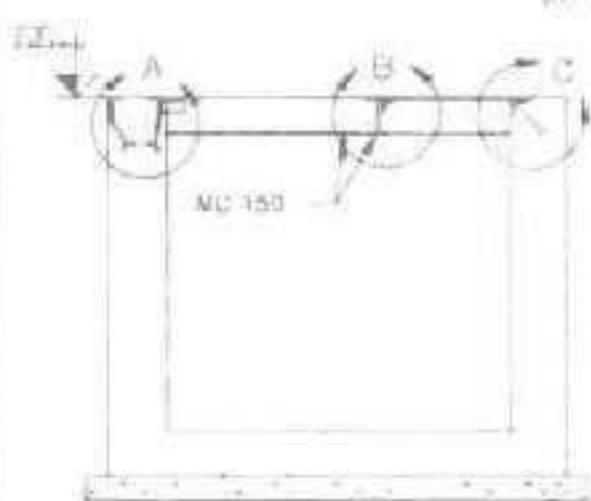
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CIVIL ENGINEERING

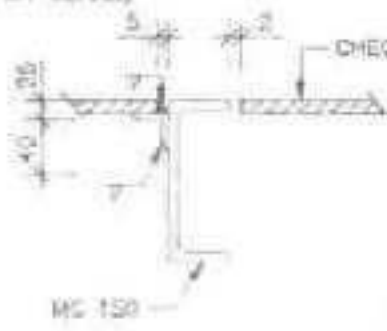
NO	DATE	REVISION	DRN	CHD	APPD
D	01.08.93	ISSUED AS STANDARD			



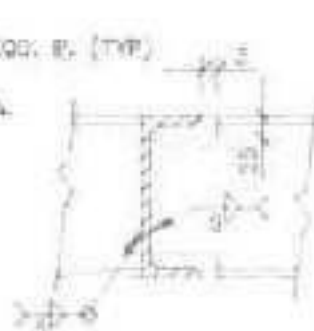
TYPICAL TRENCH PLAN
(AT SWITCH GEARS)



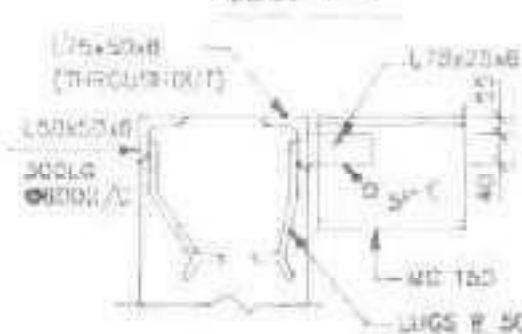
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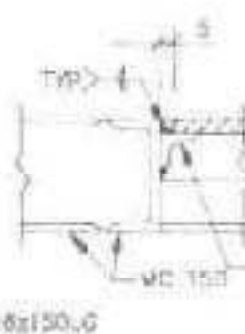
SEC. 2-2



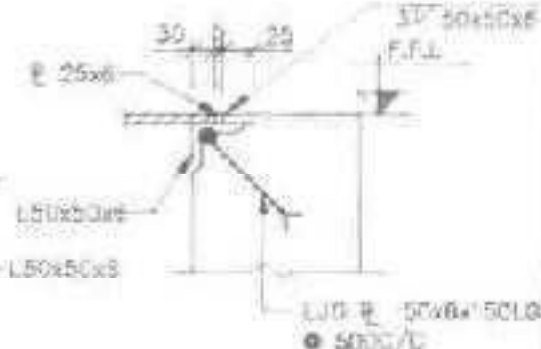
SEC. 3-3



DETAIL A



DETAIL B



DETAIL C

FILE NAME : 446S10 SHT. 16 OF 17



PROJECT ENGINEERING
BHEL HYDERABAD

CABLE TRENCH

DRAWING NO.

REV

4-38144-00046 00

3-3

CIVIL ENGINEERING

NO

DATE

REVISION

DRN

CHD

APPD

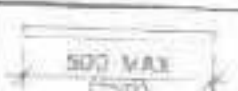
0

03.08.95

ISSUED AS STANDARD

TABLE - 7

DETAIL OF CHEQUERED PLATE COVER

S.NO	TYPE	SECTION	SECTION PROPERTIES FOR 500mm WIDE PLATE			RECOMMENDED SPAN (W) mm
			Wt. kg/m	I = cm ⁴	C m/h ³ = cm ³	
1	I		23.55	9.90	2.65	W < 500
2	II		26.55	30.30	6.90	500 < W < 1250
3	II		26.75	36.88	7.42	
4	IV		27.45	44.90	8.18	
5	V		27.03	44.56	8.14	
6	VI		27.50	26.40	12.56	1250 < W < 1500
7	VI		28.82	91.00	14.26	
8	VII		28.05	84.58	16.03	1500 < W < 2000
9	IX		29.40	134.47	19.73	
10	X		29.79	180.30	21.68	

NOTE :-

THE DESIGN IS BASED ON A LIVE LOAD OF 500 KG/M² AND
 MAXIMUM ALLOWABLE DEFLECTION = $\frac{W}{200}$ (W=SPAN)

FILE NAME : 448517 SNT 17 OF 17

PROJECT ENGINEERING
BHEL HYDERABAD

CABLE TRENCH

DRAWING NO.

REV

4-38144-00048 00

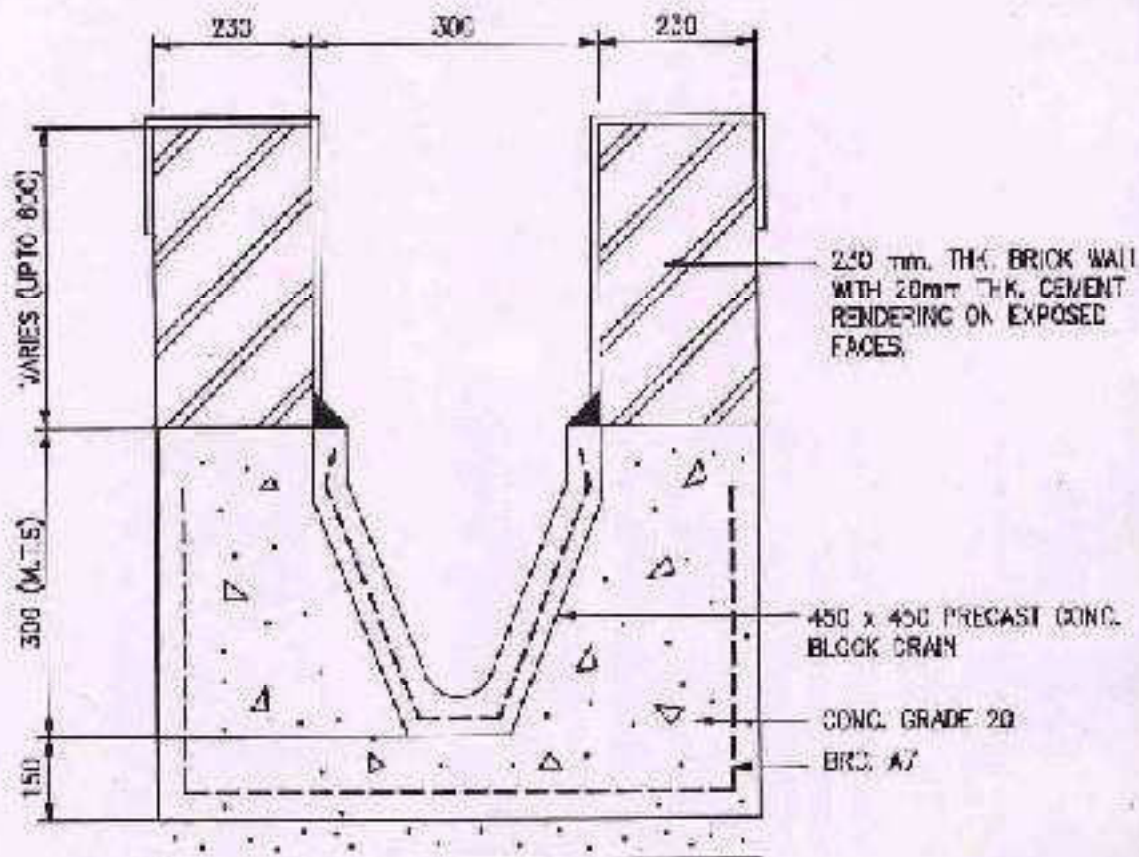


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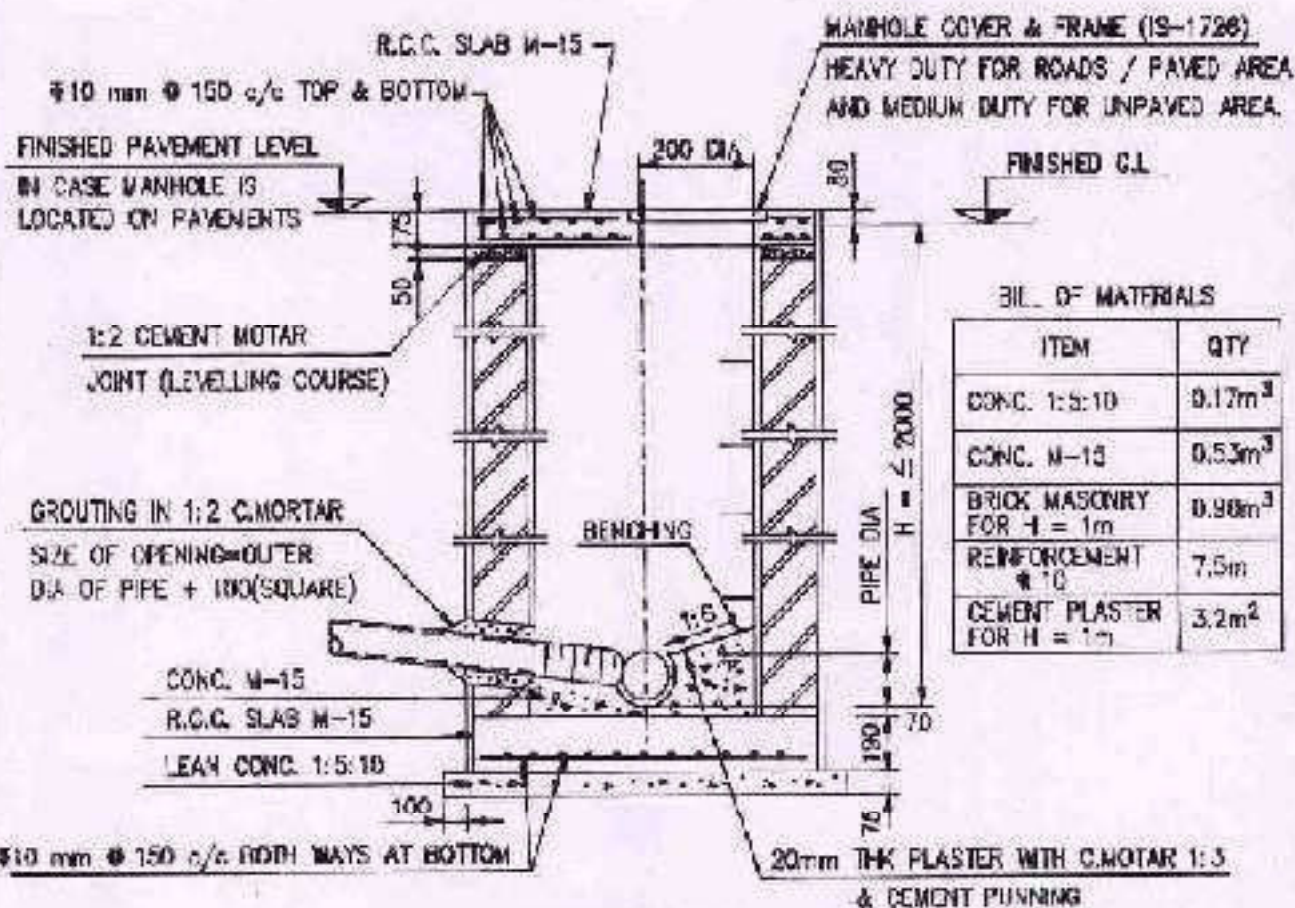
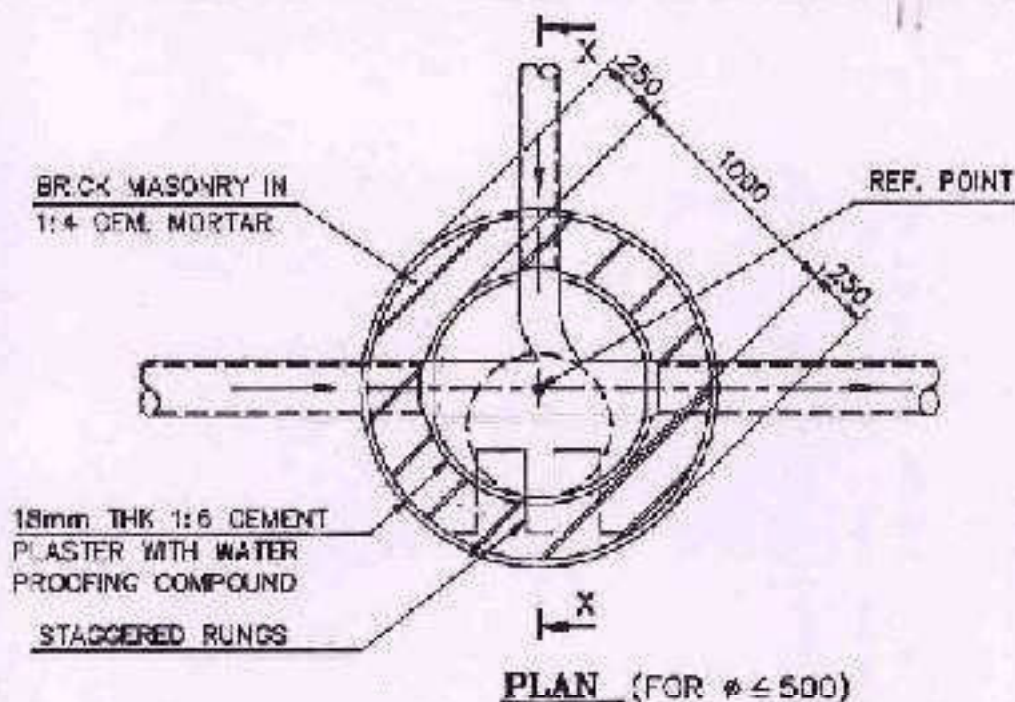
PROJECT ENGINEERING
BHEL HYDERABAD

TYPICAL ROAD SIDE
DRAIN DETAIL

DRAWING NO.	REV
4-48144-00047	00

CIVIL ENGINEERING

NO	DATE	REVISION	DRN	CHD	APPD
0	06.12.86	ISSUED AS STANDARD		<i>Shetty</i>	<i>Shetty</i>



BILL OF MATERIALS

ITEM	QTY
CONC. 1:5:10	0.17m ³
CONC. M-15	0.53m ³
BRICK MASONRY FOR $\phi = 1m$	0.98m ³
REINFORCEMENT $\phi 10$	7.5m
CEMENT PLASTER FOR H = 1m	3.2m ²

SECTION-XX



PROJECT ENGINEERING
EHEL HYDERABAD

TYPICAL
MANHOLE

DRAWING NO.

4-88144-00048

REV

00

25

STRUCTURE

NO
C

DATE
08-03-1996

REVISION
ISSUED AS STANDARD

DRN

CHD
Bharat

APPD
Bharat

25 COVER
AROUND (TYP)

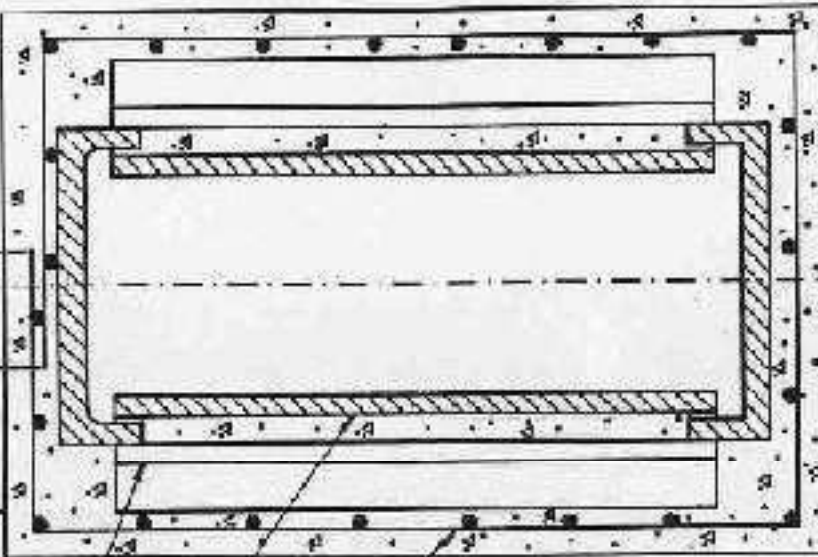
100 (TYP)

50 (TYP)

25 (TYP)

50 (TYP)

100



LACING ANGLE

18 GAUGE M.S SHEET
SHUTTERING
(REFER NOTE-1)

UNGALVANISED
WIRE MESH
(REFER NOTE-2)

CONCRETE
GRADE M 15

50 (TYP)

I - SECTION

LACED COLUMNS

NOTE :

1. IF SHUTTERING IS AVOIDED THE ENTIRE AREA OF COLUMN TO BE FILLED WITH CONCRETE.
2. HARD DRAWN STEEL WIRE FABRIC OF 3 MM DIA 100 X 100 MESH 1.43 KG/SQ MM AS PER IS : 1566 SHALL BE USED AS WIRE MESH.

TYP. DET. OF COLUMN-ENCASING



PROJECT ENGINEERING
BHEL HYDERABAD

TYPICAL DETAIL
OF COLUMN ENCASING

DRAWING NO.

4-38144-00049

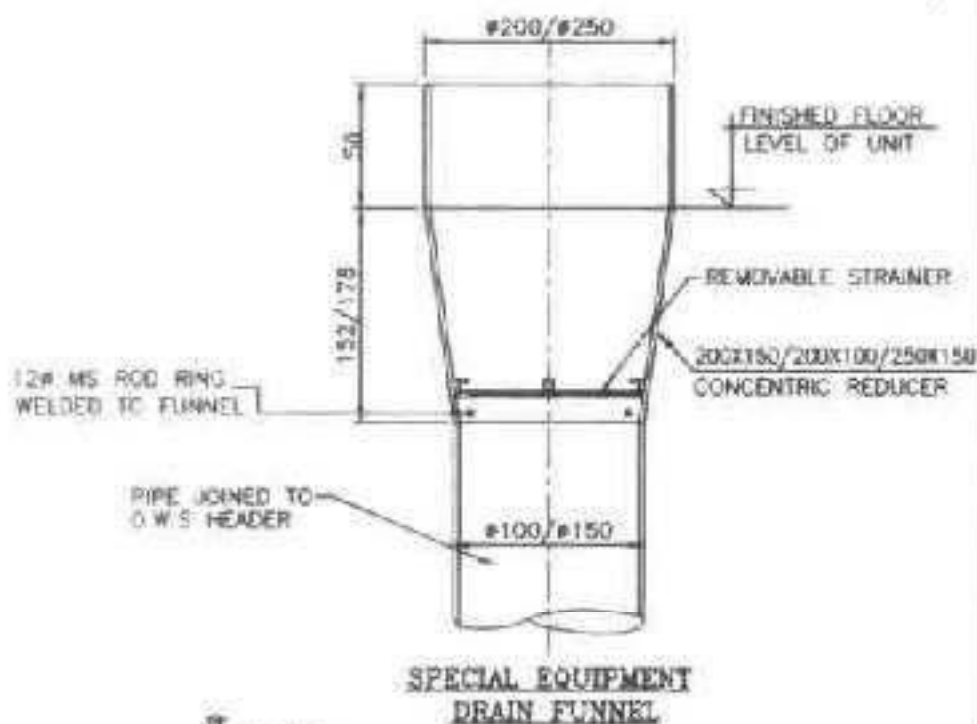
REV

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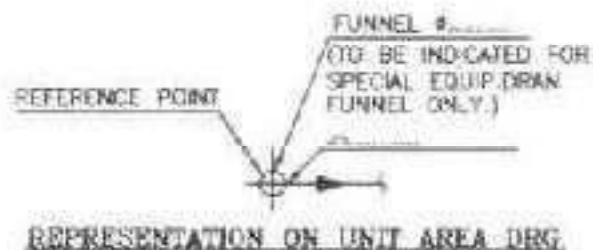
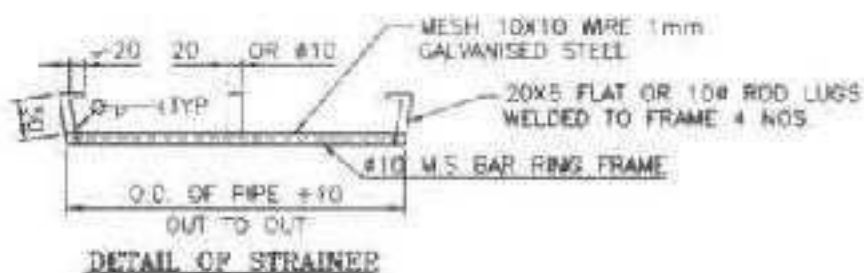
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0	3.4.99	ISSUED AS STANDARD	P.C.C		
1	3.9.99	ISSUED AS STANDARD			



ISOMETRIC VIEW OF STRAINER



PROJECT ENGINEERING
BHEL HYDERABAD

200/250 #
DRAIN FUNNEL DETAILS
FOR O.W.S

DRAWING NO

4-38144-00053

REV

0 1



75

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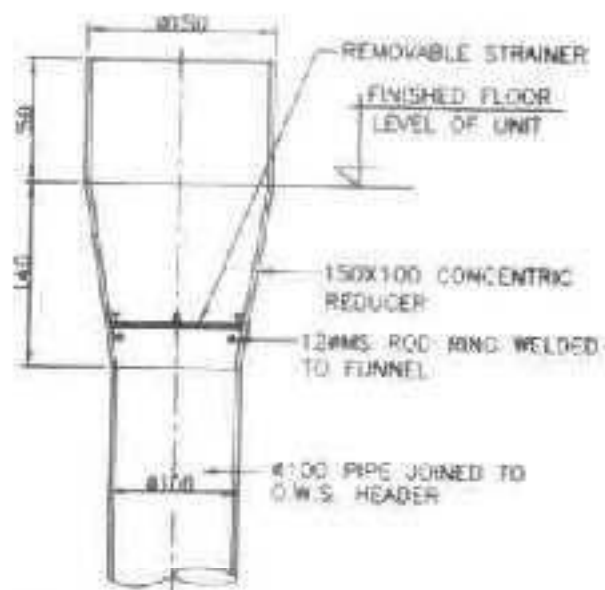
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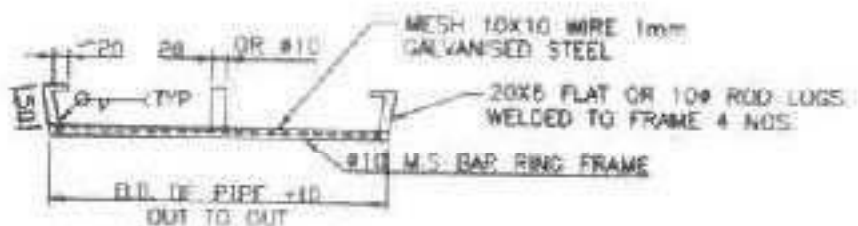
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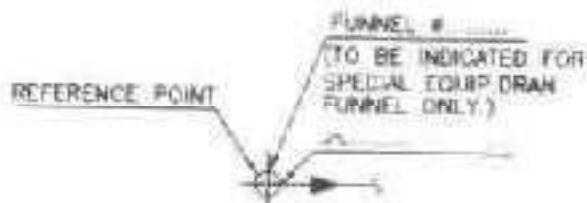
**STANDARD EQUIPMENT
DRAIN FUNNEL**



ISOMETRIC VIEW OF STRAINER



DETAIL OF STRAINER



REPRESENTATION ON UNIT AREA DRG.



PROJECT ENGINEERING
BHEL HYDERABAD

150 #
DRAIN FUNNEL DETAILS
FOR O.W.S

DRAWING NO

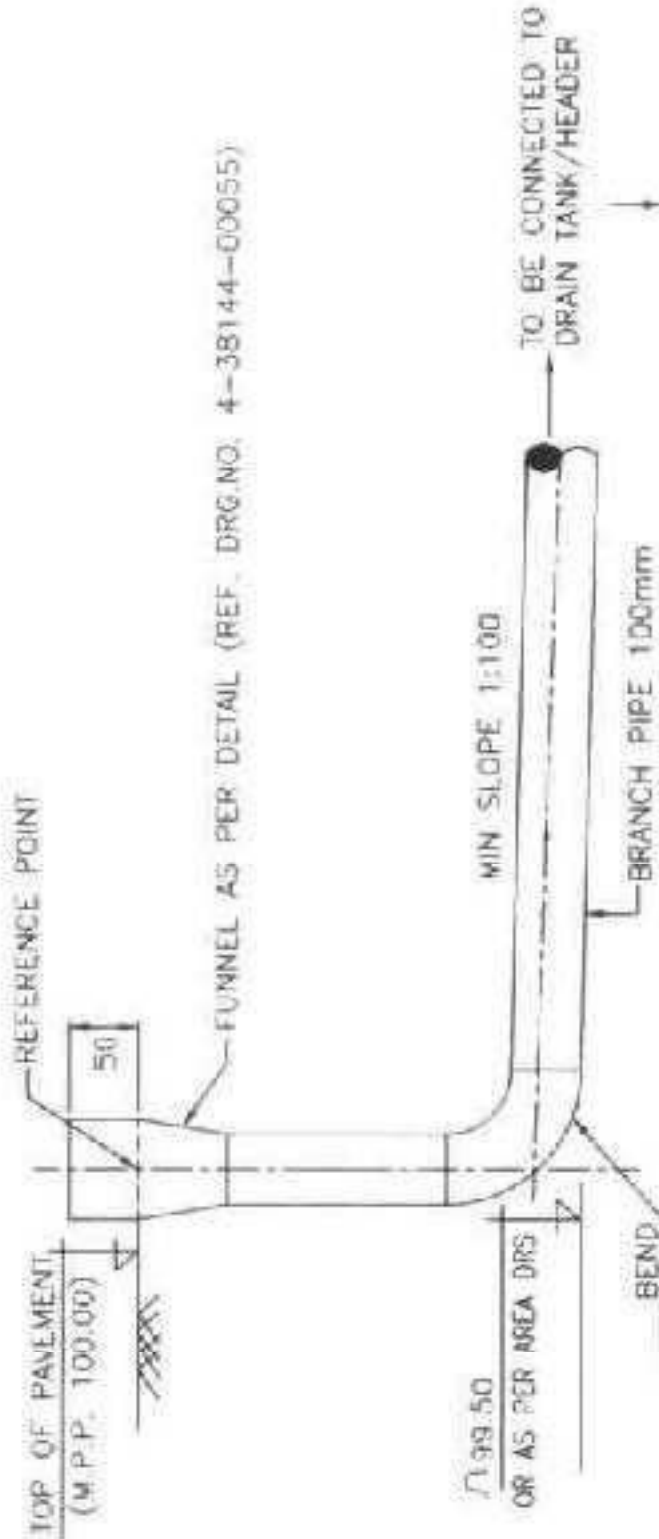
4-38144-00055

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	0	27.8.99	ISSUED AS STANDARD	ACAO	<i>[Signature]</i>	<i>[Signature]</i>



TYPICAL BRANCH CONNECTION FOR O.W.S.



PROJECT ENGINEERING
BHEL HYDERABAD

BRANCH PIPE DETAIL
FOR O.W.S

DRAWING NO
4-38144-00056

REV
00

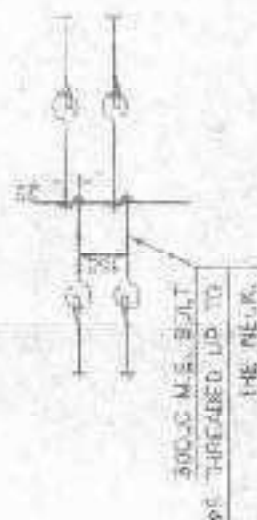
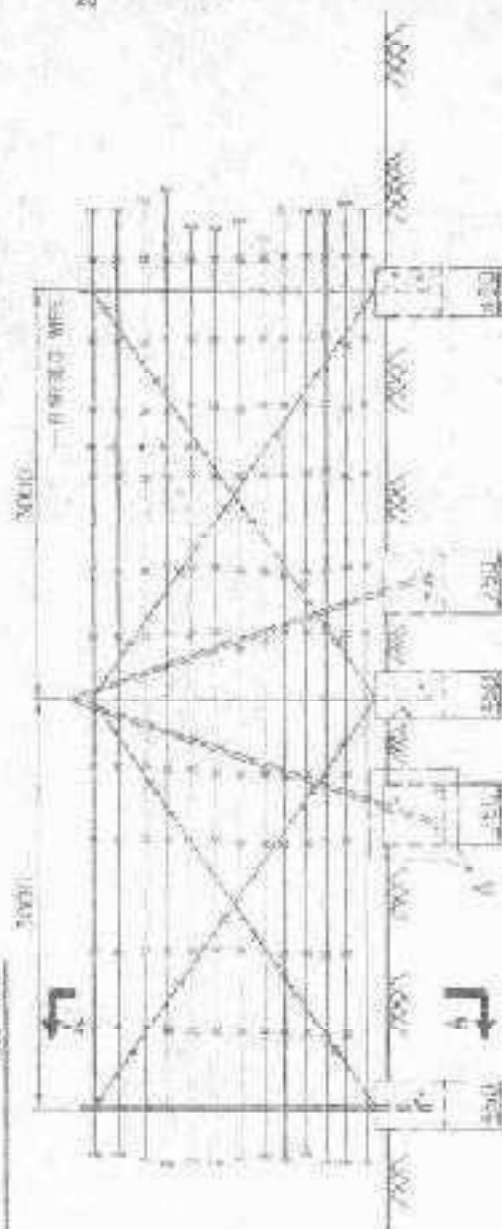
POSTAGE WILL BE PAID BY ADDRESSEE

5th, 11th, 17th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th	21st	22nd	23rd	24th	25th	26th	27th	28th	29th	30th	31st	32nd	33rd	34th	35th	36th	37th	38th	39th	40th	41st	42nd	43rd	44th	45th	46th	47th	48th	49th	50th	51st	52nd	53rd	54th	55th	56th	57th	58th	59th	60th	61st	62nd	63rd	64th	65th	66th	67th	68th	69th	70th	71st	72nd	73rd	74th	75th	76th	77th	78th	79th	80th	81st	82nd	83rd	84th	85th	86th	87th	88th	89th	90th	91st	92nd	93rd	94th	95th	96th	97th	98th	99th	100th
5th, 11th, 17th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th	21st	22nd	23rd	24th	25th	26th	27th	28th	29th	30th	31st	32nd	33rd	34th	35th	36th	37th	38th	39th	40th	41st	42nd	43rd	44th	45th	46th	47th	48th	49th	50th	51st	52nd	53rd	54th	55th	56th	57th	58th	59th	60th	61st	62nd	63rd	64th	65th	66th	67th	68th	69th	70th	71st	72nd	73rd	74th	75th	76th	77th	78th	79th	80th	81st	82nd	83rd	84th	85th	86th	87th	88th	89th	90th	91st	92nd	93rd	94th	95th	96th	97th	98th	99th	100th

242

NOTES

1. ALL DIMENSIONS ARE IN MM.
2. PROVIDE STIFFENING AT EVERY 15 TH POST AND AT CHANGE OF LEVELING.
3. LIFTING BOLTS SHALL BE PROVIDED AT THE ENDS.
4. GLASSSED WIRE SHALL BE TIED TO THE ANGLE IRON POSTS WITH CR WIRE THROUGH HOLES IN THE POST.



FIXING DETAIL OF STEAKING BOLT
WITH POST

OFFICIAL COPY

TYPE OF PROBLEM OR
NAME OF CUSTOMER/PROJECT

STANDARD

CHARGAT HEAVY ELECTRONICS LTD.
147, K. J. ROAD

		SHOROT HEVY ELECTRONICS LTD.		INTERMATIC							
TITLE BARBED WIRE FENCING		DRAWING NO. 9-38144		QTY 00015		NO. 00		DATE 01/01/01		BY 01/01/01	

SECTION A-A

Ulaganathan, S.

Unit	100
Weight	100

Col. Code	ATTEND
	201-04806

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100

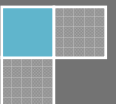
100

Rev 00
11th Mar
2014

VOLUME - IB SPECIAL CONDITIONS OF CONTRACT (SCC)

(Document No PESD:E&C:SCC)

BHARAT HEAVY ELECTRICALS LIMITED



SPECIAL CONDITIONS OF CONTRACT (SCC)

Contents

SN	DESCRIPTION	Chapter	PAGE No.
1	General Intent of the Specifications	Chapter-I	3-4
2	General Services to be rendered by the Bidder	Chapter-II	5
3	General Technical Requirements (Codes and Standards)	Chapter-III	6
4	Obligations of Contractor (In respect of Tools, Tackles, Consumables, etc employment of supervisory staff and workmen)	Chapter-IV	7-10
5	Responsibilities of Contractor (In respect of employment of Labour, Supervisory staff, etc)	Chapter-V	11-12
6	Material Handling, Storage, Preservation, etc	Chapter-VI	13-15
7	Drawings and Documents	Chapter-VII	16
8	Inspection and Quality	Chapter-VIII	17-21
9	HSE & OHSAS Obligations	Chapter-IX	22-37
10	RA Bill Payment	Chapter-XI	38
11	Performance Monitoring	Chapter-XII	39
12	Suspension of Business Dealings	Chapter-XII	40-41

SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter - I : General Intent of Specifications

1.0	INTENT OF THE SPECIFICATION
1.1	The intent of this erection specification is to provide services for execution of the project according to most modern and proven techniques and codes. The omission of specific reference to any method, equipment or material necessary for the proper and efficient services towards installation of the plant shall not relieve the contractor of the responsibility of providing such services / facilities to complete the work or portion of work awarded to him. The quoted / accepted rates / price shall deem to be inclusive of all such contingencies.
1.2	The work shall conform to dimensions and tolerances given in various drawings and documents that will be provided during erection. If any portion of works is found to be defective in workmanship and not conforming to drawings / documents or other stipulations, the contractor shall dismantle and re-do the work duly replacing the defective materials at their own cost, failing which recoveries, as determined by BHEL, shall be effected from contractor's bills.
1.3	It is not the intent of this specification to specify herein all the details of erection and commissioning. However, the system shall conform in all respects to high standards of quality and workmanship for performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material, which in his judgments is not in full accordance herewith.
1.4	The omission of specific reference to any fabrication / erection or other method, equipment or material necessary for proper and efficient working of the plant shall not relieve the tenderer of the responsibility of providing such facilities to complete the work at quoted rates. Any mismatch/ defect found due to mistake in fabrication / erection shall have to be rectified by the vendor free of cost. Inspection by BHEL/Customer does not relieve vendor of his responsibility of executing quality erection.
1.5	The work covered under this specification is of highly sophisticated nature, requiring the best quality workmanship, supervision, engineering and construction management. The contractor should ensure proper planning and successful and timely completion of the work to meet the overall project schedule. The contractor must deploy adequate quantity of tools & plants, modern / latest construction aids etc. He must also deploy adequate trained, qualified and experienced supervisory staff and skilled personnel.

SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter - I : General Intent of Specifications

1.6	Contractor shall erect and commission all the equipments and auxiliaries as per the sequence & methodology prescribed by BHEL depending upon the technical requirements. Availability of materials and fronts will decide this. BHEL Engineer's decision regarding correctness of the work and method of working shall be final and binding on the contractor. No claims for extra payment from the contractor will be entertained on the ground of deviation from the methods / sequence adopted in erection of similar sets elsewhere.
1.7	Following shall be the minimum responsibility of contractor and have to be provided within finally accepted rates / prices:
1.7.1	Provision as required of all types of labour, supervisors, engineers, watch and ward, tools & tackles, calibrated IMTEs (Inspection, measuring and testing equipment) as specified and otherwise required for the work, consumables for erection, testing and commissioning including material handling
1.7.2	Achieving Proper out-turn / Turn-over as per BHEL plan and commitment.
1.7.3	Completion of work as per BHEL Schedule
1.7.4	Good quality and accurate workmanship for proper performance of the equipment
1.7.5	Repair and rectification
1.7.6	Preservation / Re-conservation of all components during storage / erection / commissioning till handing over.

SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter - II : General Services to be rendered by the Bidder

2.0	GENERAL SERVICES TO BE RENDERED BY THE BIDDER
2.1	Services for construction, fabrication, equipment erection testing as well as trial run & commissioning of various equipment and accessories under the contract shall include but not be limited to the following:
2.2	Issuing materials from store/open yard from time to time for erection as per the construction programme. The Contractor shall be the custodian of all the materials issued till the plant/equipment is officially taken over by the owner / BHEL after complete erection any successful trial run & commissioning.
2.3	Transport of material to their respective places of erection and erection of the complete plant & equipment as supplied under this specification.
2.4	Trial run and commissioning of individual equipment / sub-systems to the satisfaction of Owner/BHEL.
2.5	Deployment of all skilled and unskilled manpower required for erection, supervision of erection, watch & ward, commissioning and other services to be rendered under this specification.
2.6	Deployment of all erection tools & tackle, construction machinery, transportation vehicles and all other implements in adequate number and size, appropriate for the erection work to be handled under scope of this specification except otherwise specified.
2.7	Supply of all consumables, eg welding electrodes, cleaning agents, diesel oil, lubricant etc as well as materials required for temporary supports, scaffolding etc as necessary for such erection work, unless specified other wise.
2.8	Providing support services for the contractor's erection staff eg construction of site offices, temporary stores, residential accommodation and transport to work site for erection personnel, watch and ward for security and safety of the materials under the Contractor's custody etc. as required.
2.9	Maintaining proper documentation of all the site activities undertaken by the Contractor as per the proforma mutually agreed with BHEL, Submission of monthly progress reports and any such document as and when desired by BHEL/owner, taking approval of all statutory authorities i.e Boiler Inspector, Factory Inspector, Inspector of Explosives etc , as applicable for respective portions of work fall under the jurisdiction of such statutes of laws.
2.10	Any other service, although not specifically called for but required for a contract of the size and nature indicated in the specification.

SPECIAL CONDITIONS OF CONTRACT (SCC)
Chapter - III : General Technical Requirements (Codes and Standards)

3.0	GENERAL TECHNICAL REQUIREMENTS (CODES AND STANDARDS)
3.1	Except where otherwise specified, the plant/equipment shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as mentioned elsewhere in contract specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary, to enable BHEL to identify all of the plant/equipment in the same detail as would be possible had there been a Standard Specification.
3.2	Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.
3.3	In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements which are more stringent shall govern.
3.4	Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.

SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter - IV : Obligations of Contractor

4.0	OBLIGATIONS OF CONTRACTOR
4.1	CONSUMABLES & OTHER ITEMS
4.1.1	The contractor shall provide within finally accepted price / rates, all consumables (excepting those indicated in BHEL scope) like welding electrodes (including alloy steel and stainless steel), filler wires, TIG filler wires (over & above as supplied by the unit along with the plant materials, which will be given free of cost to bidder), gases (inert, welding, cutting), soldering material, dye penetrants, radiography films, etc. Other erection consumables such as tapes, jointing compound, grease, mobile oil, M-seal, Araldite, petrol, CTC / other cleaning agents, grinding and cutting wheels are to be provided by the contractor. Steel, packers, shims, wooden planks, scaffolding materials hardware items etc required for temporary works such as supports, scaffoldings are to be arranged by the contractor. Sealing compounds, gaskets, gland packing, wooden/concrete sleepers, for temporary work, required for completion of work except those which are specifically supplied by manufacturing unit are also to be arranged by the contractor.
4.1.2	All the shims, gaskets and packing, which go finally as part of plant equipment, shall be supplied by BHEL free of cost.
4.1.3	It shall be the responsibility of the contractor to plan the activities and store sufficient quantity of consumables. Non-availability of any consumable materials or equivalent suggested by BHEL cannot be considered as reason for not attaining the required progress or for additional claim.
4.1.4	<u>TIG Filler wire for Boiler and Filler wires for Electrodes for P91/T91 piping:</u> These shall be supplied by BHEL free of cost as supplied by BHEL Manufacturing Units as part of regular supply. Required quantity as arrived at by calculation / standards will only be supplied. It would be the contractors' responsibility to account for the consumption of these filler wires. Additional consumption beyond standard / calculated quantity will be at cost recovery basis only unless and otherwise accounted for. Surplus quantity of TIG filler wire, if any, shall be properly stored and returned to BHEL stores.
4.1.5	It shall be the responsibility of the contractor to obtain prior approval of BHEL, regarding suppliers, type of electrodes etc before procurement of welding electrodes. On receipt of electrodes at site these shall be subjected to inspection and approval by BHEL. The contractor shall inform BHEL details regarding type of electrodes, batch number, date of expiry etc and produce test certificate for each lot / batch with correlation of batch / lot number with respective test certificate. No electrode without a valid test certificate will to be used.

SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter - IV : Obligations of Contractor

4.1.6	BHEL reserves the right to reject the use of any consumable including electrodes, gases, lubricants / special consumables if it is not found to be of the required standard / make / purity or when shelf life has expired. Contractor shall ensure display of shelf life on consumable wherever required and records maintained.
4.1.7	Storage of all consumables including welding electrodes shall be done as per requirement / instruction of the Engineer by the contractor at his cost.
4.1.8	In case of improper arrangement for procurement of any consumable, BHEL reserves the right to procure the same from any source and recover the cost from the Contractor's first subsequent bill at market value plus the departmental charges of BHEL from time to time. Postponement of such recovery is normally not permitted. The decision of BHEL Engineer in this regard shall be final and binding on the Contractor.
4.1.9	All lubricants and chemicals required for pre-commissioning, commissioning, testing, preservation and lubricants for trial runs of the equipment shall be supplied by BHEL / BHEL's client. All services including labour and T&P will be provided by the contractor for handling, filling, emptying, refilling etc. The consumption of lubricants / chemicals shall be properly accounted for. Surplus material if any shall be properly stacked/tagged and returned to BHEL/ CUSTOMER stores at no extra cost to BHEL. BHEL reserves the right to recover costs for wastage by the contractor.
4.1.10	Transportation of oil drums, from stores, filling of oil for flushing, first filling, subsequent changeover if any, topping/making up till the unit is fully commissioned and handed over to customer is included in scope of this contract. The contractor shall have to return all the empty drums to BHEL / BHEL's client store at no extra cost. Any loss / damage to above drums shall be to contractor's account.
4.1.11	All charges on account of Octroi, terminal or sales tax and other duties on materials obtained from any source for carrying out the works in the scope of the contractor shall be borne by the contractor.
4.2	TOOLS AND PLANTS / MEASURING AND MONITORING EQUIPMENT (MMEs)
4.2.1	T&Ps and MMEs to be provided by Contractor
4.2.1.1	All T&Ps and MMEs are to be provided by the Contractor. Contractor has to make his own arrangement at his cost for completing the formalities (including arrangement of Road permits, if any) if required with Sales Tax/VAT authorities, for bringing their materials, plants and equipments at site for the execution of work under this contract.

SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter - IV : Obligations of Contractor

4.2.1.2	All suitable cranes, lifting and transport equipments for material handling at stores/yard/siding of BHEL/Customer are included in scope.
4.2.1.3	All T&Ps to be deployed by the contractor shall have the approval of BHEL Engineer with regard to brand, quality and specification.
4.2.1.4	Indicative list of Major T&Ps in the scope of Contractor are given in the Technical Conditions of Contract. Bidders to note that these are only indicative and as such all other T&P necessary for timely and satisfactory completion of work in scope shall be mobilized by Contractor
4.2.1.5	Timely deployment of adequate T&Ps is the responsibility of the contractor. The contractor shall be prepared to augment the T&P at short notice to match the planned programme and to achieve the milestones.
4.2.1.6	Contractor shall maintain and operate his tools and plants in such a way that breakdowns are avoided. In the event of breakdown, contractor shall make alternative arrangements expeditiously so that the progress of work is not hampered.
4.2.1.7	In the event of contractor failing to arrange the required tools, plants, machinery, equipment, material or non-availability of the same owing to breakdown, BHEL will make alternative arrangement at the risk and cost of the contractor. Decision of BHEL shall be final and binding on the contractor
4.2.1.8	The T&P to be arranged by the contractor shall be in proper working condition and their operation shall not lead to unsafe condition. The movements of cranes, and other equipment should be such that no damage / breakage occurs to foundations, other equipments, material, property and men. All arrangements for the movement of the T&P etc shall be the contractor's responsibility.
4.2.1.9	Use of welding generators/ rectifiers only shall be permitted for welding. Use of welding transformers will be subject to specific approval of BHEL engineer.
4.2.1.10	The contractor at his cost shall carry out periodical testing of his construction equipments. Test certificates shall be furnished to BHEL.
4.2.1.11	Contractor shall ensure deployment of serviced and healthy T&Ps including cranes, lifting tackles, wire ropes, manila ropes, winches and slings etc. History card and maintenance records for major T&Ps will be maintained by the contractor and will be made available to BHEL Engineer for inspection as and when required. Fitness certificate / Test Certificates of T&P shall have to be submitted before it is put in use. Identification for such T&Ps will be done as per BHEL Engineer's advice. BHEL reserves the right to permit only new slings up to 20 mm and lifting tackles up to 3 MT capacities.

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Chapter - IV : Obligations of Contractor

4.2.1.12	Contractor shall ensure deployment of reliable and calibrated MMEs (Inspection measuring and Monitoring equipment). The MMEs shall have test / calibration certificates from authorized / Government approved / accredited agencies traceable to National / International standards. Each MME shall have a label indicating calibration status i.e. date of calibration, calibration agency and due date for calibration. A list of such instruments deployed by contractor at site with its calibration status is to be submitted to BHEL Engineer for control.
4.2.1.13	Re-testing / re-calibration shall also be arranged at regular intervals during the period of use as advised by BHEL Engineer within the contract price. The contractor will also have alternate arrangements for such MME so that work does not suffer when the particular instrument is sent for calibration. If any MMEs not found fit for use, BHEL shall have the right to stop the use of such item. It will be necessary for the contractor to deploy proper item. Any readings taken by the defective instrument will be recalled and repeat the readings taken by that instrument with a proper one. In case he fails to do so, BHEL may deploy MMEs and retake the readings at contractor's cost.
4.2.1.14	BHEL shall have lien on all T&P, MMEs and other equipment of the contractor brought to the site for the purpose of erection, testing and commissioning. BHEL shall continue to hold the lien on all such items throughout the period of contract / extended period. The contractor and / or his sub-contractors, without the prior written approval of the Engineer, shall remove no material brought to the site.
4.2.1.15	The month wise T&P deployment plan to execute the work is to be submitted as per relevant format as per the instruction of BHEL. It shall be the contractor's responsibility to deploy the required T&P, for timely and successful completion of the job, to any extent.
4.2.1.16	The area and infrastructure development of the area to be carried out by the customer. However in construction projects of this magnitude it is possible that all the areas / approaches may not be ready. In such cases backfilling of approaches where ever necessary, consolidation of ground and arrangement of sleepers / sand bag filling etc for safe operation / movement of equipment including cranes / trailers etc shall be the responsibility of the contractor at his cost. No compensation on this account shall be payable.

SPECIAL CONDITIONS OF CONTRACT (SCC)
Chapter – V : Responsibilities of Contractor in respect of Labour,
Supervisory Staff, etc.

5.0	RESPONSIBILITIES OF CONTRACTOR IN RESPECT OF LABOUR, SUPERVISORY STAFF, ETC.
5.1	Refer relevant clauses of General Conditions of Contract (GCC) also in this regard
5.2	The contractor shall deploy all the necessary skilled/semiskilled/ unskilled labour including highly skilled workmen etc. These workmen should have previous experience on similar job. They shall hold valid certificates wherever necessary. BHEL reserves the right to insist on removal of any employee of the contractor at any time if he is found to be unsuitable and the contractor shall forthwith remove him.
5.3	Contractor shall also comply with the requirements of local authorities/ project authorities calling for police verification of antecedents of the workmen, staff etc.
5.4	It is the responsibility of the contractor to engage his workmen in shifts and or on overtime basis for achieving the targets set by BHEL. This target may be set to suit BHEL's commitments to its customer or to advance date of completion of events or due to other reasons. The decision of BHEL in regard to setting the erection and commissioning targets will be final and binding on the contractor.
5.5	Contractor shall provide at different elevation suitable arrangement for urinal and drinking water facility with necessary plumbing & disposal arrangement including construction of septic tank. These installations shall be maintained in hygienic condition at all times.
5.6	The Contractor in the event of engaging 10 or more workmen, shall obtain Independent license under the Contract labour (Regulation and Abolition) Act 1970 from the concerned authorities based on Form-V issued by the Principal Employer/Customer. In order to issue Form-V by Customer, Contractor shall fulfill all Statutory requirements like Insurance Policy, PF Code/PF Account number etc as per the requirement of BHEL/Customer
5.7	Contractor shall deduct the necessary amount towards Provident Fund and contribute equal amount as per Government of India laws. This amount will be deposited regularly to the provident Fund Commissioner. BHEL/Customer may insist for submission of the account code duly certified by PF Commissioner
5.8	Contractor may also be required to comply with provisions of ESI Act in vogue if applicable and submit evidence to BHEL.
5.9	BHEL / customer may insist for witnessing the regular payment to the labour. They may also like to verify the relevant records for compliance with statutory requirements. Contractor shall enable such facilities to BHEL / Customer.

SPECIAL CONDITIONS OF CONTRACT (SCC)
**Chapter – V : Responsibilities of Contractor in respect of Labour,
Supervisory Staff, etc.**

5.10	Contractor shall deploy only qualified and experienced engineers/ supervisors. They shall have professional approach in executing the work.
5.11	The contractor's supervisory staff shall execute the work in the most professional manner in the stipulated time. Accuracy of work and aesthetic finish are essential part of this contract. They shall be responsible to ensure that the assembly and workmanship conform to dimensions and tolerances given in the drawings/instructions given by BHEL engineer from time to time.
5.12	The supervisory staff employed by the contractor shall ensure proper outturn of work and discipline on the part of the labour put on the job by the contractor. Also in general they should see that the works are carried out in a safe and proper manner and in coordination with other labour and staff employed directly by BHEL or other contractors of BHEL or BHEL's client.
5.13	It is the responsibility of the contractor to arrange gate pass for all his employees, T&P etc for entering the project premises. Necessary coordination with customer officials is the responsibility of the contractor. Contractor to follow all the procedures laid down by the customer for making gate passes. Where permitted, by customer / BHEL, to work beyond normal working hours, the contractor shall arrange necessary work permits for working beyond normal working hours.
5.14	The actual deployment will of Labour and Engineer/supervision staff shall be so as to satisfy the erection and commissioning targets set by BHEL. If at any time, it is found that the contractor is not in a position to deploy the required engineers/supervisors/workmen due to any reason, BHEL shall have the option to make alternate arrangements at the contractor's risk and cost. The expenditure incurred along with BHEL overheads thereon shall be recovered from the contractor
5.15	Contractor shall not deploy women labour at night.

SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter – VII: Drawings and documents

6.0	MATERIAL HANDLING, STORAGE AND PRESERVATION ETC
6.1	MATERIAL HANDLING AND STORAGE
6.1.1	All the equipments/materials furnished under this contract shall be received from the project stores, sheds / storage yards and transported to pre assembly area / erection site and stored in the storage spaces in a manner so that they are easily retrievable till the contractor erects them. While drawing/lifting material from BHEL / customer stores, the contractor shall ensure that the balance / other materials are stacked back immediately. No claim is admissible on this account
6.1.2	While BHEL will endeavor to store / stack / identify materials properly in their open / close / semi closed / tarpaulins covered storage yard / shed, it shall be contractor's responsibility to assist BHEL in identifying materials well in time for erection. They should take the delivery of the same, following the procedure indicated by BHEL, and transport the material safely to pre-assembly yard / erection site in time, according to program.
6.1.3	The contractor shall take delivery of components, equipment / consumables from storage area after getting the approval of BHEL Engineer on standard indent forms.
6.1.4	The contractor shall identify and deploy necessary Engineers / supervisors / workmen for the above work in sufficient number as may be needed by BHEL, for areas covering their scope.
6.1.5	All the equipment shall be handled very carefully to prevent any damage or loss. No untested wire ropes / slings etc. shall be used for unloading / handling. The equipment shall be properly protected to prevent damage either to the equipment or to the floor where they are stored. The equipment from the stores shall be moved to the actual location at the appropriate time so as to avoid damage of such equipment at site.
6.1.6	Contractor shall ensure that while lifting slings shall be put over the points indicated on the equipment or as indicated in the manufacturer's drawings. Slings / shackles of proper size shall be used for all lifting and rigging purposes. All care shall be taken to safe guard the equipment against any damage. Dragging of piping / valves should be avoided. In case of any damage the cost shall be covered from the contractor.
6.1.7	Approach road conditions from the stores / yards to the erection site may not be equipped and ideal for smooth transportation of the equipment. Contractor may have to be adequately prepared to transport the materials under the above

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Chapter – VII: Drawings and documents

	circumstances without any extra cost. . The contractor may familiar himself with soil conditions at site.
6.1.8	Contractor shall be responsible for examining all the plant and materials issued to him and notify the Engineer immediately of any damage, shortage, discrepancy etc before they are moved out of the stores / storage area. The contractor shall be solely responsible for any shortages or damages in transit, handling, storage and erection of the equipment once received by him. As the erection work will be spread in different areas / locations of the project, contractor has to arrange sufficient number of watch / ward personal to avoid any pilferage of material
6.1.9	The contractor shall maintain an accurate and exhaustive record-detailing out the list of all equipment received by him for the purpose of erection and keep such record open for the inspection of the engineer at any time.
6.1.10	All the material in the custody of contractor and stored in the open or dusty locations must be covered with suitable weather proof / fire retardant covering material wherever applicable and shall be blocked up on raised level above ground. All covering materials including blocks and sleeper shall be arranged by the contractor at his cost.
6.1.11	If the material belonging to the contractor are stored in area other than those earmarked for his operation the engineer will have the right to get it moved to the area earmarked for the contractor at the contractors risk and cost.
6.1.12	The contractor shall be responsible for making suitable indoor storage facilities to store all equipment (drawn by the contractor from BHEL / customer stores), which require indoor storage till the time of their installation. The Engineer will direct the contractor in this regard, which item in his opinion will require indoor storage, and the contractor shall comply with Engineer's decision.
6.1.13	The contractor shall ensure that all surplus / damaged / scrap / unused material, packing wood/ containers/ special transporting frames etc are returned to BHEL at a place in project area identified by the Engineer. The contractor will maintain an account for all items received and returned to BHEL. Any shortage in returning such items shall be chargeable to the contractor except allowable wastage for packing wood only.
6.1.14	The contractor shall hand over all parts / materials remaining extra over the normal requirement with proper identification tags to the stores as directed by the concerned BHEL engineer.
6.1.15	The contractor shall ensure that all the packing materials and protective devices installed on equipment during transit and storage are removed before installation.

SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter – VII: Drawings and documents

6.1.16	It shall be the responsibility of the contractor to keep the work / storage areas in neat, tidy and working conditions. All surplus/unusable packing and other materials shall be removed and deposited at location(s) specified by BHEL within the project premises. If required weighing of the same within the project premises will have to be carried out.
6.2	PRESERVATION OF COMPONENTS
6.2.1	Plant materials storage shall be subjected to the following protection besides other provisions indicated in these specifications elsewhere.
6.2.1.1	Items stored outdoors shall be stacked up at least six inches (6") off the ground. Items should not be stored in a low lying area where water logging is a possibility. Contractor should have sufficient numbers of wooden / concrete / steel sleepers for the job.
6.2.1.2	Motors, valves, electrical equipment, control equipment and instruments, and special or precision items requiring special care, etc shall be stored indoors. Motor windings shall be kept dry by use of external heat or space heaters.
6.2.1.3	Bearings and other wearing surfaces of plant materials shall be protected against corrosion and kept clean and should be regularly monitored.
6.2.1.4	Insulation materials shall be stored indoors or otherwise protected against getting wet/ damaged, using suitable measures and should be protected from direct rain.
6.2.2	It shall be the responsibility of the contractor to apply preservatives / touch up paints (primer) on equipment handled and erected by him till such time of final painting. It shall be contractor's responsibility to arrange for required paints (primer), thinners, labour, scaffolding materials, cleaning materials like wire brush, emery sheets, etc, cleaning of surface and provide one coat of preservatives / paints (primer) from time to time as decided by BHEL engineer. The accepted rate shall include this work also. It is to be noted that such painting may have to be done as and when required till such time the final painting is carried out.
6.2.3	The contractor shall effectively protect the finished work from action of weather and from damage or defacement and shall cover the finished parts then and there for their protection.
6.2.4	Any failure on the part of contractor to carry out works according to above clauses will entail BHEL to carry out the job from any other party and recover the cost from contractor.

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Chapter – VII: Drawings and documents

7.0	DRAWINGS AND DOCUMENTS
7.1	The detailed drawings, specifications available with BHEL engineers will be made available to the contractor during execution of work at site. The contractor will also ensure availability of all drawings / documents at work place.
7.2	Necessary drawings to carry out the erection work will be furnished to the contractor by BHEL on loan, which shall be returned to BHEL Engineer at site after completion of work. Contractor shall ensure safe storage and quick retrieval of these documents.
7.3	The contractor shall maintain a record of all drawings and documents available with him in a register as per format given by BHEL Engineer. Contractor shall ensure use of pertinent drawings / data / documents and removal of obsolete ones from work place and returning to BHEL.
7.4	The data furnished in various annexure enclosed with this tender specification are only approximate and for guidance. However, the change in the design and in the quantity may occur as is usual in any such large scale of work. The contractors quoted rates shall be inclusive of the above factor
7.5	Should any error or ambiguity be discovered in the specification or information the contractor shall forthwith bring the same to the notice of BHEL before commencement of work. BHEL's interpretation in such cases shall be final and binding on the contractor.
7.6	Deviation from design dimensions should not exceed permissible limit. The contractor shall not correct or alter any dimension / details, without specific approval of BHEL.

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Chapter – VIII: Inspection and Quality

8.0	INSPECTION AND QUALITY
8.1	Inspection, Quality Assurance, Quality Control
8.1.1	Preparation of quality assurance log sheets and protocols with customer/ consultants/statutory authority, welding logs, NDE records, testing & calibration records and other quality control and quality assurance documentation as per BHEL engineer's instructions, is within the scope of work/specification. These records shall be submitted to BHEL/customer for approval from time to time.
8.1.2	The protocols between contractor and customer/ BHEL shall be made prior to installation for correctness of foundations, materials, procedures, at each stage of installation, generally as per the requirement of customer/ BHEL. This is necessary to ensure elimination of errors or keeping them within tolerable limits and to avoid accumulation and multiplication of errors.
8.1.3	A daily log book should be maintained by every supervisor/engineer of contractor on the job in duplicate (one for BHEL and one for contractor) for detailing and incorporating alignment/clearance / centering / leveling readings and inspection details of various equipments etc. High pressure welding details like serial number of weld joints, welders name, date of welding, details of repair, heat treatment etc. will be documented in welding log as per BHEL Engineer's instructions. Record of radiography containing details like serial number of weld joints, date of radiography, repairs, if any, re-shots etc shall also be maintained as per BHEL Engineer's instructions. Record of heat treatments performed shall be maintained as prescribed by BHEL
8.1.4	The performance of welders will be reviewed from time to time as per the BHEL standards. Welders' performance record shall be furnished periodically furnished for scrutiny of BHEL's Engineer. Corrective action as informed by BHEL shall be taken in respect of those welders not conforming to these standards. This may include removal/ discontinuance of concerned welder(s). Contractor shall arrange for the alternate welders immediately
8.1.5	All the welders shall carry identity cards as per the proforma prescribed by BHEL/Customer/Consultant. Only welders duly authorized by BHEL/customer/consultant shall be engaged on the work.

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Chapter – VIII: Inspection and Quality

8.1.6	Contractor shall provide all the Measuring Monitoring Equipments (MMEs) required for completion of the work satisfactorily. These MMEs shall be of brand, quality and accuracy specified by BHEL Engineer and should have necessary calibration and other certificates as per the requirement of BHEL Engineer. Decision of BHEL Engineer regarding acceptance or otherwise of the measuring instruments/gauges/tools for the work under this specification, is final and binding on the contractor. BHEL may give an indicative list of MMEs required for this work and to be made available by the contractor. The list will be reviewed by BHEL and the contractor shall meet any augmentation needed wherever required.
8.1.7	It is the responsibility of the contractor to prove the accuracy of the testing/measuring/calibrating equipments brought by him based on the periodicity of calibration as called for in the BHEL's quality assurance standards/BHEL Engineer's instructions.
8.1.8	Any re-laying or re-termination of cables/re-erection of instruments/recalibration of instruments etc. required due to contractor's mistake or design requirement and found at any stage inspection, shall be carried out by the contractor at no extra cost.
8.1.9	Contractor shall ensure deployment of reliable and calibrated MMEs (Measuring and Monitoring Equipments). The MMEs shall have test / calibration certificates from authorised / Government approved / Accredited agencies traceable to National / International Standards. Re-testing / re-calibration shall also be arranged at regular intervals during the period of use as advised by BHEL Engineer within the contract price. The contractor will also have alternate arrangements for such MMEs so that work does not suffer when the particular equipment / instrument is sent for calibration. Also if any MMEs not found fit for use, BHEL shall have the right to stop the use of such item and instruct the contractor to deploy proper item and recall ie repeat the readings taken by that instrument, failing which BHEL may deploy MME and retake the readings at Contractor's cost.
8.1.10	Re-work necessitated on account of use of invalid MMEs shall be entirely to the contractor's account. He shall be responsible to take all corrective actions, including resource augmentation if any, as specified by BHEL to make-up for the loss of time.
8.1.11	In the courses of erection, it may become necessary to carry repeated checks

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Chapter – VIII: Inspection and Quality

	of the work with instruments recently calibrated, re-calibrated. BHEL may counter/ finally check the measurements with their own MMEs. Contractor shall render all assistance in conduct of such counter/final measurements.
8.1.12	Total Quality is the watchword of the work and Contractor shall strive to achieve the Quality Standards, procedures laid down by BHEL. He shall follow all the instructions as per BHEL drawings and Quality Standards.
8.2	Stage Inspection By FES/QA Engineers
8.2.1	Apart from day-to-day inspection by BHEL Engineers stationed at Site and Customer's Engineers, stage inspection of equipments under erection and commissioning at various stages shall also be conducted by teams of Engineers from Field Engineering Services of BHEL's Manufacturing Units, Quality Assurance teams from Field Quality Assurance, Unit/Factory Quality Assurance and Commissioning Engineers from Technical Services etc. Contractor shall arrange all labour, tools and tackles etc along with proper access for such stage inspections free of cost.
8.2.2	Any modifications suggested by BHEL FES and QA Engineers' team shall be carried out. Claims of contractor, if any, shall be dealt as per Section 13, and provided such modifications have not arisen for reasons attributable to the contractor.
8.3	Statutory Inspection of Work
8.3.1	The work to be executed under these specifications has to be offered for inspection, at appropriate stages of work completion, to various statutory authorities for compliance with applicable regulations. The work related statutory inspections, though not limited to, are as under: 1) Inspectorate of Steam Boilers and Smoke Nuisance 2) Electrical Inspector 3) Factory Inspector, Labour Commissioner, PF Commissioner and other authority connected to this project work The scope includes getting the approvals from the statutory authorities, which includes arranging for inspection visits of statutory authority periodically as per BHEL Engineer's instructions, arranging materials for ground inspection, taking rub outs for the pressure parts to be offered for inspection, submitting co-related inspection reports, documents, radiographs etc and following up the matter with them. Contractor shall also make all arrangements for offering the Products / Systems for inspection at location, as applicable, to the concerned

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	authority.
8.3.2	Contractor should be qualified to execute pressure parts & piping work coming under the purview of IBR, for which he should register himself with CIB of state concerned. contractor also should be aware of the latest IBR regulations and Electricity Act, including the amendments thereof.
8.3.3	Contractor shall comply with 'Qualification Tests for welders engaged in welding of Boilers and Steam Pipes under Construction, Erection and Fabrication at Site in India and in repairing Boilers and steam pipes by welding' in line with Chapter XIII of Indian Boiler Regulations-1950, for testing his welders / men / workers, including all associated fees, procedures, required instruments and equipments and their calibration there of. It shall be contractor's responsibility to obtain approval of Statutory Authorities, wherever applicable, for the conducting of any work which comes under the purview of these authorities, at his cost.
8.3.4	The following fees shall be excluded from scope of Contractor: 1. Registration Fee as per Regulation 385 of Chapter IX of Indian Boiler Regulations-1950 2. Fees for inspection of Boiler at the site of Construction as per Regulation 395 A, sl no 4 of Chapter IX of Indian Boiler Regulations-1950 However all other fees like visit fees charged by the Boiler Inspector and other arrangements for his visit or visits till satisfactory completion of work, shall be included in scope of Contractor
8.4	The basic philosophy of the Quality Management System is to define the organizational responsibility, work as per documented procedures, verify the output with respect to acceptance norms, identify the non-conforming product/ procedure and take corrective action for removal of non-conformance specifying the steps for avoiding recurrence of such non-conformities, & maintain the relevant quality records. The non conformities are to be identified through the conduct of periodical audit of implementation of quality systems at various locations/stages of work. Suppliers/vendors of various products/services contributing in the work are also considered as part of the quality management system. as such the contractor is expected not only to conform to the quality management system of BHEL but also it is desirable that they themselves are accredited under any quality management system standard.

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8.5	Field Quality Assurance
8.5.1	Contractor shall carry out all activities conforming to the approved Field Quality Plan (FQP) as revised from time to time. Total quality shall be the watchword of the work and contractor shall strive to achieve the quality standards, procedures laid down by BHEL. He shall follow all the instructions as per BHEL drawings and quality standards. Contractor shall provide the services of quality assurance engineer as per the relevant clauses.

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9.0	OCCUPATIONAL HEALTH, SAFETY & ENVIRONMENT MANAGEMENT/ QUALITY ASSURANCE PROGRAMME : Quality of work to customer's satisfaction and fulfillment of system requirements are the essence of ISO 9001 certification. Contractor shall organise/ plan/ perform all their activities to meet with the applicable requirements of these standards.
9.1	HSE (Health, safety & Environment): Contractor will comply with HSE (Health, safety & Environment) requirements of BHEL. HSE requirements in brief, are given below :-
9.1.1	Contractor will nominate one of their qualified and experienced employees as Safety Officer, who will be responsible for all HSE related issues of contractors work area. Safety Officer will have authority to stop any activity, in case he observes that the activity is not being carried out in safe manner. He will conduct surprise inspection as well as periodic inspection/drill (at least once in a month) and submit such reports to BHEL. He will conduct periodic meetings with supervisors of different working groups and explain HSE issues and use of PPEs to them. Reports of such meetings will be submitted to BHEL. Contractor will develop suitable work procedures based upon HSE guidelines and OCPs and implement it. Such work procedures will consist of Area of work, T&P Details, Work Procedure, PPE requirements etc. Contractor should highlight the requirement of safety to staff and labour through daily tool box meeting before start of the days job
9.1.2	The contractor shall ensure that proper job specific health check-up is done by medical professional for their employees during initial mobilization and thereafter if there is any change of job.
9.1.3	Following personnel protective equipments (PPEs), in adequate numbers, will be made available at site & their regular use by all concerned will be ensured :- - HELMET - SAFETY GOGGLES & WELDING FACE SHIELDS - SAFETY BELTS AND PROTECTIVE NET FOR WORKING AT HEIGHT - SAFETY SHOES - EAR PLUG - ANY OTHER SAFETY EQUIPMENT REQUIRED FOR SAFE COMPLETION OF THE WORK
9.1.4	Providing appropriate First Aid facilities for prompt treatment of injuries and illness at work place. Arranging training to contractor workmen/ employees for giving first aid.

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9.1.5	Arranging ambulance in case of any emergency situation .
9.1.6	Identification of nearest hospital and health check-up of workmen/employees
9.1.7	Providing filtered drinking water at work place in cool container.
9.1.8	Providing Canteen, Rest Room, Washing facilities to the contracted employees as per provisions of Contract Labour Regulation Act 1970 (Chapter V).
9.1.9	Providing appropriate fire fighting equipment at designated work place and nominate a fire officer/warden adequately trained for his job.
9.1.10	Identification of nearest fire station and display contact telephone nos. / person's name around work places for cases of emergencies .
9.1.11	Providing adequate no. of 24 V sources and ensure that no hand lamps are operating at voltage level above 24 Volts.
9.1.12	Fulfilling safety requirements at all power tapping points.
9.1.13	Red & White caution tape of proper width(1.5 to 2 inch) to be used for cordoning unsafe area such as open trench, excavation area etc.
9.1.14	Providing contractors company logo on cloths /uniform/ proper identity cards with photographs, for correct identification of people working at project site .
9.1.15	High/ Low pressure welders to be identified with separate colour clothings. No welders will be deployed without passing appropriate tests and holding valid welding certificates. Approved welding procedure should be displayed at work place.
9.1.16	Displaying safe handling procedures for all chemicals such as lube oil, acid, alkali, sealing compounds etc , at work place .
9.1.17	All scaffolding/ platforms should be made from materials of appropriate quality/grade so that these are safe for use. It should be certified/declared safe for use by an experienced contractor person, before any scaffolding/platform is used.
9.1.18	All T&Ps/ MMEs should be of reputed brand/appropriate quality & must have valid test/calibration certificates bearing endorsement from competent authority of BHEL.
9.1.19	Ensure that the regulatory requirement of excessive weight limit (to carry/lift/ move weights beyond prescribed limits) for male and female workers are complied with.
9.1.20	Safety slogan, Safety/ Caution boards , wherever required to be displayed in consultation with BHEL.
9.1.21	Take suitable measures for waste management and environment related laws/legislation as a part of normal construction activities. Compliance with the legal requirements on storage/ disposal of paint drums (including the empty

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	ones), Lubricant containers, Chemical Containers, and transportation and storage of hazardous chemicals will be strictly maintained. Ensure proper cleanliness of work place, housekeeping and waste management (including proper waste disposal) on daily basis.
9.1.22	It is imperative on the part of the contractor to join and effectively contribute in joint measures such as tree plantation, environment protection, contributing towards social upliftment, conversion of packing woods to school furniture, keeping good relation with local populace etc.
9.1.23	The contractor shall carry out periodic air and water quality check and illumination level checking in his area of work place and take suitable control measure.
9.1.24	The Contractor is required to provide proper safety net systems where ever the hazard of fall from height is present as per instruction of BHEL Engineer. The safety nets shall be fire resistant, duly tested and shall be of ISI Mark and the nets shall be located as per site requirements to arrest or to reduce the consequences of a possible fall of persons working at different heights.
9.1.25	All applicable OCPs (Operational control procedures) will be followed by contractor as per BHEL instructions. This will be done as part of normal scope of work. List of such OCPs is given below . In case any other OCP is found to be applicable during the execution of work at site, then contractor will follow this as well, within quoted rate. These OCPs (applicable ones) will be made available to contractor during work execution at site. However for reference purpose, these are kept with Safety Officer of BHEL, HYDERABAD or available in downloadable format in the website, which may be refereed by contractor, if they so desire.
	■ OCP for safe handling of chemicals
	■ OCP for Electrical safety
	■ OCP for energy conservation
	■ OCP for safe welding and gas cutting operation
	■ OCP for fire safety
	■ OCP for safety in use of hand tools
	■ OCP for first aid
	■ OCP for food safety at canteen
	■ OCP for safety in use of cranes
	■ OCP for storage and handing of gas cylinders
	■ OCP for manual arc welding
	■ OCP for safe use of helmets
	■ OCP for good house keeping

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■	OCP for working at height
■	OCP for safe excavation
■	OCP for safe filling of Hydrogen in cylinder
■	OCP for illumination
■	OCP for handling and erection of heavy metals
■	OCP for safe acid cleaning
■	OCP for safe alkali boil out
■	OCP for safe oil flushing
■	OCP for steam blowing
■	OCP for safe working in confined area
■	OCP for safe operation of passenger lift, material hoists & cages
■	OCP for Vehicle maintenance
■	OCP for safe radiography
■	OCP for waste disposal
■	OCP for working at night
■	OCP for blasting
■	OCP for DG Set
■	OCP for handling & storage of mineral wool
■	OCP for drilling, reaming and grinding(machining) etc.
■	OCP for hydraulic test
■	OCP for spray insulation
■	OCP for trial run of rotary equipment
■	OCP for stress relieving
■	OCP for material preservation
■	OCP for cable laying/tray work
■	OCP for electrical maintenance
■	OCP for transformer charging
■	OCP for safe handling of battery system
■	OCP for computer operation
■	OCP for storage in open yard
■	OCP for sanitary maintenance
■	OCP for batching
■	OCP for piling rig operation
■	OCP for gas distribution test
■	OCP for cleaning of hotwell / deaerator
■	OCP for electro-resistance heating
■	OCP for compressor operation

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	■ OCP for O&M of control of AC plant & system ■ OCP for air compressor ■ OCP for passivation ■ OCP for Safe EDTA Cleaning ■ OCP for Safe Chemical cleaning of Pre boiler system ■ OCP for Safe Boiler Light up ■ OCP for Safe Rolling and Synchronisation ■ OCP for Safe Loading of Unit
9.2	SAFETY AND CLEANLINESS : The contractor shall take all necessary safety precautions and arrange for appropriate appliances as per discretion of BHEL or its authorised officials (Site Construction Manager) to prevent loss of human lives, injuries, to personnel engaged and damage to property. Before commencing the work, the contractor shall submit a "Safety Plan" to the above authorised BHEL official and obtain approval on the same. The safety plan shall indicate in detail the measures that would be taken by the contractor to ensure safety of men, equipment, materials and environment during execution of the work. This will also include an organization structure, role and responsibilities of the concerned key personnel, the safety practices that will be followed, PPEs deployed, plan for handling critical activities and emergencies.
9.3	If the contractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instructions issued by the authorised BHEL official, BHEL shall have the right to take corrective steps at the risk and cost of the contractor.
9.4	During the course of construction, alternation or repairs, scrap with protruding nail, sharp edge etc and all other debris shall be kept clean from working areas, passage, ways and stairs in and around site.
9.5	Combustible scrap and debris shall be removed at regular intervals during the course of execution. Safe means shall be provided to facilitate such removal. The combustible scrap should be stored in safe place away from the plant materials to avoid fire accidents. The area shall be chosen in consultation with the Engineer and to be cordoned off.
9.6	Rigging equipment for materials handling shall be inspected prior to use in each shift and as necessary during its use to ensure that it is safe. Defective rigging equipment will be removed from service.
9.7	Rigging equipment shall not be loaded in excess of its recommended safe working load. Rigging equipment, when not in use, shall be removed from the

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	original work area so as not to present a hazard to employees.
9.8	Contractor shall notify the engineer, of his intention to bring on to site any equipment or any container, with liquid or gaseous fuel or other substance which may create a hazard. The BHEL Engineer shall have the right to prescribe the condition under which such equipment or container may be handled and used during the performance of the works and the contractor shall strictly adhere to such instructions. The BHEL Engineer shall have the right to inspect any construction tool and to forbid its use, if in his opinion it is unsafe. No claim due to such prohibition will be entertained.
9.9	Where it is necessary to provide and/or store petroleum products or petroleum mixture & explosives, the contractor shall be responsible for carrying out such provision / storage in accordance with the rules & regulations laid down in the relevant petroleum act, explosive act and petroleum and carbide of calcium manual, published by the chief inspector of explosives of India. All such storage shall have prior approval if necessary from the chief inspector of explosives or any other statutory authority. The contractor shall be responsible for obtaining the same.
9.10	Cylinders shall be moved by tilting and rolling them on their bottom edges. They shall not be intentionally dragged, struck or permitted to strike each other violently.
9.11	When cylinders are transported by powered vehicle they shall be secured in a vertical position.
9.12	All workmen of the contractor working on construction area shall wear safety shoes, hand gloves, safety helmets and safety belt as applicable. The contractor shall provide to its workforce and ensure the use of following personnel protective equipment as found necessary and as directed by BHEL.
9.12.1	Safety Helmets conforming to IS-2965 : 1984
9.12.2	Safety Belts conforming to IS-3521:1983
9.12.3	Safety Shoes conforming to IS-1989 : 1978
9.12.4	Eye and face protection devices conforming to IS – 8620 : 1977 & IS – 8950 : 1978.
9.12.5	Hand and body protection devices conforming to IS – 2575 : 1975 and IS – 6994 : 1973, IS – 8907 : 1970 & 8619 : 1977

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9.13	The contractor shall insure his workmen against all accidents and the policy shall be presented to BHEL Engineer on demand. Other wise, BHEL will arrange the same and the expenditure towards this will be debited to the contractor. In case of a fatal or disabling injury accident to any person at construction site due to lapses by the contractor, the victim and/or his/her dependants shall be compensated by the contractor as per statutory requirements. However, if considered necessary BHEL shall have the right to impose appropriate financial penalty on contractor and recover the same from payments due to the contractor for suitably compensating the victim and/or his/her dependence before imposing any such penalty. Appropriate enquiry shall be held by BHEL giving opportunity to the contractor for presenting his case. Above safety conditions are not exhaustive but gives an idea for the contractor and contractor shall adhere to all safety precaution given by the Engineer at site.
9.14	The contractor shall arrange at his cost adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. at various levels for safe and proper working operations during night hours at the work spot as well as at the pre-assembly area.
9.15	The contractor shall be responsible for provision of all the safety notices and safety equipment as enjoined on him by the application of relevant statutory regulation / provisions and/or as called upon by BHEL from time to time. He shall be held responsible for any violation of statutory regulations (local, state or central) and BHEL instruction that may endanger safety of men, equipment and material.
9.16	The contractor shall provide temporary fencing wherever required as a safety measure against accident and damage to properties. Suitable caution notices shall be displayed where access to any part is found to be unsafe and hazardous.
9.17	Contractor shall ensure safety of all the workmen, material and equipment either belonging to him or to others working at site. He shall observe safety rules and codes applied by BHEL without exception.
9.18	It will be the responsibility of the contractor to ensure safe lifting of the equipment, taking due precaution to avoid any accident and damage to other equipment and personnel. All requisite tests and inspection of handling equipment, tools & tackle shall be periodically done by the contractor. Defective equipment shall be removed from service. Any equipment shall not be loaded in

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	excess of its recommended safe working load.
9.19	The contractor shall provide necessary first aid facilities for all his employees, representatives and workmen at site and BHEL shall have no obligation in this regard. The first aid boxes should be placed at various elevations so as to make them available within the reach and at the quickest possible time. The contractor should conduct periodical first –aid classes to keep his supervisor and Engineers properly trained for attending to any emergency.
9.20	All the contractor's supervisory personnel and sufficient number of workers shall be trained for fire protection systems. Enough number of such trained personnel must be available during the tenure of contract. Contractor should nominate his supervisor to coordinate and implement the safety measures.
9.21	Contractor shall provide enough fire protecting equipment of the types and numbers at his office, stores, temporary structure in labour colony etc. Such fire protection equipment shall be easy and kept open at all times. The fire extinguishers shall be properly refilled and kept ready which should be certified at periodic intervals. The date of changing should be marked on the Cylinders. All other fire safety measures as laid down in the "codes for fire safety at construction site" issued by safety coordinator of BHEL shall be followed. Non-compliance of the above requirement under fire protection shall in no way relieve the contractor of any of his responsibility and liabilities to fire accident occurring either to his materials or equipment or those of others.
9.22	The contractor shall at his cost, remove from vicinity of work at least once each day all combustible waste, scrap, painting materials, rubbish, unused or other materials and deposit them in places specified by BHEL to keep the work site clear and tidy. Use of undercoated canvas paper, corrugated paper, fabricated carton, plastic or other flammable materials shall be restricted to the minimum and promptly removed.
9.23	The contractor shall not use any hand lamp energized by Electric power with supply voltage of more than 24 volts in confined spaces like inside water boxes, turbine casings, condensers etc.
9.24	All portable electric tools used by the contractor shall have safe plugging system to source of power and be appropriately earthed. Only electricians licensed by appropriate statutory authority shall be employed by the contractor to carry out all types of electrical works.
9.25	In case of any delay in completion of a job due to mishaps attributable to lapses by the contractor, BHEL shall have the right to recover cost of such

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	delay from the payments due to the contractor, after notifying the contractor suitably.
9.26	Valve protection caps shall be kept in place and secured.
9.27	The contractor shall be responsible for the safe storage and handling of his radio-active sources as per BARC rules and regulations.
9.28	Tarpaulin being inflammable should not be used (instead, only non infusible covering materials shall be used) as protective cover while preheating, welding, stress relieving etc. at site.
9.29	If the contractor fails to improve the standards of safety in its operation to the satisfaction of BHEL after being given reasonable opportunity to do so and/or if the contractor fails to take appropriate safety precautions or to provide necessary safety devices and equipment or to carry out instruction regarding safety issued by BHEL, BHEL shall have the right to take corrective steps at the risk and cost of the contractor after giving a notice of not less than 7 days indicating the steps that would be taken by BHEL.
9.30	If the contractor succeeds in carrying out its job in time with out any fatal or disabling injury accident and without any damage to property BHEL may, at its sole discretion, favorably consider to reward the contractor suitably for the performance.
9.31	The contractor shall carefully follow the safety requirement of BHEL/ the purchaser with the regard to voltages used in critical areas.
9.32	The contractor shall use only properly insulated and armored cables which conform to the requirement of Indian Electricity Act and Rules for all wiring, electrical applications at site. BHEL reserves the right to replace any unsafe electrical installations, wiring, cabling etc. at the cost of the contractor. All electrical appliances used in the work shall be in good working condition and shall be properly earthed. No maintenance work shall be carried out on live equipment. The contractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installations.
9.33	The contractor shall arrange adequate number of persons specifically for clearing any debris and for house keeping of the erection area including restacking of components in the erection areas.
9.34	In case of any damage to property due to lapses by the contractor, BHEL shall have the right to recover the cost of such damages from the contractor after holding an appropriate enquiry.

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9.35	The contractor shall submit report of all accidents, fires and property damage etc to the Engineer immediately after such occurrence, but in any case not later than 24 hours of the occurrence. Such reports shall be furnished in the manner prescribed by BHEL. In addition periodic reports on safety shall also be submitted by the contractor to BHEL from time to time as prescribed by the Engineer.
9.36	Before commencing the work, the contractor shall appoint/nominate a responsible person to supervise implementation of all safety measures and liaison with his counterpart of BHEL.
9.37	Suitable scaffolds shall be provided for workman for all works that cannot safely be done from the ground, or from solid construction except in the case of short duration of work which can be done safely from ladders. When a ladder is used, it shall be of rigid construction made of steel. The steps shall have a minimum width of 45 cm and a maximum rise of 30 cm. Suitable handholds of good quality wood or steel shall be provided and the ladder shall be given an inclination not steeper than $\frac{1}{4}$ horizontal and 1 vertical.
9.38	Scaffolding or staging more than 3.6 m above the ground floor, swung or suspended from an overhead support or erected with stationery support shall have a guard rail properly bolted, braced or otherwise secured, at least 90 cm above the floor or platform of such scaffolding or staging and extending along the entire length of the out side and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from savor, from swaying, from the building or structure.
9.39	Working platforms, gangways and stairways shall be so constructed that they do not sag unduly or unequally and if the height of the platform gangways provided is more than 3.6 m above ground level or floor level, they shall be closely boarded and shall have adequate width which shall not be less than 750 mm and be suitably fenced as described above.
9.40	Every opening in the floor or a building or in a working platform shall be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 90 cm.
9.41	Wherever there are open excavation in ground, they shall be fenced off by suitable railing and danger signals installed at night so as to prevent persons slipping into the excavations.

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9.42	Safe means of access shall be provided to all working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9 m in the length while the width between side rails in rung ladder shall in no case be less than app. 29.2 cm for ladder upto and including 3 m in length. For longer ladders this width shall be increased at least ¼” for each additional foot of length.
9.43	A sketch of the ladders and scaffolds proposed to be used shall be prepared and approval of the Engineer obtained prior to Construction.
9.44	All personnel of the Contactor working within the plant site shall be provided with safety helmets. All welders shall wear welding goggles while doing welding work and all metal worker shall be provided with safety gloves. Persons employed on metal cutting and grinding shall wear safety glasses.
9.45	Adequate precautions shall be taken to prevent danger for electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or the public.
9.46	All trenches, four feet or more in depth, shall at all times be supplied with at least one ladder for each 30 m in length or fraction thereof. The ladder shall be extended from bottom of the trench to at least 90 cm above the surface of the ground. Sides of the trenches which are 1.50 m or more in depth shall be stepped back to give suitable slope or securely held by timer bracing, so as to avoid the danger of sides collapsing. The excavated materials shall not be placed within 1.5 m of the edges of the trench or half of the depth of the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be done.
9.47	The Contactor shall take all measures at the sites of the work to protect all persons from accidents and shall be bound to bear the expenses of defense of every suit, action or other proceeding at law that may be brought by any persons for injury sustained or death owing to neglect of the above precautions and to pay any such persons such compensation or which may with the consent of the Contractor be paid to compromise any claim by any such person should such claim proceeding be filed against BHEL, the Contractor hereby agrees to indemnify BHEL against the same.
9.48	Before any demolition work is commenced and also during the process of the work the following shall be ensured:
9.48.1	All roads and open areas adjacent to the work site shall either be closed or suitably protected.

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9.48.2	No electric cable or apparatus which is liable to be a source of danger nor a cable or an apparatus used by the operator shall remain electrically charged.
9.48.3	All practical steps shall be taken to prevent danger to persons employed from the risks of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render them unsafe.
9.49	All necessary personnel safety equipment as considered adequate by the Engineer should be kept available for the use of the persons employed in the Site and maintained in a condition suitable for immediate use and the Contractor should take adequate steps to ensure proper use of equipment by those concerned.
9.49.1	Workers employed on mixing asphalted materials, cement and lime mortars shall be provided with protective foot wear and protective goggles.
9.49.2	Those engaged in white washing and mixing or stacking of cement bags or any materials which is injurious to the eyes shall be provided with protective goggles.
9.49.3	Those engaged in welding works shall be provided with welder's protective eyesight lids.
9.49.4	Stone breakers shall be provided with protective goggles and protective clothing and seated sufficient to safe intervals.
9.49.5	Where workers are employed in sewers and manholes, which are in use, the Contractor shall ensure that the manhole covers are opened and ventilated at least for an hour before the workers are allowed to get into manhole, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to the public.
9.49.6	The Contractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, the following precautions should be taken.
9.49.6.1	No paint containing lead or lead products shall be used except in the form of paste or ready made paint.
9.49.6.2	Suitable face masks should be supplied for use by the workers where paints are applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

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9.49.6.3	Overalls shall be supplied by the Contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.
9.50	When the work is being done near any place where there is risk of drowning all necessary equipment should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision should be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.
9.51	Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safe guards. Hoisting appliance should be provided with such means as will reduce to the minimum the risk of any part of a suspended load becoming accidentally displaced. When workers employed on electrical installations which are already energized, insulting mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided. The worker should not wear any rings, watches and carry keys or other materials which are good conductor of electricity.
9.52	All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near the places of work.
9.53	The contractor shall maintain and ensure necessary safety measures as required for inspection and tests HV test, Pneumatic test, Hydraulic test, Spring test, Bend test etc as applicable, to enable. inspection Agency for performing Inspection. If any test equipment is found not complying with proper safety requirements then the Inspection Agency may withhold inspection, till such time the desired safety requirements are met.
9.54	The Contractor shall notify BHEL of his intention to bring to site any equipment or material which may create hazard. BHEL shall have the right to prescribe the conditions under which such equipment or materials may be handled and the contractor shall adhere to such instructions. BHEL may prohibit the use of any construction machinery, which according to him is unsafe. No claim for compensation due to such prohibition will be entertained by BHEL.
9.55	All safety precautions shall be taken for welding and cutting operations as per IS-818. All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.

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9.56	These safety provisions should be brought to the notice of all concerned by display on a notice board at a prominent, place at work spot. The persons responsible for compliance of the safety code shall be named therein by the Contractor.																											
9.57	To ensure effective enforcement of the rules and regulations relating to safety precautions the arrangement made by the contract shall be open to inspection by the Engineer of the Engineer's Representative.																											
9.58	Keeping the work area clean/ free from debris, removed scaffoldings, scraps, insulation/sheeting wastage /cut pieces, temporary structures, packing woods etc. will be in the scope of the contractor. Such cleanings has to be done by contractor within quoted rate, on daily basis by an identified group. If such activity is not carried out by contractor / BHEL is not satisfied, then BHEL may get it done by other agency and actual cost alongwith BHEL overheads will be deducted from contractor's bill. Such decisions of BHEL shall be binding on the contractor.																											
9.59	Notwithstanding the above clauses there is nothing to exit the Contractor from the operations of any other Act or Rule in force in area of work in this respect. Provided always that all safety measures apart from those specifically provided in this agreement which are brought to the notice of the Contractor from time to time by the Engineer shall be complied by the Contractor. Provided further that all consequences, damages, or losses arising by reason of any safety code shall be met with by the Contractor.																											
9.60	<u>NON COMPLIANCE:-</u> NONCONFORMITY OF SAFETY RULES AND SAFETY APPLIANCES WILL BE VIEWED SERIOUSLY AND BHEL HAS RIGHT TO IMPOSE FINES ON THE CONTRACTOR AS UNDER <u>for every instance of violation noticed:</u> <table><tr><th>SN</th><th>Violation of Safety Norms</th><th>Fine (in Rs)</th></tr><tr><td>01</td><td>Not Wearing Safety Helmet</td><td>50/-</td></tr><tr><td>02.</td><td>Not wearing Safety Belt</td><td>100/-</td></tr><tr><td>03.</td><td>Grinding Without Goggles</td><td>50/-</td></tr><tr><td>04.</td><td>Not using 24 V Supply For Internal Work</td><td>500/-</td></tr><tr><td>05.</td><td>Electrical Plugs Not used for hand Machine</td><td>100/-</td></tr><tr><td>06.</td><td>Not Slings property</td><td>200/-</td></tr><tr><td>07.</td><td>Using Damaged Sling</td><td>200/-</td></tr><tr><td>08.</td><td>Lifting Cylinders Without Cage</td><td>500/-</td></tr></table>	SN	Violation of Safety Norms	Fine (in Rs)	01	Not Wearing Safety Helmet	50/-	02.	Not wearing Safety Belt	100/-	03.	Grinding Without Goggles	50/-	04.	Not using 24 V Supply For Internal Work	500/-	05.	Electrical Plugs Not used for hand Machine	100/-	06.	Not Slings property	200/-	07.	Using Damaged Sling	200/-	08.	Lifting Cylinders Without Cage	500/-
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SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter-IX:HSE & OHSAS

	09.	Not Using Proper Welding Cable With Lot of Joints And Not Insulated Property.	200/-
	10.	Not Removing Small Scrap From Platforms	200/-
	11.	Gas Cutting Without Taking Proper Precaution or Not Using Sheet Below Gas Cutting	200/-
	12.	Not Maintaining Electric Winches Which are Operated Dangerously	500/-
	13.	Improper Earthing Of Electrical T&P	500/-
	14.	Accident Resulting in Partial Loss in Earning Capacity	25,000/- per victim
	15.	Fatal Accident/Accidents Resulting in total loss in Earning Capacity	1,00,000/- per victim
	Any other non-conformity noticed not listed above will also be fined as deemed fit by BHEL. The decision of BHEL engineer is final on the above. The amount will be deducted from running bills of the contractor. The amount collected above will be utilized for giving award to the employees who could avoid accident by following safety rules. Also the amount will be spent for purchasing the safety appliances and supporting the safety activity at site.		
9.61	<u>CITATION:</u>-If safety record of the contractor in execution of the awarded job is to the satisfaction of safety department of BHEL, issue of an appropriate certificate to recognize the safety performance of the contractor may be considered by BHEL after completion of the job		
9.62	<u>MEMORANDUM OF UNDERSTANDING</u> After Award Of Work, Contractors Are Required To Enter Into A Memorandum Of Understanding As Given Below: <u>Memorandum of Understanding</u> ➤ BHEL PESD, HYDERABAD is committed to Health, Safety and Environment Policy (EHS Policy). ➤ M/s _____ do hereby also commit to the same EHS Policy while executing the Contract Number ID1111103. ➤ M/s _____ shall ensure that safe work practices not limited to the above are followed by all construction workers and supervisors. Spirit and content therein shall be reached to all workers and		

SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter-IX:HSE & OHSAS

	supervisors for compliance. ➤ BHEL PESD, HYDERABAD will be carrying out EHS audits twice a year and M/s _____ shall ensure to close any non-conformity observed/reported within fifteen days. Signed by authorized representative of M/s ----- Name : Place & Date:

SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter-X: RA Bill Payments

10.0	RA Bill Payments
10.1	The contractor shall submit his monthly RA bills with all the details required by BHEL on specified date every month covering progress of work in all respects and areas for the previous calendar month.
10.2	Mode of payment and measurement of work completed shall be as per relevant clauses of General Conditions of Contract
10.3	Release of payment in each running bill including PVC Bills will be restricted to 95% of the value of work admitted as per stages of progressive pro rata payments.
10.4	The 5% thus remaining shall be treated as 'Retention Amount' and shall be released as per terms specified in the General Conditions of Contract.
10.5	The payment for running bills will normally be released within 30 days of submission of running bill complete in all respects with all documents. It is the responsibility of the contractor to make his own arrangements for making timely payments towards labour wages, statutory payments, outstanding dues etc and other dues in the meanwhile.
10.6	BHEL shall release payment through Electronic Fund Transfer (EFT)/RTGS. In order to implement this system, Contractor to furnish details pertaining to his Bank Accounts where proceeds will be transferred through BHEL's banker, as per prescribed formats: Note: BHEL may also choose to release payment by other alternative modes as applicable
10.7	Paying Authority shall be the Construction Manager of the Site. Any change in the paying Authority shall be intimated to the Contactor accordingly.

SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter-XI : Performance Monitoring

11.0	Performance Monitoring											
11.1	Performance of the contractor is monitored through various reports/reviews and shall be jointly evaluated every quarter as per prescribed formats. Based on the net weighted score obtained, Contractors shall be rated 'Good' or 'Satisfactory' or 'Unsatisfactory'											
11.2	Annual performance (Financial Year wise) and Over all Performance (for the Contract) shall be based on the averages of Quarterly net weighted scores.											
11.3	In case Annual/Quarterly performance is found 'Unsatisfactory', BHEL reserves the right to put on hold such Contractors as given below: <table><tr><td>Sl No</td><td>Performance status</td><td>Type of suspension</td></tr><tr><td>1</td><td>'Unsatisfactory' in the Annual performance in the last Financial Year (if the agency is executing only one job in the Region)</td><td>Hold for a period of six months for similar Work</td></tr><tr><td>2</td><td>'Unsatisfactory' in the Annual performance in the last Financial Year or in the 'Overall' Performances, for 2 or more Works/Contracts being executed by the Contractor in the Region</td><td>Hold for a period of six months for similar Works for which performance is 'Unsatisfactory'.</td></tr></table> Note: If there is any conflict between the "Overall" performance and the latest "Annual" performance, then the 'Overall' performance shall prevail. However, BHEL reserves the right on the decision of 'Hold', in case of consistent 'Annual' improvement notwithstanding the vendors 'Overall' performance being unsatisfactory.			Sl No	Performance status	Type of suspension	1	'Unsatisfactory' in the Annual performance in the last Financial Year (if the agency is executing only one job in the Region)	Hold for a period of six months for similar Work	2	'Unsatisfactory' in the Annual performance in the last Financial Year or in the 'Overall' Performances, for 2 or more Works/Contracts being executed by the Contractor in the Region	Hold for a period of six months for similar Works for which performance is 'Unsatisfactory'.
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SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter-XII: Suspension of Business Dealings

12.0	Suspension of Business dealings
12.1	BHEL reserves the right to take action against contractors who fail to perform or indulge in malpractices, by suspending business dealings with them.
12.2	Suspension could be in the form of 'Hold', 'De-listing' or 'Banning' a contractor.
12.3	A bidder may be put on HOLD for a period of 6 months, for future tenders for specific works on the basis of one or more of the following reasons: a) Bidder does not honour his own offer or any of its conditions within the validity period. b) Bidder fails to respond against three consecutive enquires of BHEL. c) After placement of order, Bidder fails to execute a contract. d) Bidder fails to settle sundry debt account, for which he is legitimately liable, within one year of its occurrence. e) Bidder's performance rating falls below 60% in specific category (more fully described in chapter 'Performance Monitoring') f) Bidder works are under strike/ lockout for a long period.
12.4	A Bidder may be de-listed from the list of registered Bidders of the region for a period of 1 year on the basis of one or more of the following reasons:- a) Bidder tampers with tendering procedure affecting ordering process or commits any misconduct which is contrary to business ethics. b) Bidder has substituted, damaged, failed to return, short returned or unauthorizedly disposed off materials/ documents/ drawings/ tools etc of BHEL. c) Bidder no longer has the technical staff, equipment, financial resources etc. required to execute the orders/ contracts.
12.5	A Bidder can be banned from doing any business with all Units of BHEL for a period of 3 years on the basis of one or more of the following reasons: a) Bidder is found to be responsible for submitting fake/ false/ forged documents, certificates, or information prejudicial to BHEL's interest. b) In spite of warnings, the Bidder persistently violates or circumvents the provisions of labour laws/ regulations/ rules and other statutory requirements. c) Bidder is found to be involved in cartel formation

SPECIAL CONDITIONS OF CONTRACT (SCC)

Chapter-XII: Suspension of Business Dealings

	d) The Bidder has indulged in malpractices or misconduct such as bribery, corruption and fraud, pilferage etc which are contrary to business ethics. e) The Bidder is found guilty by any court of law for criminal activity/ offences involving moral turpitude in relation to business dealings. f) The Bidder is declared bankrupt, insolvent, has wound up or been dissolved; i.e ceases to exist for all practical purposes. g) Bidder is found to have obtained Official Company information/ documentation by questionable means. h) Communication is received from the administrative Ministry of BHEL to ban the Bidder from business dealings.
12.6	Contracts already entered with a contractor before the date of issue of order of 'HOLD' or 'DE-LISTING' shall not be affected.
12.7	All existing contracts with a 'BANNED' contractor shall normally be short closed
12.8	Once the order for suspension is passed, existing offers/new offers of the contractor shall not be entertained
12.9	The above guidelines are not exhaustive but enunciate broad principles governing action against contractors

VOLUME – I C

General Conditions of Contract

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CHAPTER -1

1. GENERAL INSTRUCTION TO TENDERERS

1.1. DESPATCH INSTRUCTION

- i) The General Conditions of Contract form part of the Tender specifications. **All pages of the tender documents shall be duly signed, stamped and submitted along with the offer in token of complete acceptance thereof.** The information furnished shall be complete by itself. The tenderer is required to furnish all the details and other documents as required in the following pages
- ii) Tenderers are advised to study all the tender documents carefully. Any submission of tender by the tenderer shall be deemed to have been done after careful study and examination of the tender documents and with the full understanding of the implications thereof. Should the tenderers have any doubt about the meaning of any portion of the Tender Specification or find discrepancies or omissions in the drawings or the tender documents issued are incomplete or shall require clarification on any of the technical aspect, the scope of work etc., he shall at once, contact the authority inviting the tender well in time (so as not to affect last date of submission) for clarification before the submission of the tender. Tenderer's request for clarifications shall be with reference to Sections and Clause numbers given in the tender documents. The specifications and terms and conditions shall be deemed to have been accepted by the tenderer in his offer. Non compliance with any of the requirements and instructions of the tender enquiry may result in the rejection of the tender.
- iii) Integrity pact (IP) shall be applicable for all tenders / contracts if indicated in NIT. This integrity pact shall be issued as part of the Tender documents and shall be returned by the bidder along with Techno-commercial bid duly filled, signed and stamped by the authorized signatory who signs the bid. Only those vendors / bidders who have entered into such an IP with BHEL shall be considered qualified to participate in the bidding. Entering into this pact shall be a preliminary qualification.

1.2. SUBMISSION OF TENDERS

- 1.2.1 The tenderers must submit their tenders to Officer inviting tender as per instructions in the NIT
- 1.2.2 Tenders submitted by post shall be sent by 'REGISTERED POST ACKNOWLEDGEMENT DUE / by COURIER' and shall be posted with due allowance for any postal/courier delays. BHEL takes no responsibility for delay, loss or non-receipt of tenders sent by post/courier. **The tenders received after the specified time of their submission are treated as 'Late Tenders' and shall not be considered under any circumstances.** Offers received by Fax/Email/Internet shall be considered as per terms of NIT.
- 1.2.3 Tenders shall be opened by authorised Officer of BHEL at his office at the time and date as specified in the NIT, in the presence of such of those tenderers or their authorised representatives who may be present.

- 1.2.4 Tenderers whose bids are found techno commercially qualified shall be informed the date and time of opening of the Price Bids and such Tenderers may depute their representatives to witness the opening of the price bids. BHEL's decision in this regard shall be final and binding.
- 1.2.5 Before submission of Offer, the tenderers are advised to inspect the site of work and the environments and be well acquainted with the actual working and other prevalent conditions, facilities available, position of material and labor, means of transport and access to Site, accommodation, etc. No claim will be entertained later on the grounds of lack of knowledge of any of these conditions.
- 1.3. LANGUAGE**
- 1.3.1 The tenderer shall quote the rates in English language and international numerals. These rates shall be entered in figures as well as in words. For the purpose of the tenders, the metric system of units shall be used.
- 1.3.2 All entries in the tender shall either be typed or written legibly in ink. Erasing and over-writing is not permitted and may render such tenders liable for rejection. All cancellations and insertions shall be duly attested by the tenderer.
- 1.4 PRICE DISCREPANCY:**
- 1.4.1 **Conventional (Manual) Price Bid opening :** In the case of price bid opening without resorting to Reverse Auction, if there are differences between the rates given by the tenderer in words and figures or in amount worked out by him, the following procedure for evaluation and award shall be followed:
- i) When there is a difference between the rates in figures and in words, the rates which corresponds to the amounts worked out by the contractor, shall be taken as correct
 - ii) When the amount of an item is not worked out by the contractor or it does not correspond with the rate written either in figure or in words, then the rate quoted by the contractor in words shall be taken as correct
 - iii) When the rate quoted by the contractor in figures and words tallies but the amount is not worked out correctly, the rate quoted by the contractor shall be taken as correct and not the amount.
 - iv) In case of lumpsum price, if there is any difference between the amount in figures and in words, the amount quoted by the bidder in words shall be taken as correct.
 - v) In case of omission in quoting any rate for one or more items, the evaluation shall be done considering the highest quoted rate obtained against the respective items by other tenderers for the subject tender. If the tenderer becomes L-1, the notional rates for the omission items shall be the lowest rates quoted for the respective items by the other tenderers against the respective omission items for the subject job and the 'Total quoted price (loaded for omissions)' shall be arrived at. However the overall price remaining the same as quoted originally, the rates for all the items in the 'Total quoted price (loaded for omissions)' shall be reduced item wise in proportion to the ratio of 'Original' total price and the 'Total quoted price (loaded for omissions)'.
- 1.4.2 **Reverse Auction:** In case of Reverse Auction, the successful bidder shall undertake to execute the work as per overall price offered by him during the Reverse Auction process. In case of omission of rates, the procedure shall be as per 'Guidelines for Reverse Auction' enclosed.
- 1.5. QUALIFICATION OF TENDERERS**
- i) Only tenderers who have previous experience in the work of the nature and description detailed in the Notice Inviting Tender and/or tender specification are expected to quote for this work duly detailing their experience along with offer.

- ii) Offers from tenderers who do not have proven and established experience in the field shall not be considered.
- iii) Offers from tenderers who are under suspension (banned) by any Unit/Region/Division of BHEL shall not be considered.
- iv) Offers from tenderers who do not comply with the latest guidelines of Ministry/Commissions of Govt of India shall not be considered.

1.6. EVALUATION OF BIDS

- i) Technical Bids submitted by the tenderer will be opened first and evaluated for fulfilling the Pre Qualification criteria and other conditions in NIT/Tender documents, based on documentary evidences submitted along with the offer
- ii) In case the same qualifying experience is claimed by more than one agency, then the agency who has executed the work as per documentary evidence submitted shall only be qualified. Scope of qualifying work should be totally with the agency who has executed and in case it is only labor+ consumables without T&P, then the responsibility of execution is assigned to the first agency and not to the agency who has executed only as labor supply contractor. Further, BHEL reserves the right to ask for further proofs including submission of TDS certificates for the said job
- iii) In case the qualifying experience is claimed by private organizations based on Work Order and completion certificates from another private organization, BHEL reserves the right to ask for further proofs including submission of TDS certificates for the said job.
- iv) Assessing Bidder Capacity for executing the current tender shall be as per Notice Inviting Tender
- v) Price Bids of shortlisted bidders shall only be opened either through the conventional price bid opening or through electronic Reverse Auction, at the discretion of BHEL
- vi) Price Bids of unqualified bidders shall not be opened. Reasons for rejection shall be intimated in due course after issue of LOI/LOA to successful bidder and receipt of unqualified acceptance from the successful bidder
- vii) Bidders are advised to also refer to clause no 2.9.4 regarding evaluation of their performance in ongoing projects for the current tender

1.7. DATA TO BE ENCLOSED

Full information shall be given by the tenderer in respect of the following. Non-submission of this information may lead to rejection of the offer.

- i) **INCOME TAX PERMANENT ACCOUNT NUMBER**
Certified copies of Permanent Account Numbers as allotted by Income Tax Department for the Company/Firm/Individual Partners, etc. shall be furnished along with tender.
- ii) **ORGANIZATION CHART**
The organization chart of the tenderer's organization, including the names, addresses and contact information of the Directors/Partners shall be furnished along with the offer.
- iii) An attested copy of the Power of Attorney, in case the tender is signed by an individual other than the sole proprietor
- iv) **IN CASE OF INDIVIDUAL TENDERER:**
His / her full name, address and place & nature of business.
- v) **IN CASE OF PARTNERSHIP FIRM**

The names of all the partners and their addresses, A copy of the partnership deed/instrument of partnership duly certified by the Notary Public shall be enclosed.

vi) **IN CASE OF COMPANIES:**

- a. Date and place of registration including date of commencement certificate in case of Public Companies (certified copies of Memorandum and articles of Association are also to be furnished).
- b. Nature of business carried on by the Company and the provisions of the Memorandum relating thereof.

1.8 **AUTHORISATION AND ATTESTATION**

Tenders shall be signed by a person duly authorized/empowered to do so. An attested copy of the Power of Attorney, in case the tender is signed by an individual other than the sole proprietor shall be submitted along with the tenders

1.9 **EARNEST MONEY DEPOSIT**

1.9.1 Every tender must be accompanied by the prescribed amount of Earnest Money Deposit (EMD) in the manner described herein.

- i) EMD shall be furnished along with the offer in full as per the amount indicated in the Special Conditions of Contract / NIT
- ii) EMD is to be paid in cash (as permissible under Income Tax Act), Pay order or Demand Draft in favour of 'Bharat Heavy Electricals Limited' and payable at Hyderabad(PESD HQ) issuing the tender.
- iii) No other form of EMD remittance shall be acceptable to BHEL
- iv) Bidder may opt to deposit "One Time EMD" of Rs. 2.0 lakhs (Rupees Two lakhs only) with BHEL Hyderabad(PESD HQ) issuing the tender, which will enable them to participate in all the future tender enquiries in respect of Erection and Commissioning services issued from the respective office. Interested bidders may clearly send their consent for converting the present EMD into a "One Time EMD" in their offer.
 - Note : The 'One Time EMD' cannot be withdrawn by the tenderers within 3 years from the date of deposit, under any circumstances. The Tenderer who wishes to withdraw after three years will not be allowed to submit 'One Time EMD' again.
- v) Bidders who have already deposited such "One Time EMD" of Rs. 2.00 lakh are exempted from submission of EMD for this tender. However a copy of 'One Time EMD' certificate issued by BHEL PESD HQ issuing the tender shall be enclosed along with the offer.

1.9.2 EMD by the bidder will be forfeited as per Tender Documents if

- i) After opening the tender, the bidder revokes his tender within the validity period or increases his earlier quoted rates.
- ii) The bidder does not commence the work within the period as per LOI/Contract. In case the LOI / contract is silent in this regard then within 15 days after award of contract.

1.9.3 EMD shall not carry any interest.

1.9.4 In the case of unsuccessful bidders, the Earnest Money will be refunded to them within a reasonable time after acceptance of award by successful tenderer.

1.10 SECURITY DEPOSIT

1.10.1 Upon acceptance of Tender, the successful Tenderer should deposit the required amount of Security Deposit for satisfactory completion of work, as per the rates given below:

SN	Contract Value	Security Deposit Amount
1	Up to Rs. 10 lakhs	10% of Contract Value
2	Above Rs. 10 lakhs up to Rs.50 lakhs	1 lakh + 7.5% of the Contract Value exceeding Rs. 10 lakhs.
3	Above Rs. 50 lakhs	Rs 4 lakhs + 5% of the Contract Value exceeding Rs. 50 lakhs.

1.10.2 The security Deposit should be furnished before start of the work by the contractor.

1.10.3 Security Deposit may be furnished in any one of the following forms

- i) Cash (as permissible under the Income Tax Act)
- ii) Pay Order / Demand Draft in favour of BHEL.
- iii) Local cheques of scheduled banks, subject to realization.
- iv) Securities available from Post Offices such as National Savings Certificates, Kisan Vikas Patras etc. (Certificates should be held in the name of Contractor furnishing the security and duly pledged in favour of BHEL and discharged on the back).
- v) Bank Guarantee from Scheduled Banks / Public Financial Institutions as defined in the Companies Act. The Bank Guarantee format for Security Deposit shall be in the prescribed formats
- vi) Fixed Deposit Receipt issued by Scheduled Banks / Public Financial Institutions as defined in the Companies Act. The FDR should be in the name of the contractor, A/C BHEL, duly discharged on the back.
- vii) Security deposit can also be recovered at the rate of 10% from the running bills. However in such cases at least 50% of the Security Deposit should be deposited in any form as prescribed before start of the work and the balance 50% may be recovered from the running bills.
- viii) EMD of the successful bidder can be converted and adjusted against the cash portion of Security Deposit excepting for such bidders who have remitted One Time EMD.

NOTE: Acceptance of Security Deposit against Sl. No. (iv) and (vi) above will be subject to hypothecation or endorsement on the documents in favour of BHEL. However, BHEL will not be liable or responsible in any manner for the collection of interest or renewal of the documents or in any other matter connected therewith.

1.10.4 The Security Deposit shall not carry any interest.

1.10.5 In case the value of work exceeds / reduces from the awarded / accepted value, the Security Deposit shall be correspondingly enhanced / reduced as given below:

- i) The enhanced part of the Security Deposit shall be immediately deposited by the Contractor or adjusted against payments due to the Contractor.
- ii) There will be no reduction in Security Deposit value in case of variation in contract value upto the lower limit specified in Quantity variation clause. In case of reduction of contract value beyond the lower limit specified in Quantity Variation clause, then the Security Deposit shall be re adjusted in proportion.
- iii) In case of reduction, the reduced Contract value shall be certified by BHEL Construction Manager after ascertaining / freezing of BOQ / Drawings from the Design / Engineering Centre. The reduced Security Deposit value can only be considered after taking into account the adequacy of the

securities held by BHEL to meet the liabilities of the contractor for the contract, and the performance of the contract in general. **In such cases, the revised value of Security Deposit shall be worked out only after execution of not less than the lower limit of the revised scope of work/contract value as per quantity variation clause, and as certified by Construction Manager. This reduction in value of Security Deposit shall not entitle the contractor to any amendment of Contract and shall be operated at the discretion of BHEL.**

- iv) Contract value for the purpose of operating the reduced/increased value of Security Deposit due to Quantity Variation, shall be exclusive of Extra works done on manday rates.

1.10.6 The validity of Bank Guarantees towards Security Deposit shall be initially upto the completion period as stipulated in the Letter of Intent/Award + 3 months, and the same shall be kept valid by proper renewal till the acceptance of Final Bills of the Contractor, by BHEL.

1.10.7 BHEL reserves the right of forfeiture of Security Deposit in addition to other claims and penalties in the event of the Contractor's failure to fulfill any of the contractual obligations or in the event of termination of contract as per terms and conditions of contract. BHEL reserves the right to set off the Security Deposit against any claims of other contracts with BHEL.

1.11 RETURN OF SECURITY DEPOSIT

Security Deposit shall be refunded/Bank Guarantee(s) released to the Contractor along with the 'Final Bill' after deducting all expenses / other amounts due to BHEL under the contract / other contracts entered into with them by BHEL.

1.12 BANK GUARANTEES

Where ever Bank Guarantees are to be furnished/submitted by the contractor, the following shall be complied with

- i) Bank Guarantees shall be from Scheduled Banks / Public Financial Institutions as defined in the Companies Act.
- ii) The Bank Guarantees shall be as per prescribed formats.
- iii) It is the responsibility of the bidder to get the Bank Guarantees revalidated/extended for the required period (subject to a minimum period of six months), as per the advice of BHEL Site Engineer / Construction Manager. BHEL shall not be liable for issue of any reminders regarding expiry of the Bank Guarantees.
- iv) In case extension/further extensions of any Bank Guarantees are not required, the bidders shall ensure that the same is explicitly endorsed by the Construction Manager and submitted to PESD HQ.
- v) In case the Bank Guarantees are not extended before the expiry date, BHEL reserves the right to invoke the same by informing the concerned Bank in writing, without any advance notice/communication to the concerned bidder.
- vi) Bidders to note that any corrections to Bank Guarantees shall be done by the issuing Bank, only through an amendment in an appropriate non judicial stamp paper.
- vii) The Original Bank Guarantee shall be sent directly by the Bank to BHEL under Registered Post (Acknowledgement Due), addressed to the Subcontracting Department of the PESD.

1.13 VALIDITY OF OFFER

The rates in the Tender shall be kept open for acceptance for a minimum period of **SIX MONTHS** from latest due date of offer submission (including extension, if any) . In case BHEL (Bharat Heavy Electricals Ltd) calls for negotiations, such negotiations shall not amount to cancellation or withdrawal of the original offer which shall be binding on the tenderers.

1.14 EXECUTION OF CONTRACT AGREEMENT

The successful tenderer's responsibility under this contract commences from the date of issue of the Letter of Intent by Bharat Heavy Electricals Limited. The Tenderer shall submit an unqualified acceptance to the Letter of Intent/Award within the period stipulated therein.

The successful tenderer shall be required to execute an agreement in the prescribed form, with BHEL, within a reasonable time after the acceptance of the Letter of Intent/Award, and in any case before releasing the first running bill. The contract agreement shall be signed by a person duly authorized/empowered by the tenderer. The expenses for preparation of agreement document shall be borne by BHEL

1.15 REJECTION OF TENDER AND OTHER CONDITIONS

1.15.1 The acceptance of tender will rest with BHEL which does not bind itself to accept the lowest tender or any tender and reserves to itself full rights for the following without assigning any reasons whatsoever:-

- a. To reject any or all of the tenders.
- b. To split up the work amongst two or more tenderers as per NIT
- c. To award the work in part if specified in NIT
- d. In case of either of the contingencies stated in (b) and (c) above, the time for completion as stipulated in the tender shall be applicable.

1.15.2 Conditional tenders, unsolicited tenders, tenders which are incomplete or not in the form specified or defective or have been materially altered or not in accordance with the tender conditions, specifications etc., are liable to be rejected.

1.15.3 Tenders are liable to be rejected in case of unsatisfactory performance of the tenderer with BHEL, or tenderer under suspension (hold/banning /delisted) by any unit / region / division of BHEL or tenderers who do not comply with the latest guidelines of Ministry/Commissions of Govt of India. BHEL reserves the right to reject a bidder in case it is observed that they are overloaded and may not be in a position to execute this job as per the required schedule in line with clause no. 9.0 of the 'NIT'. The decision of BHEL will be final in this regard.

1.15.4 If a tenderer who is a proprietor expires after the submission of his tender or after the acceptance of his tender, BHEL may at their discretion, cancel such tender. If a partner of a firm expires after the submission of tender or after the acceptance of the tender, BHEL may then cancel such tender at their discretion, unless the firm retains its character.

1.15.5 BHEL will not be bound by any Power of Attorney granted by changes in the composition of the firm made subsequent to the execution of the contract. They may, however, recognise such power of Attorney and changes after obtaining proper legal advice, the cost of which will be

chargeable to the contractor concerned.

- 1.15.6 If the tenderer deliberately gives wrong information in his tender, BHEL reserves the right to reject such tender at any stage or to cancel the contract if awarded and forfeit the Earnest Money/Security Deposit/any other money due.
- 1.15.7 Canvassing in any form in connection with the tenders submitted by the Tenderer shall make his offer liable to rejection.
- 1.15.8 In case the Proprietor, Partner or Director of the Company/Firm submitting the Tender, has any relative or relation employed in BHEL, the authority inviting the Tender shall be informed of the fact as per specified format, along with the Offer. Failing to do so, BHEL may, at its sole discretion, reject the tender or cancel the contract and forfeit the Earnest Money/Security Deposit.
- 1.15.9 The successful tenderer should not sub-contract part or complete work detailed in the tender specification undertaken by him without written permission of BHEL's Construction Manager/Site Incharge. The tenderer is solely responsible to BHEL for the work awarded to him.
- 1.15.10 The Tender submitted by a techno commercially qualified tenderer shall become the property of BHEL who shall be under no obligation to return the same to the bidder. However unopened price bids and late tenders shall be returned to the bidders
- 1.15.11 Unsolicited discount received after the due date and time of Bid Submission shall not be considered for evaluation. However, if the party who has submitted the unsolicited discount/rebate becomes the L-1 party, then the awarded price i.e contract value shall be worked out after considering the discount so offered.
- 1.15.12 BHEL shall not be liable for any expenses incurred by the bidder in the preparation of the tender irrespective of whether the tender is accepted or not.
- 1.15.13 Additional security deposit (SD) has to be submitted by the successful bidder with value as follows :
- a) In case the Final Price of the successful bidder is greater than equal to Rs 100 Crores:

The value of additional SD shall be equal to:

$0.30 \times \{ \text{the difference of (95\% of BHEL's estimate OR 95\% of the party's 'online sealed bid' (in case of RA)/ Paper price bid (in case of conventional paper bid), whichever is higher) and the final offered price of the successful bidder} \}$

b) In case the Final Price of the successful bidder is less than Rs 100 Crores:

The value of additional SD shall be equal to:

$0.30 \times \{ \text{the difference of (90\% of BHEL's estimate OR 90\% of the party's 'online sealed bid' (in case of RA)/ Paper price bid, whichever is higher) and the final offered price of the successful bidder} \}$

This additional SD shall have the same validity as that of the Security Deposit and shall be revalidated /released in the manner as spelt out for the Security Deposit as per relevant clause of GCC.

The BHEL's estimated value shall be disclosed after RA/Paper Bid opening

CHAPTER-2

2.1 **DEFINITION:** The following terms shall have the meaning hereby assigned to them except where the context otherwise requires

- i) BHEL shall mean Bharat Heavy Electricals Limited (PESD, Hyderabad), a company registered under Indian Companies Act 1956, with its Registered Office at BHEL HOUSE, SIRI FORT, NEW DELHI – 110 049, or its Power Sector Regional Offices/PESD HQ or its Authorised Officers or its Site Engineers or other employees authorised to deal with any matters with which these persons are concerned on its behalf.
- ii) “EXECUTIVE DIRECTOR” or ‘GROUP GENERAL MANAGER’ or “GENERAL MANAGER (Incharge)” or “GENERAL MANAGER” shall mean the Officer in Administrative charge of Project Engineering & System Division, Hyderabad.
- iii) “COMPETENT AUTHORITY” shall mean Executive Director or Group General Manager or General Manager (Incharge) or General Manager or BHEL Officers who are empowered to act on behalf of the Executive Director or General Manager (Incharge) or General Manager of BHEL.
- iv) “ENGINEER” or “ENGINEER IN CHARGE” shall mean an Officer of BHEL as may be duly appointed and authorized by BHEL to act as “Engineer” on his behalf for the purpose of the Contract, to perform the duty set forth in this General Conditions of Contract and other Contract documents. The term also includes ‘CONSTRUCTION MANAGER’ or ‘SITE INCHARGE’ as well as Officers at Site or at the Headquarters of the PESD.
- v) “SITE” shall mean the places or place at which the plants/equipments are to be erected and services are to be performed as per the specification of this Tender.
- vi) “CLIENT OF BHEL” or “CUSTOMER” shall mean the project authorities with whom BHEL has entered into a contract for supply of equipments or provision of services.
- vii) “CONTRACTOR” shall mean the successful Bidder/Tenderer who is awarded the Contract and shall include the Contractor’s successors, heirs, executors, administrators and permitted assigns.
- viii) “CONTRACT” or “CONTRACT DOCUMENT” shall mean and include the Agreement of Work Order, the accepted appendices of Rates, Schedules, Quantities if any, General Conditions of Contract, Special Conditions of Contract, Instructions to the Tenderers, Drawings, Technical Specifications, the Special Specifications if any, the Tender documents, subsequent amendments mutually agreed upon and the Letter of Intent/Acceptance issued by BHEL. Any conditions or terms stipulated by the contractor in the tender documents or subsequent letters shall not form part of the contract unless, specifically accepted in writing by BHEL in the Letter of Intent/Award and incorporated in the agreement.
- ix) “GENERAL CONDITIONS OF CONTRACT” shall mean the ‘Instructions to Tenderers’ and ‘General Conditions of Contract’ pertaining to the work for which above tenders have been called for.
- x) “TENDER SPECIFICATION” or “TENDER” or “TENDER DOCUMENTS” shall mean General Conditions, Common Conditions, Special Conditions, Price Bid, Rate Schedule, Technical

	Specifications, Appendices, Annexures, Corrigendum, Amendments, Forms, procedures, Site information, etc and drawings/documents pertaining to the work for which the tenderers are required to submit their offers. Individual specification number will be assigned to each Tender Specification.
xi)	“LETTER OF INTENT” shall mean the intimation by a Letter/Fax/email to the tenderer that the tender has been accepted in accordance with provisions contained in the letter. The responsibility of the contractor commences from the date of issue of this letter and all terms and conditions of the contract are applicable from this date.
xii)	“COMPLETION TIME” shall mean the period by ‘date/month’ specified in the ‘Letter of Intent/Award’ or date mutually agreed upon for handing over of the intended scope of work, the erected equipment/plant which are found acceptable by the Engineer, being of required standard and conforming to the specifications of the Contract.
xiii)	“PLANT” shall mean and connote the entire assembly of the plant and equipments covered by the contract.
xiv)	“EQUIPMENT” shall mean equipment, machineries, materials, structural, electricals and other components of the plant covered by the contract.
xv)	“TESTS” shall mean and include such test or tests to be carried out on the part of the contractor as are prescribed in the contract or considered necessary by BHEL, in order to ascertain the quality, workmanship, performance and efficiency of the contractor or part thereof.
xvi)	“APPROVED”, “DIRECTED” or “INSTRUCTED” shall mean approved, directed or instructed by BHEL.
xvii)	“WORK or CONTRACT WORK” shall mean and include supply of all categories of labour, specified consumables, tools and tackles and Plants required for complete and satisfactory site transportation, handling, stacking, storing, erecting, testing and commissioning of the equipments to the entire satisfaction of BHEL.
xviii)	“SINGULAR AND PLURALS ETC” words carrying singular number shall also include plural and vice versa, where the context so requires. Words imparting the masculine Gender shall be taken to include the feminine Gender and words imparting persons shall include any Company or Associations or Body of Individuals, whether incorporated or not.
xix)	“HEADING” – The heading in these General Conditions are solely for the purpose of facilitating reference and shall not be deemed to be part thereof or be taken as instructions thereof or of the contract.
xx)	“MONTH” shall mean calendar month unless otherwise specified in the Tender.
xxi)	Day’ or ‘Days’ unless herein otherwise expressly defined shall mean calendar day or days of twenty four (24) hours each. A week shall mean continuous period of seven (7) days.
xxii)	“COMMISSIONING” shall mean the synchronization testing and achieving functional operation of the Equipment with associated system after all initial adjustments, trials, cleaning, re-assembly required at site if any, have been completed and Equipment with associated system is

	ready for taking into service.
xxiii)	“WRITING” shall include any manuscript type written or hand written or printed statement or electronically transmitted messages, under the signature or seal or transmittal of BHEL.
xxiv)	“TEMPORARY WORK” shall mean all temporary works for every kind required in or for the execution, completion, maintenance of the work.
xxv)	‘CONTRACT PRICE’ or ‘CONTRACT VALUE’ shall mean the sum mentioned in the LOI/LOA/Contract Agreement subject to such additions thereto or deductions there from as may be made under provisions hereinafter contained
xxvi)	“COMMENCEMENT DATE” or “START DATE” shall mean the commencement/start of work at Site as per terms defined in the Tender
xxvii)	“SHORT CLOSING” or “FORE CLOSING” of Contract shall mean the premature closing of Contract, for reasons not attributable to the contractor and mutually agreed between BHEL and the contractor
xxviii)	“TERMINATION” of Contract shall mean the pre mature closing of contract due to reasons as mentioned in the contract
xxix)	“DE MOBILISATION” shall mean the temporary winding up of Site establishment by Contractor leading to suspension of works temporarily for reasons not attributable to the contractor
xxx)	“RE MOBILISATION” shall mean the resumption of work with all resources required for the work after demobilization.
2.2	LAW GOVERNING THE CONTRACT AND COURT JURISDICTION The contract shall be governed by the Law for the time being in force in the Republic of India. The Civil Court having original Civil Jurisdiction at <u>Hyderabad for PESD</u>, Delhi for PSNR, at Kolkata for PSER, at Nagpur for PSWR and at Chennai for PSSR, shall alone have exclusive jurisdiction in regard to all claims in respect of the Contract. No other Civil Court shall have jurisdiction in case of any dispute, under this contract
2.3	ISSUE OF NOTICE 2.3.1 <u>Service of notice on contractor</u> Any notice to be given to the Contractor under the terms of the contract shall be served by sending the same by Registered Post / Speed Post to or leaving the same at the Contractor’s last known address of the principal place of business (or in the event of the contractor being a company, to or at its Registered Office). In case of change of address, the notice shall be served at changed address as notified in writing by the Contractor to BHEL. Such posting or leaving of the notice shall be deemed to be good service of such notice and the time mentioned to the condition for doing any act after notice shall be reckoned from the date so mentioned in such notice. 2.3.2 <u>Service of notice on BHEL</u> Any notice to be given to BHEL in-charge/Region under the terms of the Contract shall be served by sending the same by Registered Post / Speed Post to or leaving the same at BHEL address or changed address as notified in writing by BHEL to the Contractor.
2.4	USE OF LAND No land belonging to BHEL or their Customer under temporary possession of BHEL shall be occupied by the contractor without written permission of BHEL.

2.5 COMMENCEMENT OF WORK

- 2.5.1 The contractor shall commence the work as per the time indicated in the Letter of Intent from BHEL and shall proceed with the same with due expedition without delay.
- 2.5.2 If the contractor fails to start the work within stipulated time as per LOI or as intimated by BHEL, then BHEL at its sole discretion will have the right to cancel the contract. The Earnest Money and/or Security Deposit with BHEL will stand forfeited without any further reference to him without prejudice to any and all of BHEL's other rights and remedies in this regard.
- 2.5.3 All the work shall be carried out under the direction and to the satisfaction of BHEL.

2.6 MEASUREMENT OF WORK AND MODE OF PAYMENT:

- 2.6.1 All payments due to the contractors shall be made by e mode only, unless otherwise found operationally difficult for reasons to be recorded in writing
- 2.6.2 For progress running bill payments: - The Contractor shall present detailed measurement sheets in triplicate, duly indicating all relevant details based on technical documents and connected drawings for work done during the month/period under various categories in line with terms of payment as per contract. The basis of arriving at the quantities, weights shall be relevant documents and drawings released by BHEL. These measurement sheets shall be prepared jointly with BHEL Engineers and signed by both the parties.
- 2.6.3 These measurement sheets will be checked by BHEL Engineer and quantities and percentage eligible for payment under various groups shall be decided by BHEL Engineer. The abstract of quantities and percentage so arrived at based on the terms of payment shall be entered in Measurement Book and signed by both the parties.
- 2.6.4 Based on the above quantities, contractor shall prepare the bills in prescribed format and work out the financial value. These will be entered in Measurement Book and signed by both the parties. Payment shall be made by BHEL after effecting the recoveries due from the contractor.
- 2.6.5 All recoveries due from the contractor for the month/period shall be effected in full from the corresponding running bills unless specific approval from the competent authorities is obtained to the contrary.
- 2.6.6 Measurement shall be restricted to that portion of work for which it is required to ascertain the financial liability of BHEL under this contract.
- 2.6.7 The measurement shall be taken jointly by persons duly authorized on the part of BHEL and by the Contractor.
- 2.6.8 The Contractor shall bear the expenditure involved if any, in making the measurements and testing of materials to be used/used in the work. The contractor shall, without extra charges, provide all the assistance with appliances and other things necessary for measurement.
- 2.6.9 If at any time due to any reason whatsoever, it becomes necessary to re-measure the work done in full or in part, the expenses towards such re measurements shall be borne by the contractor unless such re measurements are warranted solely for reasons not attributable to contractor.

- 2.6.10 Passing of bills covered by such measurements does not amount to acceptance of the completion of the work measured. Any left out work has to be completed, if pointed out at a later date by BHEL.
- 2.6.11 Final measurement bill shall be prepared in the final bill format prescribed for the purpose based on the certificate issued by BHEL Engineer that entire works as stipulated in tender specification has been completed in all respects to the entire satisfaction of BHEL. Contractor shall give unqualified "No Claim" Certificate. All the tools and tackles loaned to him should be returned in satisfactory condition to BHEL. The abstract of final quantities and financial values shall also be entered in the Measurement Books and signed by both parties to the contract. The Final Bill shall be prepared and paid within a reasonable time after completion of work.
- 2.7 RIGHTS OF BHEL**
BHEL reserves the following rights in respect of this contract during the original contract period or its extensions if any, as per the provisions of the contract, without entitling the contractor for any compensation.
- 2.7.1 To withdraw any portion of work and/or to restrict/alter quantum of work as indicated in the contract during the progress of work and get it done through other agencies to suit BHEL's commitment to its customer or in case BHEL decides to advance the date of completion due to other emergent reasons/ BHEL's obligation to its customer.
- 2.7.2 To terminate the contract or get any part of the work done through other agency or deploy BHEL's own/hired/otherwise arranged resources , at the risk and cost of the contractor after due notice of a period of two weeks by BHEL, in the event of:-
- i) Contractor's continued poor progress
 - ii) Withdrawal from or abandonment of the work before completion of the work
 - iii) Contractor's inability to progress the work for completion as stipulated in the contract
 - iv) Poor quality of work
 - v) Corrupt act of Contractor
 - vi) Insolvency of the Contractor
 - vii) Persistent disregard to the instructions of BHEL
 - viii) Assignment, transfer, sub-letting of contract without BHEL's written permission
 - ix) Non fulfillment of any contractual obligations
 - x) In the opinion of BHEL, the contractor is overloaded and is not in a position to execute the job as per required schedule
- 2.7.3 To meet the expenses including BHEL overheads on the differential cost at 5%, over and above the liquidated damages/penalties arising out of "Risk & Cost" as explained above under SI.No. 2.7.2. BHEL shall recover the amount from any money due from Contractor, from any money due to the Contractor including Security Deposit or by forfeiting any T&P or material of the contractor under this contract or any other contract of BHEL or by any other means or any combination thereof
- 2.7.4 To terminate the contract or to restrict the quantum of work and pay for the portion of work executed in case BHEL's contract with their customer are terminated for any reason, as per mutual agreement.
- 2.7.5 To effect recovery from any amounts due to the contractor under this or any other contract or in

any other form, the moneys BHEL is statutorily forced to pay to anybody, due to contractor's failure to fulfill any of his obligations. BHEL shall levy overheads of 5% on all such payments along with the interest as defined elsewhere in the GCC.

2.7.6 While every endeavor will be made by BHEL to this end, they cannot guarantee uninterrupted work due to conditions beyond their control. The Contractor will not be normally entitled for any compensation/extra payment on this account unless otherwise specified elsewhere in the contract.

2.7.7 In case the execution of works comes to a complete halt or reaches a stage wherein worthwhile works cannot be executed and there is no possibility of commencement of work for a period of not less than two months, due to reasons not attributable to the contractor and other than Force Majeure conditions, BHEL may consider permitting the contractor to de mobilize forthwith and re mobilize at an agreed future date. Cost of such demobilization/remobilization shall be mutually agreed. The duration of contract/time extension shall accordingly get modified suitably. In case of any conflict, BHEL decision in this regard shall be final and binding on the contractor.

2.7.8 In the unforeseen event of inordinate delay in receipt of materials, drawings, fronts, etc, due to which inordinate discontinuity of work is anticipated, BHEL at its discretion may consider contractor's request to short close the contract in the following cases

- a) The balance works (including but not limited to Trial Operation, PG Test, etc) are minor vis a vis the scope of work envisaged as per the contract.
- b) There has been no significant work in past 6 months OR no significant work is expected in next 6 months (example in Hydro projects or in projects where work has stopped due to reasons beyond the control of BHEL)
- c) The balance works cannot be done within a reasonable period of time as they are dependent on unit shutdown or on other facilities of customer or any other reasons not attributable to the contractor

At the point of requesting for short closure, contractor shall establish that he has completed all works possible of completion and he is not able to proceed with the balance works due to constraints beyond his control. In such a case, the estimated value of the unexecuted portion of work(or estimated value of services to be provided for carrying out milestone/stage payments like Trial Operation/PG Test, etc) as mutually agreed, shall however be reduced from the final contract value.

2.7.9 **LIQUIDATED DAMAGES/PENALTY**

If the contractor fails to maintain the required progress of work which results in delay in the completion of the work as per the contractual completion period, BHEL shall have the right to impose Liquidated Damage/Penalty at the rate of 0. 5% of the contract value, per week of delay or part thereof subject to a maximum of 10% of the contract value. For this purpose, the period of delay shall be the delay attributable to the Contractor for the completion of work as per contract. Contract Value for this purpose, shall be the final executed value exclusive of Extra Works executed on Man day rate basis, Supplementary/Additional Items.

2.8 **RESPONSIBILITIES OF THE CONTRACTOR IN RESPECT OF LOCAL LAWS, EMPLOYMENT**

OF WORKERS ETC.

The following are the responsibilities of the contractor in respect of observance of local laws, employment of personnel, payment of taxes etc. The subcontractor shall fully indemnify BHEL against any claims of whatsoever nature arising due to the failure of the contractor in discharging any of his responsibilities hereunder:

- 2.8.1 As far as possible, Unskilled Workers shall be engaged from the local areas in which the work is being executed.
- 2.8.2 The contractor at all times during the continuance of this contract shall, in all his dealings with local labor for the time being employed on or in connection with the work, have due regard to all local festivals and religious and other customs.
- 2.8.3 The contractor shall comply with all applicable State and Central Laws, Statutory Rules, Regulations etc. such as Payment of Wages Act, Minimum Wages Act, Workmen Compensation Act, Employer's Liability Act, Industrial Disputes Act, Employers Provident Act, Employees State Insurance Scheme, Contract Labor (Regulation and Abolition) Act 1970, Payment of Bonus & Gratuity Act and other Acts, Rules and Regulations for labor as may be enacted by the Government during the tenure of the Contract and having force or jurisdiction at Site. The Contractor shall also give to the local Governing Body, Police and other relevant Authorities all such notices as may be required by the Law.
- 2.8.4 The contractor shall obtain independent License under the Contract Labor (Regulations and Abolition Act, 1970) as required from the concerned Authorities based on the certificate (Form-V) issued by the Principal Employer/Customer
- 2.8.5 The contractor shall pay all taxes, fees, license charges, deposits, duties, tolls, royalties, commission or other charges which may be levied on account of his operations in executing the contract.
- 2.8.6 While BHEL would pay the inspection fees and Registration fees of Boiler/Electrical Inspectorate, all other arrangements for site visits periodically by the Inspectorate to site, Inspection certificate etc. will have to be made by contractor. However, BHEL will not make any payment to the Inspectorate in connection with contractor's Welders/Electricians qualification tests etc.
- 2.8.7 Contractor shall be responsible for provision of Health and Sanitary arrangements (more particularly described in Contract Labor Regulation & Abolition Act), Safety precautions etc. as may be required for safe and satisfactory execution of contract.
- 2.8.8 The contractor shall be responsible for proper accommodation including adequate medical facilities for personnel employed by him.
- 2.8.9 The contractor shall be responsible for the proper behavior and observance of all regulations by the staff employed by him.
- 2.8.10 The contractor shall ensure that no damage is caused to any person/property of other parties working at site. If any such damage is caused, it is responsibility of the contractor to make good the losses or compensate for the same.

- 2.8.11 All the properties/equipments/components of BHEL/their Client loaned with or without deposit to the contractor in connection with the contract shall remain properties of BHEL/their Client.
- 2.8.12 The contractor shall use such properties for the purpose of execution of this contract. All such properties/equipments/components shall be deemed to be in good condition when received by the contractor unless he notifies within 48 hours to the contrary. The contractor shall return them in good condition as and when required by BHEL/their Client. In case of non-return, loss, damage, repairs etc, the cost thereof as may be fixed by BHEL Engineer will be recovered from the contractor
- 2.8.13 In case the contractor is required to undertake any work outside the scope of this contract, the rates payable shall be those mutually agreed upon if the item rates are not mentioned in existing contract
- 2.8.14 Any delay in completion of works/or non achievement of periodical targets due to the reasons attributable to the contractor, the same may have to be compensated by the contractor either by increasing manpower and resources or by working extra hours and/or by working more than one shift. All these are to be carried out by the contractor at no extra cost.
- 2.8.15 The contractor shall arrange, coordinate his work in such a manner as to cause no hindrance to other agencies working in the same premises.
- 2.8.16 All safety rules and codes applied by the Client/BHEL at site shall be observed by the contractor without exception. The contractor shall be responsible for the safety of the equipment/material and works to be performed by him and shall maintain all light, fencing guards, slings etc. or other protection necessary for the purpose. Contractor shall also take such additional precautions as may be indicated from time to time by the Engineer with a view to prevent pilferage, accidents, fire hazards. Due precautions shall be taken against fire hazards and atmospheric conditions. Suitable number of Clerical staff, watch and ward, store keepers to take care of equipment/materials and construction tools and tackles shall be posted at site by the contractor till the completion of work under this contract.
- The contractor shall arrange for such safety devices as are necessary for such type of work and carry out the requisite site tests of handling equipment, lifting tools, tackles etc. as per prescribed standards and practices.
- Contractor has to ensure the implementation of Health, Safety and Environment (HSE) requirements as per directions given by BHEL/Customer. The contractor has to assist in HSE audit by BHEL/Customer and submit compliance Report. The contractor has to generate and submit record/reports as per HSE plan/activities as per instruction of BHEL/Customer
- 2.8.17 The contractor will be directly responsible for payment of wages to his workmen. A pay roll sheet giving all the payments given to the workers and duly signed by the contractor's representative should be furnished to BHEL site for record purpose, if so called for.
- 2.8.18 In case of any class of work for which there is no such specification as laid down in the contract, such work shall be carried out in accordance with the instructions and requirements of the Engineer.
- 2.8.19 Also, no idle charges will be admissible in the event of any stoppage caused in the work resulting in

contractor's labor and Tools & Plants being rendered idle due to any reason at any time.

- 2.8.20 The contractor shall take all reasonable care to protect the materials and work till such time the plant/equipment has been taken over by BHEL or their Client whichever is earlier.
- 2.8.21 The contractor shall not stop the work or abandon the site for whatsoever reason of dispute, excepting force majeure conditions. All such problems/disputes shall be separately discussed and settled without affecting the progress of work. Such stoppage or abandonment shall be treated as breach of contract and dealt with accordingly
- 2.8.22 The contractor shall keep the area of work clean and shall remove the debris etc. while executing day-to-day work. Upon completion of work, the contractor shall remove from the vicinity of work, all scrap, packing materials, rubbish, unused and other materials and deposit them in places specified by the Engineer. The contractor will also demolish all the hutments, sheds, offices, etc. constructed and used by him and shall clean the debris. In the event of his failure to do so, the same will be arranged to be done by the Engineer and the expenses recovered from the contractor.
- 2.8.23 The contractor shall execute the work in the most substantial and workman like manner in the stipulated time. Accuracy of work and timely execution shall be the essence of this contract. The contractor shall be responsible to ensure that the quality, assembly and workmanship conform to the dimensions and clearance given in the drawings and/ or as per the instructions of the Engineer.
- 2.8.24 The Contractor to note that equipment taken on loan basis from BHEL/ their client may not be insured. The Contractor will take necessary precautions and due care to protect the same while in his custody from any damage/ loss till the same is handed over back to BHEL. In case the damage / loss is due to carelessness/ negligence on the part of the contractor, the Contractor is liable to get them repair/ replaced immediately and in case of his failure to do so within a reasonable time, BHEL will reserve the right to recover the loss from the contractor.

2.9 PROGRESS MONITORING, MONTHLY REVIEW AND PERFORMANCE EVALUATION

- 2.9.1 A detailed plan/program for completion of the contractual scope of work as per the time schedule given in the contract shall be jointly agreed between BHEL and Contractor, before commencement of work. The above program shall be supported by month wise deployment of resources viz Manpower, T&P, Consumables, etc. Progress will be reviewed periodically (Daily/Weekly/Monthly) vis a vis this jointly agreed program. The Contractor shall submit periodical progress reports (Daily/Weekly/Monthly) and other reports/information including manpower, consumables, T&P mobilization etc as desired by BHEL.
- 2.9.2 Monthly progress review between BHEL and Contractor shall be based on the agreed program as above, availability of inputs/fronts etc, and constraints if any, as per prescribed formats. Manpower, T&P and consumable reports as per prescribed formats shall be submitted by contractor every month. Release of RA Bills shall be contingent upon certification by BHEL Site Engineer of the availability of the above prescribed formats duly filled in and signed.
- 2.9.3 The burden of proof that the causes leading to any shortfall is not due to any reasons attributable to the contractor is on the contractor himself. The monthly progress review shall record shortfalls attributable to (i) Contractor, (ii) Force Majeure Conditions and (iii) BHEL
- 2.9.4 Performance of the contractor shall be assessed as per prescribed formats and shall form the basis for 'Annual/Overall Performance Evaluation' of the Contractor. BHEL reserves the right to revise

the evaluation formats during the course of execution of the works.	
2.10	TIME OF COMPLETION
2.10.1	The time schedule shall be as prescribed in the Contract. The time for completion shall be reckoned from the date of commencement of work at Site as certified by BHEL Engineers
2.10.2	The entire work shall be completed by the contractor within the time schedule or within such extended periods of time as may be allowed by BHEL under clause 2.11
2.11	EXTENSION OF TIME FOR COMPLETION
2.11.1	If the completion of work as detailed in the scope of work gets delayed beyond the contract period, the contractor shall request for an extension of the contract and BHEL at its discretion may extend the Contract.
2.11.2	Based on the monthly reviews jointly signed, the works balance at the end of original contract period less the backlog attributable to the contractor shall be quantified, and the number of months of 'Time extension' required for completion of the same shall be jointly worked out. Within this period of 'Time extension', the contractor is bound to complete the portion of backlog attributable to the contractor. Any further 'Time extension' or 'Time extensions' at the end of the previous extension shall be worked out similarly.
2.11.3	However if any 'Time extension' is granted to the contractor to facilitate continuation of work and completion of contract, due to backlog attributable to the contractor alone, then it shall be without prejudice to the rights of BHEL to impose penalty/LD for the delays attributable to the contractor, in addition to any other actions BHEL may wish to take at the risk and cost of contractor.
2.11.4	A joint program shall be drawn for the balance amount of work to be completed during the period of 'Time Extension', along with matching resources (with weightages) to be deployed by the contractor as per specified format. Review of the program and record of shortfall shall be done every month of the 'Time extension' period in the same manner as is done for the regular contract period.
2.11.5	During the period of 'Time extension', contractor shall maintain their resources as per mutually agreed program
2.11.6	At the end of total work completion as certified by BHEL Engineer, and upon analysis of the total delay, the portion of time extensions attributable to (i) Contractor, (ii) Force majeure conditions, and (iii) BHEL, shall be worked out and shall be considered to be exhausted in the same order. The total period of time extensions shall be the sum of (i), (ii) and (iii) above and shall be equal to period between the scheduled date of completion and the actual date of completion of contract. LD shall be imposed/ levied for the portion of time extensions attributable to contractor and recoverable from the dues payable to the contractor.
2.12	OVERRUN COMPENSATION
NOT APPLICABLE	
2.13	INTEREST BEARING RECOVERABLE ADVANCES
2.13.1	Normally no advance is payable to the contractor. However, advance payment in exceptional circumstances shall be interest bearing and secured through an equivalent Bank Guarantee and shall be limited to a maximum of 5% of contract value. This 'Interest Bearing Recoverable Advance' shall be payable in not less than two installments with any of the installment not exceeding 60% of the total eligible advance.

- 2.13.2 In exceptional circumstances, with due justification, Competent Authority of BHEL is empowered to approve proposals for payment of additional interim interest bearing advance against matching Bank Guarantee, for resource augmentation towards expediting work for project implementation.
- 2.13.3 Bank Guarantee towards 'Interest Bearing Recoverable Advance' shall be at least 110% of the advance so as to enable recovery of not only principle amount but also the interest portion, if so required.
- 2.13.4 Contractor shall establish the utilization of advance drawn before the release of next installment.
- 2.13.5 Payment and recovery of Interest Bearing Recoverable advance shall be at the sole discretion of BHEL and shall not be a subject matter of arbitration.
- 2.13.6 The rate of interest applicable for the above advances shall be the prime lending rate of State Bank of India prevailing at the time of disbursement of the advance + 2%, and such rate will remain fixed till the total advance amount is recovered
- 2.13.7 Unadjusted amount of advances paid shall not exceed 5% of the total contract value at any point of time. Recovery of advances shall be made progressively from each Running Bill such that the advance amounts paid along with the interest is fully recovered by the time the contractor's billing reaches 80% of contract value.
- 2.13.8 Recovery rate per month shall be the sum of:
- 10% of Running Bill amount
 - Simple interest up to the date of RA Bill on the outstanding Principle amount/amounts
- 2.13.9 Contractor to submit Bank Guarantee as per prescribed formats for each of the advance and shall be valid for at least one year or the recovery duration or the balance contract period which ever is later. In case the recovery of dues does not get completed within the aforesaid BG period, the contractor shall renew the BG or submit fresh BG for the outstanding amount and the remaining recovery period.
- 2.13.10 BHEL is entitled to make recovery of the entire outstanding amount in case the contractor fails to comply with the BG requirement

2.14 QUANTITY VARIATION

- 2.14.1 The quoted rates shall remain firm irrespective of any variations in the individual quantities. No compensation becomes payable in case the variation of the final executed contract value is within the limits of Plus (+) or Minus (-) 15% of awarded contract value
- 2.14.2 Compensation due to variation of final executed value in excess of the limits defined in clause above, shall be as follows:
- In case the finally executed contract value reduces below the lower limit of Contract Value due to quantity variation specified above, the contractor will be eligible for compensation @ 15% of the difference between the lower limit of the contract value and the actual executed value.
 - In case the finally executed contract value increases above the upper limit of Contract Value due to quantity variation specified above, there will be no revision in the rates within the contract period.

2.15 EXTRA WORKS

- 2.15.1 All rectifications/modifications, revamping, and reworks required for any reasons not due to the fault of the contractor, or needed due to any change in deviation from drawings and design of equipments, operation/maintenance requirements, mismatching, or due to damages in transit, storage and erection/commissioning, and other allied works which are not very specifically indicated in the drawings, but are found essential for satisfactory completion of the work, will be considered as extra works.
- 2.15.2 Extra works arising on account of the contractor's fault, irrespective of time consumed in rectification of the damage/loss, will have to be carried out by the contractor free of cost. Under such circumstances, any material and consumable required for this purpose will also have to be arranged by the contractor at his cost.
- 2.15.3 All the extra work should be carried out by a separately identifiable gang, without affecting routine activities. Daily log sheets in the pro-forma prescribed by BHEL should be maintained and shall be signed by the contractor's representative and BHEL engineer. No claim for extra work will be considered/ entertained in the absence of the said supporting documents i.e. daily log sheets. Signing of log sheets by BHEL Engineer does not necessarily mean the acceptance of such works as extra works.
- 2.15.4 BHEL retains the right to award or not to award any of the major repair/ rework/modification/rectification/fabrication works to the contractor, at their discretion without assigning any reason for the same
- 2.15.5 After eligibility of extra works is established and finally accepted by BHEL engineer/designer, payment will be released on competent authority's approval at the following rate.

MAN-HOUR RATE FOR ELIGIBLE EXTRA WORKS: Single composite average labor man-hour rate, including overtime if any, supervision, use of tools and tackles and other site expenses and incidentals, consumables for carrying out any major rework/ repairs/ rectification/ modification/ fabrication as certified by site as may arise during the course of erection, testing, commissioning or extra works arising out of transit, storage and erection damages, payment, if found due will be at Rs 60/- per man hour.

- 2.15.6 The above composite labor man hour rate towards extra works shall remain firm and not subject to any variation during execution of the work. Rate revision, Over Run Charges/compensation etc will not be applicable due to extra works.
- 2.15.7 **Extra Works for Civil Packages** shall be regulated as follows
- i) Rates for Extra Works arising due to (1) non availability of BOQ (Rate Schedule), OR (2) change in Specifications of materials/works (3) rectification/modification/dismantling & re erecting etc due to no fault of Contractor, shall be in the order of the following:
- Item rates are to be derived from similar nature of items in the BOQ (Rate Schedule) with applicable escalation derived from All India Consumer Price Index for Whole Sale Commodities.
 - As per CPWD-DSR-2007 (or latest edition) with applicable escalation derived from All India Consumer price Index for Whole Sale Commodities, OR, Notification issued by the office of CPWD for 'Cost Index' in that Region where the project is being executed, whichever is less
 - Item rates are to be worked out on the basis of prevailing market rates mutually agreed between BHEL and Contractor, plus 15% towards Contractor's overheads and profit.

2.16 SUPPLEMENTARY ITEMS

2.16.1 For Non Civil Works

Supplementary items are items/works required for completion of entire work but not specified in the scope of work. Subject to certification of such items/works as supplementary items by BHEL Engineer, rates shall be derived on the basis of any one of the following on mutual agreement:

- i) Based on percentage breakup/rates indicated for similar/nearby items
- ii) In case (i) above does not exist, then BHEL/site may derive the percentage breakup/rates to suit the type of work

2.16.2 For Civil Works

- i) Rates for Supplementary Works/Additional Works arising out due to additions/alterations in the original scope of works as per contract subject to certification of BHEL Engineer shall be worked out as under:
 - a) Item rates which are available in existing BOQ (Rate Schedule) shall be operated with applicable escalation derived from All India Consumer Price Index for Whole Sale Commodities
 - b) Items of works which are not available in existing BOQ shall be operated as an 'Extra Works' and rate shall be derived as per clause no 2.15.7
- ii) Execution of Supplementary Works/Additional Works through the Contractor shall be at the sole discretion of BHEL, and shall be considered as part of executed contract value for the purpose of Quantity Variation as per clause 2.14
- iii) BHEL Engineer's decision regarding fixing the rate as above is final and binding on the contractor.

2.17 PRICE VARIATION COMPENSATION

NOT APPLICABLE

2.18 INSURANCE

2.18.1 BHEL/their customer shall arrange for insuring the materials/properties of BHEL/customer covering the risks during transit, storage, erection and commissioning.

2.18.2 It is the sole responsibility of the contractor to insure his materials, equipments, workmen, etc. against accidents and injury while at work and to pay compensation, if any, to workmen as per Workmen's compensation Act. The work will be carried out in a protected area and all the rules and regulations of the client /BHEL in the area of project which are in force from time to time will have to be followed by the contractor.

2.18.3 If due to negligence and or non-observation of safety and other precautions by the contractors, any accident/injury occurs to the property / manpower belong to third party, the contractor shall have to pay necessary compensation and other expense, if so decided by the appropriate authorities.

2.18.4 The contractor will take necessary precautions and due care to protect the material, while in his custody from any damage/ loss due to theft or otherwise till the same is taken over by BHEL or customer. For lodging / processing of insurance claim the contractor will submit necessary documents. BHEL will recover the loss including the deductible franchise from the contractor, in case the damage / loss is due to carelessness / negligence on the part of the contractor. In case of any theft of material under contractor's custody, matter shall be reported to police by the contractor immediately and copy of FIR and subsequently police investigation report shall be submitted to BHEL for taking up with insurance. However this will not relieve the contractor of his

contractual obligation for the material in his custody.

2.19 STRIKES & LOCKOUT

2.19.1 The contractor will be fully responsible for all disputes and other issues connected with his labor. In the event of the contractor's labor resorting to strike or the Contractor resorting to lockout and if the strike or lockout declared is not settled within a period of one month, BHEL shall have the right to get the work executed through any other agencies and the cost so incurred by BHEL shall be deducted from the Contractor's bills.

2.19.2 For all purposes whatsoever, the employees of the contractor shall not be deemed to be in the employment of BHEL

2.20 FORCE MAJEURE

The following shall amount to Force Majeure:-

2.20.1 Acts of God, act of any Government, War, Sabotage, Riots, Civil commotion, Police action, Revolution, Flood, Fire, Cyclones, Earth quake and Epidemic and other similar causes over which the contractor has no control.

2.20.2 If the contractor suffers delay in the due execution of the contractual obligation due to delays caused by force majeure as defined above, the agreed time of completion of the job covered by this contract or the obligations of the contractor shall be extended by a period of time equal to period of delay, provided that on the occurrence of any such contingency, the contractor immediately reports to BHEL in writing the causes of delay and the contractor shall not be eligible for any compensation.

2.21 ARBITRATION & RECONCILIATION

2.21.1 In case amicable settlement is not reached in the event of any dispute or difference arising out of the execution of the Contract or the respective rights and liabilities of the parties or in relation to interpretation of any provision by the Contractor in any manner touching upon the Contract, such dispute or difference shall (except as to any matters, the decision of which is specifically provided for therein) be referred to the sole arbitration of the arbitrator appointed by BHEL/In charge PESD.

The award of the Arbitrator shall be binding upon the parties to the dispute

Subject as aforesaid, the provisions of Arbitration and Reconciliation Act 1996 (India) or statutory modifications or re enactments thereof and the rules made there under and for the time being in force shall apply to the arbitration proceedings under this clause. The venue of the arbitration shall be the place from which the contract is issued or such other place as the Arbitrator at his discretion may determine

2.21.2 In case of Contract with Public Sector Enterprise (PSE) or a Government Department, the following shall be applicable :

In the event of any dispute or difference relating to the interpretation and application of the provisions of the Contract, such dispute or difference shall be referred to by either party to the arbitration of one of the arbitrators in the department of public enterprises. The award of the arbitrator shall be binding upon the parties to the dispute, provided, however, any party aggrieved by such award may make further reference for setting aside or revision of the award to the Law

Secretary, Department of Legal Affairs, Ministry of Law and Justice, Government of India. Upon such reference the dispute shall be decided by the Law Secretary or the Special Secretary or Additional Secretary when so authorized by the Law Secretary, whose decision shall bind the parties hereto finally and conclusively.

2.21.3 The cost of arbitration shall be borne equally by the parties.

2.21.4 Work under the contract shall be continued during the arbitration proceedings

2.22 RETENTION AMOUNT

2.22.1 Retention Amount shall be 5% of executed contract value and shall be recovered at the rate of 5% from each Running Bill admitted. Retention amount shall always be retained in cash and shall not be released against BG under any circumstance.

2.22.2 Refund of Retention Amount shall be as follows.

- i) 50% of retention amount along with 'Final Bill'
- ii) Balance 50% of retention amount shall be retained towards 'Performance Guarantee for Workmanship' and shall become refundable after expiry of Guarantee period, provided all the defects noticed during the guarantee period have been rectified to the satisfaction of BHEL Site Engineer/BHEL Construction Manager, and after deducting all expenses/other amounts due to BHEL under the contract/other contracts entered into by BHEL with them. Bank Guarantees are not acceptable towards this portion of retention

2.23 PAYMENTS

Payments to Contractors are made in any one of the following forms

2.23.1 Running Account Bills (RA Bills)

- i) These are for interim payments when the contracts are in progress. The bills for such interim payments are to be prepared by Contractor in prescribed formats (RA Bill forms).
- ii) Payments shall be made according to the extent of work done as per measurements taken up to the end of the calendar month and in line with the terms of payments described in the Tender documents
- iii) Recoveries on account of electricity, water, statutory deductions, etc are made as per terms of contract
- iv) Full rates for the work done shall be allowed only if the quantum of work has been done as per the specifications stipulated in the contract. If the work is not executed as per the stipulated specifications, BHEL may ask the contractor to re do the work according to the required specifications, without any extra cost. However, where this is not considered necessary 'OR' where the part work is done due to factors like non-availability of material to be supplied by BHEL 'OR' non availability of fronts 'OR' non availability of drawings, fraction payment against full rate, as is considered reasonable, may be allowed with due regard for the work remaining to be done. BHEL decision in this regard will be final and binding on the contractor.
- v) In order to facilitate part payment, BHEL Site Engineer at his discretion may further split the contracted rates/percentages to suit site conditions, cash flow requirements according to the progress of work

2.23.2 Final Bill

'Final Bill' is used for final payment on closing of Running Account for works or for single payment after completion of works. 'Final Bill' shall be submitted as per prescribed format after completion

of works as per scope and upon material reconciliation, along with the following. i) 'No Claim Certificate' by contractor ii) Clearance certificates where ever applicable viz Clearance Certificates from Customer, various Statutory Authorities like Labor department, PF Authorities, Commercial Tax Department, etc iii) Indemnity bond as per prescribed format BHEL shall settle the final bills after deducting all liabilities of Contractor to BHEL
2.24 PERFORMANCE GUARANTEE FOR WORKMANSHIP 2.24.1 Even though the work will be carried out under the supervision of BHEL Engineers the Contractor will be responsible for the quality of the workmanship and shall guarantee the work done for a period of twelve months from the date of commencement of guarantee period as defined in Special Conditions of Contract, for good workmanship and shall rectify free of cost all defects due to faulty construction/erection detected during the guarantee period. In the event of the Contractor failing to repair the defective works within the time specified by the Engineer, BHEL may proceed to undertake the repairs of such defective works at the Contractor's risk and cost, without prejudice to any other rights and recover the same from the Guarantee money. 2.24.2 BHEL shall release the guarantee money subject to the following i) Contractor has submitted 'Final Bill' ii) Guarantee period as per contract has expired iii) Contractor has furnished 'No Claim Certificate' in specified format iv) BHEL Site Engineer/Construction Manager has furnished the 'No Demand Certificate' in specified format v) Contractor has carried out the works required to be carried out by him during the period of Guarantee and all expenses incurred by BHEL on carrying out such works is included for adjustment from the Guarantee money refundable.
2.25 CLOSING OF CONTRACTS The Contract shall be considered completed and closed upon completion of all contractual obligations and settlement of Final Bill or completion of Guarantee period whichever is later. Upon closing of Contract, BHEL shall issue a completion certificate as per standard format, based on specific request of Contractor.
2.26 REVERSE AUCTION: BHEL reserves the right to go for Reverse Auction for Price Bid Opening by BHEL appointed service provider, instead of opening the submitted sealed price bid in the conventional way. The Business Rules for Reverse Auction shall be as per BHEL guidelines issued from time to time.
2.27 SUSPENSION OF BUSINESS DEALINGS BHEL reserves the right to take action against Contractors who either fail to perform or Tenderers/Contractor who indulge in malpractices, by suspending business dealings with them in line with BHEL guidelines issued from time to time.
2.28 OTHER ISSUES 2.28.1 Value of Non judicial Stamp Paper for Bank Guarantees and for Contract Agreement shall be not less than Rs 100/- unless otherwise required under relevant statutes. 2.28.2 In case of any conflict between the General Conditions of Contract and Special Conditions of Contract, provisions contained in the Special Conditions of Contract shall prevail. 2.28.3 Unless otherwise specified in NIT, offers from consortium /JVs shall not be considered. 2.28.4 BHEL may not insist for signing of Contract Agreements in respect of low value and short time period contracts like providing services for Hot water flushing, Chemical Cleaning, Transportation, etc

REVERSE AUCTION GUIDELINES

ANNEXURE – I to GCC of Tender Notice No.

HY/PEnSD/EnC/ STP HPEP/CIVIL/001

Terms & Conditions of Reverse Auction

Against this enquiry for the subject item/ system with detailed scope of supply as per enquiry specifications, BHEL may resort to “REVERSE AUCTION PROCEDURE” i.e., ON LINE BIDDING (THROUGH A SERVICE PROVIDER). The philosophy followed for reverse auction shall be English Reverse (No ties).

1. For the proposed reverse auction, technically and commercially acceptable bidders only shall be eligible to participate.
2. Those bidders who have given their acceptance for Reverse Auction (quoted against this tender enquiry) will have to necessarily submit „online sealed bid” in the Reverse Auction. Non-submission of „online sealed bid” by the bidder for any of the eligible items for which techno-commercially qualified, will be considered as tampering of the tender process and will invite action by BHEL as per extant guidelines in vogue.
3. BHEL will engage the services of a service provider who will provide all necessary training and assistance before commencement of on line bidding on internet.
4. In case of reverse auction, BHEL will inform the bidders the details of Service Provider to enable them to contact & get trained.
5. Business rules like event date, time, bid decrement, extension etc. also will be communicated through service provider for compliance.
6. Bidders have to fax the Compliance form (annexure IV) before start of Reverse auction. Without this, the bidder will not be eligible to participate in the event.
7. In line with the NIT terms, BHEL will provide the calculation sheet (e.g., EXCEL sheet) which will help to arrive at “Total Cost to BHEL” like Packing & forwarding charges, Taxes and Duties, Freight charges, Insurance, Service Tax for Services and loading factors (for non-compliance to BHEL standard Commercial terms & conditions) for each of the bidder to enable them to fill-in the price and keep it ready for keying in during the Auction.
8. Reverse auction will be conducted on scheduled date & time.
9. At the end of Reverse Auction event, the lowest bidder value will be known on auction portal.

Annexure - I

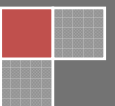
10. The lowest bidder has to fax/e-mail the duly signed and filled-in prescribed format for price breakup including that of line items, if required, (Annexure VII) as provided on case-to-case basis to Service provider within two working days of Auction without fail.
11. In case BHEL decides not to go for Reverse Auction procedure for this tender enquiry, the Price bids and price impacts, if any, already submitted and available with BHEL shall be opened as per BHEL's standard practice.
12. Bidders shall be required to read the "Terms and Conditions" section of the auctions site of Service provider, using the Login IDs and passwords given to them by the service provider before reverse auction event. Bidders should acquaint themselves of the „Business Rules of Reverse Auction“, which will be communicated before the Reverse Auction.
13. If the Bidder or any of his representatives are found to be involved in Price manipulation/ cartel formation of any kind, directly or indirectly by communicating with other bidders, action *as per extant BHEL guidelines*, shall be initiated by BHEL and the results of the RA scrapped/ aborted.
14. The Bidder shall not divulge either his Bids or any other exclusive details of BHEL to any other party.
15. In case BHEL decides to go for reverse auction, the H1 bidder(s) (whose quote is highest in online sealed bid) may not be allowed to participate in further RA process.

Rev00
11th Mar
2014

VOLUME I - D FORMS & PROCEDURES

(Doc.No. HY/BHEL/PESD/HPEP-STP/F&P/001)

BHARAT HEAVY ELECTRICALS LIMITED



FORMS & PROCEDURES

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FORMS & PROCEDURES

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: will be released later

OFFER FORWARDING LETTER / TENDER SUBMISSION LETTER
(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

Offer Reference No:.....
To,

Date:.....

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub: Submission of Offer against Tender Specification No:

I/We hereby offer to carry out the work detailed in the Tender Specification issued by Bharat Heavy Electricals Limited, Power Sector-....., in accordance with the terms and conditions thereof.

I/We have carefully perused the following listed documents connected with the above work and agree to abide by the same.

1. Amendments/Clarifications/Corrigenda/Errata/etc. issued in respect of the Tender documents by BHEL
2. Notice Inviting Tender (NIT)
3. Price Bid
4. Technical Conditions of Contract
5. Special Conditions of Contract
6. General Conditions of Contract
7. Forms and Procedures

Should our Offer be accepted by BHEL for Award, I/we further agree to furnish 'Security Deposit' for the work as provided for in the Tender Conditions within the stipulated time as may be indicated by BHEL.

I/We further agree to execute all the works referred to in the said Tender documents upon the terms and conditions contained or referred to therein and as detailed in the appendices annexed thereto.

I/We have deposited/depositing herewith the requisite Earnest Money Deposit (EMD) as per details furnished in the Check List.

Authorized Representative of Bidder

Signature:

Name:

Address:

Place:

Date:

DECLARATION BY AUTHORISED SIGNATORY OF BIDDER

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Declaration by Authorised Signatory**

Ref : 1) NIT/Tender Specification No:
2) All other pertinent issues till date

I/We, hereby certify that all the information and data furnished by me with regard to the above Tender Specification are true and complete to the best of my knowledge. I have gone through the specifications, conditions, stipulations and all other pertinent issues till date, and agree to comply with the requirements and Intent of the specification.

I further certify that I am authorised to represent on behalf of my Company/Firm for the above mentioned tender and a valid Power of Attorney to this effect is also enclosed.

Yours faithfully,

(Signature, Date & Seal of Authorized
Signatory of the Bidder)

Date:

Enclosed : Power of Attorney

NO DEVIATION CERTIFICATE

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **No Deviation Certificate**

Ref : 1) NIT/Tender Specification No:,
2) All other pertinent issues till date

We hereby confirm that we have not changed/ modified/materially altered any of the tender documents as downloaded from the website/ issued by BHEL and in case of such observance at any stage, it shall be treated as null and void.

We also hereby confirm that we have neither set any Terms and Conditions and nor have we taken any deviation from the Tender conditions together with other references applicable for the above referred NIT/Tender Specification.

We further confirm our unqualified acceptance to all Terms and Conditions, unqualified compliance to Tender Conditions, Integrity Pact (if applicable) and acceptance to Reverse Auctioning process.

We confirm to have submitted offer in accordance with tender instructions and as per aforesaid references.

Thanking you,

Yours faithfully,

(Signature, date & seal of authorized
representative of the bidder)

DECLARATION CONFIRMING KNOWLEDGE ABOUT SITE CONDITIONS
(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Declaration confirming knowledge about Site conditions**

Ref : 1) NIT/Tender Specification No:,

2) All other pertinent issues till date

I/We, _____ hereby declare and confirm that we have visited the Project Site as referred in BHEL Tender Specifications and acquired full knowledge and information about the Site conditions including Wage structure, Industrial Climate, the Law & Order and other conditions prevalent at and around the Site. We further confirm that the above information is true and correct and we shall not raise any claim of any nature due to lack of knowledge of Site conditions.

I/We, hereby offer to carry out work as detailed in above mentioned Tender Specification, in accordance with Terms & Conditions thereof.

Yours faithfully,

(Signature, Date & Seal of Authorized
Representative of the Bidder)

Date :

Place:

DECLARATION FOR RELATION IN BHEL

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder failing which the offer of Bidder is liable to be summarily rejected)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Declaration for relation in BHEL**

Ref : 1) NIT/Tender Specification No:,

I/We hereby submit the following information pertaining to relation/relatives of Proprieter/Partner(s)/Director(s) employed in BHEL

Tick(✓) any one as applicable:

1. The Proprieter, Partner(s), Director(s) of our Company/Firm DO NOT have any relation or relatives employed in BHEL

OR

2. The Proprieter, Partner(s), or Director(s) of our Company/Firm HAVE relation/relatives employed in BHEL and their particulars are as below:

(i)

(ii)

Signature of the Authorised Signatory

Note:

1. Attach separate sheet, if necessary.
2. If BHEL Management comes to know at a later date that the information furnished by the Bidder is false, BHEL reserves the right to take suitable against the Bidder/Contractor.

NON DISCLOSURE CERTIFICATE

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

NON DISCLOSURE CERTIFICATE

I/We understand that BHEL PESD is committed to Information Security Management System as per their Information Security Policy.

Hence, I/We M/s.....
who are submitting offer for providing services to BHEL PESD __ against
Tender Specification No:_____,
hereby undertake to comply with the following in line with Information
Security Policy of BHEL PESD.

- To maintain confidentiality of documents & information which shall be used during the execution of the Contract.
- The documents & information shall not be revealed to or shared with third party which shall not be in the business interest of BHEL PESD.

(Signature, date & seal of Authorized
Signatory of the bidder)

Date:

BANK ACCOUNT DETAILS FOR E-PAYMENT

(To be given on Letter head of the Company /Firm of Bidder, and **ENDORSED (SIGNED & STAMPED) BY THE BANK** to enable BHEL release payments through Electronic Fund Transfer (EFT/RTGS))

1. Beneficiary Name :
2. Beneficiary Account No. :
3. Bank Name & Branch :
4. City/Place :
5. 9 digit M ICR Code of Bank Branch :
6. IFSC Code of Bank Branch :
7. Beneficiary E-mail ID :
(for payment confirmation)

NOTE: In case Bank endorsed certificate regarding above has already been submitted earlier, Kindly submit photocopy of the same

FORMAT FOR SEEKING CLARIFICATION

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : **Request for Clarification**

Ref : 1) NIT/Tender Specification No:,
 2) All other pertinent issues till date

Sl no	Reference clause of Tender Document	Existing provision	Bidder's query	BHEL's clarification
1				
2				
3				
4				
5				
6				

Yours faithfully,

(Signature, date & seal of Authorized
Representative of the Bidder)

BANK GUARANTEE FOR SECURITY DEPOSIT

B.G. NO.

Date

This deed of Guarantee made this ----- day of -----two thousand ---- by <Name and Address of Bank> hereinafter called the "The Guarantor" (which expression shall unless repugnant to the context or meaning thereof be deemed to include its successors and assigns) in favour of M/s Bharat Heavy Electrical Limited (A Govt. of India Undertaking) a company incorporated under the Companies Act, 1956, having its registered office at BHEL House, Siri Fort, Asiad, New Delhi – 110049 through its unit at Bharat Heavy Electricals Limited, PE&SD ,Ramachandrapuram , Hyderabad-502 032 hereinafter called "The Company" (which expression shall unless repugnant to the context or meaning thereof be deemed to include its successors and assigns)

WHEREAS < Contractor's Name and Address> (hereinafter referred to as the Contractor) have entered into a contract arising out of Letter of Intent no. < LOI REF & Date > (hereinafter referred to as "the contract") for < Name of Work > with the company.

AND WHEREAS the contract inter-alia provides that the contractor shall furnish to the company a sum of Rs.----- (Rupees-----) towards security deposit for due and faithful performance of the contract in the form and manner specified therein.

AND WHEREAS the contractor has approached the Guarantor and in consideration of the arrangement arrived at between the contractor and the Guarantor, the Guarantor has agreed to give the Guarantee as hereinafter mentioned in favour of the company.

The Guarantor do hereby guarantee to the company the due and faithful performance, observance or discharge of the Contract by the contractor and further unconditionally and irrevocably undertake to pay to the Company without demur and merely on a demand, to the extent of Rs.----- (Rupees-----) against any claim by the company on them for any loss, damage, costs, charges and expenses caused to or suffered by the company by reasons of the contractor making any default in the performance, observance or discharge of the terms, conditions, stipulations or undertakings or any of them as contained in the contract.

The decision of the company whether any default has occurred or has been committed by the contractor in the performance, observance or discharge of any of the terms, conditions, stipulations or undertakings or any one of them as contained in the contract and / or as to the extent of loss, damage, costs, charges and expenses caused to or suffered by the company by reason of the contractor making any default in the performance, observance or discharge of any of the terms, conditions, stipulations or undertakings or any one of them shall be conclusive and binding on the Guarantor irrespective of the fact whether the contractor admits or denies the default or questions the correctness of any demand made by the company in any Court, Tribunal or Arbitration proceedings or before any other Authority.

The company shall have the fullest liberty without affecting in any way the liability of the Guarantor under this Guarantee, from time to time to vary any of the terms and conditions of the contract or extend time of performance by the contractor or to postpone for any time and from time to time any of the powers exercisable by it against the contractor and either enforce or forebear from enforcing any of the terms and conditions governing the contract or securities available to the company and the Guarantor shall not be released from its liability under these presents by any exercise by the company of the liberty with reference to the matters aforesaid or by reasons of time being given to the contractor or any other forbearance, act or commission on the part of the company or any indulgence by the company to the contractor or any other matter or thing whatsoever which under the law relating to sureties would, but for this provision have the effect of so releasing the Guarantor from its liability under this guarantee.

The Guarantor further agrees that the Guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the contract and its claim satisfied or discharged and till the company certifies that the terms and conditions of the contract have been fully and properly carried out by the contractor and accordingly discharges this Guarantee, subject however, that the company shall have no claim under this Guarantee after -- i.e. (the present date of validity of Bank Guarantee unless the date of validity of this Bank Guarantee is further extended from time to time, as the case may be) unless a notice of the claim under this Guarantee has been served on the Guarantor before the expiry of the said period in which case the same shall be enforceable against the Guarantor notwithstanding the fact that the same is enforced after the expiry of the said period.

BANK GUARANTEE FOR SECURITY DEPOSIT

The Guarantor undertakes not to revoke this Guarantee during the period it is in force except with the previous consent of the Company in writing and agrees that any liquidation or winding up or insolvency or dissolution or any change in the constitution of the contractor or the Guarantor shall not discharge the Guarantor's liability hereunder.

It shall not be necessary for the company to proceed against the contractor before proceeding against the Guarantor and the Guarantee herein contained shall be enforceable against them notwithstanding any security which the Company may have obtained or obtain from the Contractor shall at the time when proceedings are taken against the Guarantor hereunder be outstanding or unrealized.

Notwithstanding anything contained herein before, our liability under the Guarantee is restricted to Rs.-----
- (Rupees-----). Our guarantee shall remain in force until -----, i.e. (the present date of validity of Bank Guarantee unless the date of validity of this Bank Guarantee is further extended from time to time) unless a claim or demand under this guarantee is made against us on or before ----- we shall be discharged from our liabilities under this Guarantee thereafter.

Any claim or dispute arising under the terms of this documents shall only be enforced or settled in the courts of at Nagpur only.

The Guarantor hereby declares that it has power to execute this guarantee and the executant has full powers to do so on behalf of the Guarantor.

IN WITNESS whereof the ----- (Bank) has hereunto set and subscribed its hand the day, month and year first, above written.

(Name of the Bank)

Signed for and on behalf of the Bank
(Designation of the Authorized Person Signing the Guarantee)

(Signatory No.-----)

DATED:

SEAL

=====

Notes :

1. The BG shall be executed on non-judicial stamp papers of adequate value procured in the name of the Bank in the State where the Bank is located.
2. The BG is required to be sent by the executing Bank directly to BHEL at the address where tender is submitted / accepted under sealed cover.

BANK GUARANTEE FOR INTEREST BEARING REFUNDABLE ADVANCE

B.G. No.

Date

This deed of Guarantee made this _____ day of _____ two thousand _____ by < **Name and Address of Bank**> hereinafter called the "The Guarantor" (which expression shall unless repugnant to the context or meaning thereof be deemed to include its successors and assigns) in favour of M/S Bharat Heavy Electricals Limited a Company incorporated under the Companies Act, 1956, having its registered office at BHEL House, Siri Fort, New Delhi - 110049 through its unit at Bharat Heavy Electricals Limited, PE&SD, Ramachandrapuram, Hyderabad-502 032, hereinafter called "The Company" (which expression shall unless repugnant to the context or meaning thereof be deemed to include its successors and assigns).

WHEREAS M/s. _____ (hereinafter referred to as the Contractor) have entered into a Contract arising out of Letter of Intent no. _____ dtd _____ (hereinafter referred to as "the Contract") for the < **Name of work**> with the Company.

AND WHEREAS the Contract inter-alia provides that the Company will pay to the Contractor interest bearing advance of Rs. _____ (Rupees _____ only) on certain terms and conditions specified in the Contract subject to the Contractor furnishing a Bank Guarantee for Rs. _____ (Rupees _____ only) in favour of the Company.

AND WHEREAS the Company has agreed to accept a Bank Guarantee from a Bank to cover the said advance.

AND WHEREAS the Contractor has approached the Guarantor and in consideration of the arrangement arrived at between the Contractor and the Guarantor, the Guarantor has agreed to give the Guarantee as hereinafter mentioned in favour of the Company.

NOW THIS DEED WITNESSES AS FOLLOWS:-

- (1) In consideration of the Company having agreed to advance a sum of Rs. _____ (Rupees _____ only) to the Contractor, the Guarantor do hereby guarantee the due recovery by the Company of the said advance with interest thereon as provided according to the terms and conditions of the Contract. If the said Contractor fails to utilise the said advance for the purpose of the Contract and /or the said advance together with interest as aforesaid is not fully recovered by the Company the Guarantor do hereby unconditionally and irrevocably undertake to pay to the Company without demur and merely on a demand, to the extent of the said sum of Rs. _____ (Rupees _____ only) any claim made by the Company on them for the loss or damage caused to or suffered by the Company by reasons of the Company not being able to recover in full the advance with interest as aforesaid.

BANK GUARANTEE FOR INTEREST BEARING REFUNDABLE ADVANCE

-
- (2) The decision of the Company whether the Contractor has failed to utilise the said advance or any part thereof for the purpose of the Contract and / or as to the extent of loss or damage caused to or suffered by the Company by reason of the Company not being able to recover in full the said sum of Rs. _____ with interest if any shall be final and binding on the Guarantor, irrespective of the fact whether the Contractor admits or denies the default or questions the correctness of any demand made by the Company in any Court Tribunal or Arbitration proceedings or before any other Authority.
 - (3) The Company shall have the fullest liberty without affecting in any way the liability of the Guarantor under this Guarantee, from time to time to vary any of the terms and conditions of the Contract or extend time of performance by the Contractor or to postpone for any time and from time to time any of the powers exercisable by it against the Contractor and either enforce or forebear from enforcing any of the terms and conditions governing the Contract or securities available to the Company and the Guarantor shall not be released from its liability under these presents by any exercise by the Company of the liberty with reference to the matters aforesaid or by reasons of time being given to the Contractor or any other forbearance, act or commission on the part of the Company or any indulgence by the Company to the Contractor or of any other matter or thing whatsoever which under the law relating to sureties would, but for this provision have the effect of so releasing the Guarantor from its liability under this guarantee.
 - (4) The Guarantor further agrees that the Guarantee herein contained shall remain in full force and effect during the period till the Company discharges this Guarantee, subject to however, that the Company shall have no claim under this Guarantee after _____ i.e. (the present date of validity of Bank Guarantee unless the date of validity of this Bank Guarantee is further extended from time to time, as the case may be) unless a notice of the claim under this Guarantee has been served on the Guarantor before the expiry of the said period in which case the same shall be enforceable against the Guarantor notwithstanding the fact that the same is enforced after the expiry of the said period.
 - (5) The Guarantor undertakes not to revoke this Guarantee during the period it is in force except with the previous consent of the Company in writing and agrees that any liquidation or winding up or insolvency or dissolution or any change in the constitution of the Contractor or the Guarantor shall not discharge the Guarantor's liability hereunder.
 - (6) It shall not be necessary for the Company to proceed against the Contractor before proceeding against the Guarantor and the Guarantee herein contained shall be enforceable against them notwithstanding any security which the Company may have obtained or obtain from the Contractor shall at the time when proceedings are taken against the Guarantor hereunder be outstanding or unrealised.
 - (7) Notwithstanding anything contained herein before, our liability under the Guarantee is restricted to Rs. _____ (Rupees _____). Our guarantee shall remain in force until _____, i.e. the present date of validity of Bank Guarantee unless the date of validity of this Bank Guarantee is further extended from time to time. Unless a claim or demand under this guarantee is made against us on or before-----, we shall be discharged from our liabilities under this Guarantee thereafter.

BANK GUARANTEE FOR INTEREST BEARING REFUNDABLE ADVANCE

- (8) Any claim or dispute arising under the terms of this document shall only be enforced or settled in the courts at Nagpur only.
- (9) The Guarantor hereby declares that it has power to execute this Guarantee under its Memorandum and Articles of Association and the executant has full powers to do so on its behalf under the Power of Attorney dated _____ (To be incorporated by the Bank) granted to him by the proper authorities of the Guarantor.

IN WITNESS whereof the _____ (Bank) has hereunto set and subscribed its hand the day, month and year first, above written.

(Name of the Bank)

Signed for and on behalf of the Bank
(Designation of the Authorized Person Signing the Guarantee)

(Signatory No.-----)

DATED:

SEAL

=====

Notes :

1. The BG shall be executed on non-judicial stamp papers of adequate value procured in the name of the Bank in the State where the Bank is located.
2. The BG is required to be sent by the executing Bank directly to BHEL at the address where tender is submitted / accepted, under sealed cover.

FORM for EXTENSION OF VALIDITY OF BANK GUARANTEE

1. To be typed on non judicial Stamp Papers of value as applicable in the State of India from where the BG has been issued or the State of India where the BG shall be operated
2. The non judicial stamp papers shall be purchased in the name of the Party on whose behalf the BG is being issued or the BG issuing Bank

BANK GUARANTEE No:

Date:.....

To

(Write Designation and Address of Officer of BHEL inviting the Tender)

Dear Sir

Sub : Validity of Bank Guarantee No:..... Dated for
..... Rs in favour of yourself, expiry date
....., on account of M/s in respect of
Contract Number....., (herein after called the Original bank Guarantee)

At the request of M/s....., we Bank,
having its branch Office at and having Head office
at, do hereby extend our liability under the above mentioned Bank Guarantee
number..... dated for a further period of Months/years
from to expire on

Except as provided above, all other terms and conditions of the Original Bank Guarantee No
..... Dated..... shall remain unaltered and binding on us.

Kindly treat this extension as an integral part of the original Bank Guarantee to which it
would be attached.

Yours faithfully

Signature.....

Name & Designation.....

Power of Attorney/Signing Power No

Seal of Bank



PE&SD

MONTHLY PLAN & REVIEW WITH CONTRACTOR

Page 1 of 4

Name of Site		Contract No.	
		Name of Contractor	
Review for the month of		Brief Scope of work	
Date of Review			

PART- A PHYSICAL REVIEW

Sl.No	Description of work	Unit of Measurement	Original Plan (QTY Planned for the month as per joint review of previous month)	Last months shortfall (attributable to Contractor)	Total Planned for the month (including previous month backlog attributable to Contractor)	Achieved	Shortfall attributable to (in Qty)		REMARKS
			(a)	(b)	C=(a)+(b)		BHEL	Contractor	
		UOM	Phy.	Phy	Phy	Phy.	Phy.	Phy.	

Use separate sheets if necessary

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

MONTHLY PLAN & REVIEW WITH CONTRACTOR

Page 2 of 4

PART – B-1 REVIEW OF DEPLOYMENT OF MAJOR T&Ps

SUPPLIER SCOPE:-

SN.	MAJOR T&P TO BE DEPLOYED AS PER WORK PLANNED FOR THE MONTH	QTY.	DEPLOYMENT STATUS (ACTUAL DEPLOYED)	REMARKS (WORKS EFFECTED DUE TO NON-DEPLOYMENT OF T&Ps

BHEL SCOPE:-

CONTRACTOR
(Sign with name, designation and date)



PE&SD

MONTHLY PLAN & REVIEW WITH CONTRACTOR

Page 3 of 4

CONTRACT NO:

CONTRACTOR:

PART – B-2 REVIEW OF DEPLOYMENT OF MANPOWER

SUPPLIER SCOPE:-

SNO.	AREA OF WORK	CATEGORY OF LABOUR	NO. OF LABOUR REQUIRED AS PER CATEGORY	DEPLOYED FOR THE PERIOD	REMARKS (WORKS AFFECTED DUE TO NON- AVAILABILITY OF LABOUR)

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)



PE&SD

MONTHLY PLAN & REVIEW WITH CONTRACTOR

Page 4 of 4

CONTRACT No.:**Date of Report:****PART C1 : PLAN FOR THE NEXT MONTH (PHYSICAL)**

SL NO.	DESCRIPTION OF WORK (Area Wise)	PLANNED MT/ % / QTY (EXCLUDING SHORTFALLS ATTRIBUTABLE TO CONTRACTOR TILL DATE)	T&Ps REQUIRED	MANPOWER REQUIRED	REMARKS

NOTE: USE SEPARATE SHEETS, IF REQUIRED

**PART C2: PLAN FOR THE NEXT MONTH
(OTHERS)**

SL NO.	DESCRIPTION OF WORK (Area Wise)	PLANNED MT/ % / QTY	T&Ps REQUIRED	MANPOWER REQUIRED	REMARKS

NOTE: USE SEPARATE SHEETS, IF REQUIRED

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)

 PE&SD	MONTHLY PLAN & REVIEW WITH CONTRACTOR	Page 5 of 4

BHEL
(Sign with name, designation and date)

CONTRACTOR
(Sign with name, designation and date)



QUARTERLY EVALUATION OF OF CONTRACTOR PERFORMANCE

NOTE: This evaluation should be done **EVERY QUARTER** * by the respective Regions for all Contracts under executions

* : March, June, September & December of every year

A	GENERAL	
1	Reporting Period	Quarter ending : Year :
2	Name of Site	
3	Name of Contractor	
4	Contract Number/LOI Number & Date	
5	Name of Work	
6	Contract Start Date	
	I. As per Contract	
	II. Actual Date of Start	
7	Completion Status (as on date)	
	I. Physical completion in %age	
	II. Running Bill amount paid in %age of Contract Value	
8	Scheduled Completion Time	
9	Actual Date of Completion	
10	Awarded Contract Value	
11	Final contract Value	
BHEL		Contractor
(Signature with Name, Designation & date)		(Signature with Name, Designation & date)



QUARTERLY EVALUATION OF CONTRACTOR PERFORMANCE

		MAX SCORE
1.0 QUALITY		
1.1	Amenability to Quality System	5
1.2	Adherence to Quality Standards	5
1.3	Preventing recurrence of Defects/Complaints	5
1.4	Finishing and aesthetics	5
1.5	Housekeeping	5
1.6	Rating of Quality Officer for Quality Control of Job	5
2.0 DELIVERY		
2.1	Achievements vis a vis Requirements/Commitments	5
2.2	Timely Depoyment of Manpower	5
2.3	Timely Depoyment of T&Ps and MMEs	5
2.4	Timely arrangement of Consumables	5
3.0 MANPOWER		
3.1	Experience and Job knowledge of Supervisory personnel	5
3.2	Aptitude of supervisory Personnel (w.r.t. Attitude, Initiative, Leadership, Cooperativeness, etc.)	5
3.3	Adequacy of Manpower (Work Force) deployed	5
3.4	Competence of Manpower (Work Force) deployed	5
4.0 T&P, IMTEs & CONSUMABLES		
4.1	Adequacy of T&P & MMEs as per Site requirement	5
4.2	Condition of T&P & MMEs	5
4.3	Ensuring Fitness & Calibration of T&P & MMEs	5
4.4	Adequacy of Consumables as per Site requirement	5
5.0 SITE INFRASTRUCTURE AND SERVICE		
5.1	Site Organization vis a vis Commitment	5
5.2	Readiness to rectify Defects	5
5.3	Providing support Documents and Records	5
5.4	Speed of response	5
5.5	Cooperativeness in Delivering and Implementing Improvement Measures	5
5.6	Approachability of Top Management during critical requirements and its cooperation	5
BHEL (Signature with Name, Designation & date) (Signature with Name, Designation & date)		



QUARTERLY EVALUATION OF CONTRACTOR PERFORMANCE

6.0 SITE FINANCE

6.1	Regularity in Payment to Staff and Workers	5
6.2	Financing Site Operation	5

7.0 HSE (Health Safety & Environment) & SA (Social Accountability)

7.1	Health & Safety Awareness among Employeess	5
7.2	Rating of Safety Supervisor on HSE Aspects	
7.2.1	Experience and Job knowledge of Safety Supervisor	5
7.2.2	Rating of safety Supervisor for controlling Safety at Site	5
7.3	Quality & Usage of Safety gadgets	
7.3.1	Personal Protective Equipments (PPE)	5
7.3.2	Use of Safety Equipments & Safety in Equipments (Safety Net, Toeguard, Proper earthing, Fire-fighting Equipments etc.)	5
7.4	Use of Safety Posters	5
7.5	Compliance to Social Accountability Norms	5
7.6	Rating based on feed back of HSE & SA Audits	5

8.0 OTHERS

8.1	Concern for Employees Welfare and Health (like First Aid)	5
8.2	Compliance to Statutory Requirements, State and Local Laws/Regulations	5
8.3	Tendency of taking undue advantage by interpreting Contract Clauses in their favour (Score 5 for no tendency)	5
8.4	Understanding of Contract (Scope & Contract Clauses)	5
8.5	Planning of Work Activities (Monthly/Weekly/Daily)	5
8.6	Submission of Monthly/Weekly/daily Report	5

BHEL

(Signature with Name, Designation & date)

(Signature with Name, Designation & date)

Page No 2 Of 4

SCORE OBTAINED

[illegible]

Contractor
nation & date)

Page No 3 Of 4

[illegible]

Contractor
nation & date)



QUARTERLY EVALUATION OF CONTRACTOR PERFORMANCE

SI No	Category	Max Score	Score obtained	Weightage factor	Weighted Score
1	Quality	30		0.4	
2	Delivery	20		0.75	
3	Manpower	20		0.6	
4	T&Ps, MMEs & Consumables	20		0.75	
5	Site Infrastructure & Service	30		0.4	
6	Site Finance	10		1.1	
7	HSE & SA	40		0.35	
8	Others	30		0.3	
9	Total Weighted Score				
10	Any detail which Construction Manager wants to share with Management				
11	<u>Less</u> Score for Accidents attributable to Contractor during the Reporting Period (Major at@3 Minor@1)				
a	Major Accidents-----Fatal,Permanent Disability, Major Damage to Equipment.				(-)
b	Minor Accidents ----- All others				(-)
12	<u>Net Weighted Score (OUT OF 100):</u>				
Overall Performance Evaluation : Net Weighted Score 80% and Above - Good Between 60% To 80% -Satisfactory 60% and Below -Unsatisfactory Good / Satisfactory / Unsatisfactory Dated: Section Head/ Site Engineer Specific Recommendation of Construction Manager: Construction Manager					
FOR SUB CONTRACT DEPT. Dated Head (S/C) GM/PROJECTS					

Note: This summary evaluation sheet is to be sent to Contractor after every Evaluation



**ANNUAL EVALUATION OF CONTRACTOR
PERFORMANCE**
(EVALUATED FINANCIAL YEAR WISE AT HQ)

Page 1 of 1

1. Contract No.:

2. Contractor:

3. Name of Site :

4. Reporting Period (Financial Year):

Sl No	QUARTER	Net Weighted score
1	Quarter-I	
2	Quarter-II	
3	Quarter-III	
4	Quarter-IV	
5	Total for the 4 Quarters	
6	Average for the Year (Financial Year)	
7	Annual Evaluation of Contractor Performance (based on net weighted score)	➤ 80% and above : Good ➤ Between 60% to 80% : Satisfactory ➤ 60% and below : Unsatisfactory

Comments if any:

Head/Subcontracts

Date:

General Manager/Projects



**OVERALL PERFORMANCE OF CONTRACTOR FOR THE
CONTRACT**
(EVALUATED CONTRACT WISE AT HQ)

Page 1 of 1

1. Contract No.:

2. Contractor:

3. Name of Site :

4. Reporting period (From : To :)

SI No	FINANCIAL YEAR	QUARTER	Net Weighted score
1		Quarter-I	
		Quarter-II	
		Quarter-III	
		Quarter-IV	
2		Quarter-I	
		Quarter-II	
		Quarter-III	
		Quarter-IV	
3		Quarter-I	
		Quarter-II	
		Quarter-III	
		Quarter-IV	
4		Quarter-I	
		Quarter-II	
		Quarter-III	
		Quarter-IV	
5		Total for all the quarters	
6		Average for the all the Quarters (Contract Period)	
7		Overall Performance for the Contract (based on net weighted score)	➤ 80% and above : Good ➤ Between 60% to 80%: Satisfactory ➤ 60% and below : Unsatisfactory

Comments if any:

Head/Subcontracts

Date:

General Manager/Projects

MILESTONE COMPLETION CERTIFICATE
(issued by BHEL on the specific request of Contractor)

Ref :

Date:

To,

(Name & address of Contractor)

Dear Sir,

References

1. Contract No:
2. Job Description:

This is to hereby confirm that the following Milestone Activity has been achieved in respect of the Contract /Job under reference

SI No	Milestone Activity	Remarks

This certificate is issued as per your request vide letter no
without any prejudice to the rights of BHEL in line with the terms and conditions of the
above referred Contract

Yours faithfully,

For and on behalf of Bharat Heavy Electricals Limited

Construction Manager/Head (Subcontracts)

CONTRACT COMPLETION CERTIFICATE
(Issued by BHEL/HQ on the specific request of Contractor)

Ref :

Date:

To Whom so ever it may concern

1	DESCRIPTION OF WORK	
2	NAME AND ADDRESS OF THE CONTRACTOR	
3	CONTRACT NO	
4	CONTRACT VALUE	
5	LETTER OF INTENT NO & DATE	
6	CONTRACT PERIOD//CONTRACT DURATION	
7	FINAL EXECUTED VALUE	
8	PERFORMANCE	GOOD SATISFACTORY UNSATISFACTORY

This certificate is issued as per your request vide letter no
without any prejudice to the rights of BHEL to use this certificate for evaluation of your offers for future tenders

Yours faithfully,

For and on behalf of Bharat Heavy Electricals Limited

Head (Subcontracts)

INDEMNITY BOND

(To be executed on a Non Judicial Stamp Paper of the requisite value as per Stamp Duty prevalent in the respective State)

 This Indemnity Bond executed by <name of company> having their Registered Office at <xxxxxxxxxxx> in favour of M/s Bharat Heavy Electricals Limited, a Company incorporated under the Companies Act, 1956, having its Registered Office at BHEL House, Siri Fort, Asiad, New Delhi - 110049 through its Unit at Bharat Heavy Electricals Limited, PE&SD, Ramachandrapuram, Hyderabad-502 032.

And whereas the Company has entered into a Contract with M/s xxxxxxxxxx, the executants of this Deed (hereinafter referred to as the Contractor) as its contractor in respect of the work of "xxxxxxxxxxxxxxxxxxxxxxxxxxxxxx".

AND WHEREAS under the provisions of GCC further stipulates that the Contractor shall indemnify the Company against all claims of whatever nature arising during the course of execution of Contract including defects liability period of <xx Months> i.e till <xx xx xxxx>

Now this deed witness that in case the Company is made liable by any Authority including Court to pay any claim or compensation etc. in respect of all labourers or other matters at any stage under or relating to the Contract with the Contractor, the Contractor hereby covenants and agrees with the Company that they shall indemnify and reimburse the Company to the extent of such payments and for any fee, including litigation charges, lawyers' fees, etc, penalty or damages claimed against the Company by reason of the Contractor falling to comply with Central/States Laws, Rules etc, or his failure to comply with Contract (including all expenses and charges incurred by the Company).

The Contractor further indemnifies the Company for the amount which the Company may be liable to pay by way of penalty for not making deductions from the Bills of the Contractor towards such amount and depositing the same in the Government Treasury.

The Contractor further agree that the Company shall be entitled to with hold and adjust the Security Deposit and/or with hold and adjust payment of Bills of Contractor

INDEMNITY BOND

(To be executed on a Non Judicial Stamp Paper of the requisite value as per Stamp Duty prevalent in the respective State)

pertaining to this Contract against any payment which the Company has made or is required to make for which the Contractor is liable under the Contract and that such amount can be withheld, adjusted by the Company till satisfactory and final settlement of all pending matters and the Contractor hereby gives his consent for the same.

The Contractor further agrees that the terms of indemnity shall survive the termination or completion of this contract.

The contractor further agrees that the liability of the contractor shall be extended on actual basis notwithstanding the limitations of liability clause, in respect of :

1. breach of terms of contract by the contractor
2. breach of laws by the contractor
3. breach of Intellectual property rights by the contractor
4. breach of confidentiality by the contractor

Nothing contained in this deed, shall be construed as absolving or limiting the liability of the Contractor under said Contract between the Company and the Contractor. That this Indemnity Bond is irrevocable and the condition of the bond is that the Contractor shall duly and punctually comply with the terms and the conditions of this deed and contractual provisions to the satisfaction of the Company.

In witness where of M/s xxxxxxxxxxxxxx these presents on the day, month and year first, above written at xxxxxxxx by the hand of its signatory Mr. xxxxxxxxxxxx.

Signed for and on behalf of
M/s xxxxxxxxxxxxxxxxxxxx

Witness:

1
2

CONSORTIUM AGREEMENT

(To be executed on Rs. 50/- Non – Judicial Stamp Paper)

THIS AGREEMENT is made and executed on this _____ day of _____, by and between (1) M/s _____, (The First Party, i.e, the Bidder) a company incorporated under the Company's Act 1956, having its registered office at _____ (herein after called the "Bidder", which expression shall include its' successors, administrators, executors and permitted assigns) and (2) M/s _____, (The Second Party, i.e, the **associates** (Guarantor)), a company incorporated under the Company's Act 1956, having its registered office at _____ (herein after called the " Guarantor", which expression shall include its' successors, administrators, executors and permitted assigns).

WHEAEAS the Owner, Bharat Heavy Electricals Ltd, a Government of India Undertaking, proposes to issue / issued an NIT (herein after referred to as the said NIT) inviting bids from the individual Bidders for undertaking the work of _____, at _____ (herein after referred to as the said works).

WHEREAS the said NIT enables submission of a bid by a Consortium subject to fulfillment of the stipulations specified in the said NIT.

AND WHEREAS M/s _____ (The First Party, i.e, the Bidder) will submit its proposal in response to the aforesaid invitation to bid by the Owner for _____ as detailed in the Bid doc. no. < TENDER REF----->

AND WHEREAS M/s _____ (The First Party, i.e the Bidder) is willing to execute the said work under the complete supervision of M/s _____ (The Second Party, the Guarantor) and this tie-up agreement is being entered into with M/s _____ (The Second Party, the Guarantor) , who has guaranteed the first party entire technical support and supervision for executing said works (_____).

WHEREAS the First Party and the Second Party are contractors engaged in the business of carrying out various items of works. WHEREAS the two parties have agreed to constitute themselves into a consortium for the purpose of carrying out the said works by the First Party under the support and supervision of second party, and that the consortium will be continued till the completion of the works in all respects.

WHEREAS the parties have agreed to certain terms and conditions in this regard:

CONSORTIUM AGREEMENT

NOW THEREFORE THIS AGREEMENT WITNESSETH AS FOLLOWS :

1. First and Second parties hereby constitute themselves into a Consortium for the purpose of bidding and undertaking the said works by the first party under the support and supervision of second party pursuant to the said NIT as hereinafter stated.
2. The First Party will be the Prime bidder (Lead Partner) and will be responsible for the entire works and Second Party shall be Back-up Guarantor.
3. The First Party shall undertake the entire scope of work detailed in the NIT namely _____
4. The Second Party shall undertake/guarantee to provide technical support and supervision to first party to carry out entire scope of work.
5. The parties hereby declare and confirm that each of them will fulfill the required minimum qualifying requirements as prescribed in the said NIT.
6. It is also agreed between the parties hereto that all of them shall be individually and severally responsible for the completion of the said works as per the schedule. Further, if the Employer/Owner sustains any loss or damage on account of any breach of the Contracts, we the, Consortium partners individually and severally undertake to promptly indemnify and pay such losses / damages caused to the Employer/Owner on its written demand without any demur, reservation, contest or protest in any manner whatsoever.
7. The parties hereby agree and undertake that they shall provide adequate finances, suitable Tools, Plants, Tractors, Trailers, other transportation equipment, other Tools & Plants, Measuring & Monitoring Equipments (MMEs), Men and Machinery etc. for the proper and effective execution of the works to be undertaken by them as specified here-in-above.
8. It is agreed interse between the parties hereto that all the consequences liabilities etc., arising out of any default in the due execution of the said works shall be borne by the party in default, that is by party in whose area of works default has occurred, provided however, so far as M/s Bharat Heavy Electricals Limited is concerned, all the parties shall be liable jointly and severally.

IN WITNESS HEREOF the parties above named have signed this agreement on the day month and year first above written at _____(Place) .

CONSORTIUM AGREEMENT

WITNESS

For

1. NAME
2. OFFICIAL ADDRESS

(FIRST PARTY)

WITNESS

For

1. NAME
2. OFFICIAL ADDRESS

(SECOND PARTY)

[The successful bidder shall have to execute the " JOINT DEED OF UNDERTAKING " in the format to be made available by BHEL at the time of awarding].

REFUND OF SECURITY DEPOSIT-----
To,The Construction Manager
BHEL Site Office

Dear Sir,

Sub : **Refund of Security Deposit**

Ref : Contract No:,

Work:.....

I/We have submitted Final Bill in respect of the above Contract/Work vide our letter no:..... dated In line with Tender conditions (GCC clause no 1.11), kindly arrange to release/refund the Security Deposit along with Final Bill payments.

The details of Security Deposit are as below:

1. Cash Portion :
2. BG Portion :

Thanking You

Date: _____

Authorised representative of Contractor
=====**To be filled up by BHEL**

1. Security Deposit to be refunded:
 - a. Cash Portion:
 - b. BG Portion :
2. Less
 - a. Amount spent by BHEL on behalf of Contractor:
 - b. Payments made by BHEL on behalf of Contractor:
 - c. Other recoveries for Services etc
 - d. Any other recoveries
 - e. Total of 'a' to 'd':
3. Net Amount to be released (1-2) :
4. Certified that
 - a. The payment recommended for release is in order and there are no demands other than those included in the claim outstanding from the Contractor
 - b. Contract Guarantee period of Months commenced wef : _____
 - c. All objections raised so far have been settled
 - d. A note for refund of Security Deposit has been made in the Measurement Book

Signature of BHEL Engineer

Construction Manager

Date:-----

REFUND OF GUARANTEE MONEY**BHARAT HEAVY ELECTRICALS LIMITED
PE&SD, HYDERABAD.**

Ref No:

Date:

1. Name and Address of Contractor :
2. Contract Agreement/LOI No :
3. Date of Contract Agreement/LOI :
4. Name of the Work undertaken :
5. Date of commencement of the Work :
6. Date of Completion of the Work :
7. Period of Maintenance :
(Guarantee Period)
8. Date on which the Final Bill was paid :
9. Last date of making good the defect :
during Maintenance Period
10. Expenditure incurred by BHEL during :
Maintenance Period, if any, recoverable
11. Date on which Guarantee Money refund:
falls due as per Contract
12. Amount of Guarantee Money to be refunded:
13. Less Amounts recoverable (with details)
 - a. Amount spent by BHEL on maintenance :
 - b. Payments made by BHEL on behalf of Contractor:
 - c. Court dues/penalties/compensation :
 - d. Other recoveries for Services, etc :
 - e. Total of 'a' to 'd' :
14. Net Amount recommended for release (12-13) :

Signature of BHEL Engineer

Date: _____

REFUND OF GUARANTEE MONEY

**BHARAT HEAVY ELECTRICALS LIMITED
PE&SD, HYDERABAD.**

CERTIFICATE TO BE FURNISHED BY THE CONTRACTOR

I/We have no claim or demand outstanding against BHEL _____, for the work done or for labour or material supplied or any other account arising out of or connected with the Contract Agreement/LOI (No _____ dated _____) and the payment of this bill shall be in full and final settlement of all my/our claims and demands including the 'Deposits' of the Contract Agreement/LOI referred to.

Signature of Contractor

Date:

CERTIFICATE TO BE FURNISHED BY SENIOR ENGINEER/CONSTRUCTION MANAGER

1. Certified that
 - a. The payment recommended for release is in order and there are no demands other than those included in the claim outstanding from the Contractor
 - b. Maintenance period (Contract Guarantee period) is over and the Contractor has carried out the works required to be carried out by him during the period of maintenance (Guarantee) to our satisfaction, and all expenses incurred by the Company on carrying out such works have been included for adjustment
 - c. All objections raised so far have been settled
 - d. A note for refund of Guarantee Amount has been made in the Measurement Book and Contract Agreement/Work Order

Signature of BHEL Engineer

Construction Manager

Date:-----

FOR USE IN ACCOUNTS DEPARTMENT

Passed for Rs _____ (Rupees _____ only)

Accountant

Accounts Officer

ACKNOWLEDGE BY THE CONTRACTOR

Received Rs _____ in full and final settlement of my/our claim

Signature of Contractor

Date:

POWER OF ATTORNEY for SUBMISSION OF TENDER/SIGNING CONTRACT AGREEMENT

(To be typed on non judicial Stamp Papers of appropriate value as applicable and Notarised)

KNOW ALL MEN BY THESE PRESENTS, that I/We do hereby make, nominate, constitute and appoint Mr , whose signature given below herewith to be true and lawful Attorney of M/s..... hereinafter called 'Company', for submitting Tender/entering into Contract and inter alia, sign, execute all papers and to do necessary lawful acts on behalf of Company with Bharat Heavy Electricals Limited, PE&SD, Ramachandrapuram , Hyderabad-502 032 in connection with

..... vide Tender Specification No : _____,
dated _____.

And the Company do hereby agree to ratify and confirm all acts, deeds, things or proceedings as may be lawfully done by the said attorney and by or on behalf of the company and in the name of the company, by virtue of the powers conferred herein and the same shall be binding on the company and shall have full force and effect.

IN WITNESS WHEREOF the common seal of the company has been hereunto affixed in the manner hereinafter appearing on the document.

Dated at _____, this _____ day of _____

Director/CMD/Partner/Proprietor

Signature of Mr.....(Attorney)

Attested by: Director/CMD/Partner/Proprietor

Witness

Notary Public

ANALYSIS OF UNIT RATES QUOTED

(To be typed and submitted in the Letter Head of the Company/Firm of Bidder)

Offer Reference No:.....

Date:.....

To,

(Write Name & Address of Officer of BHEL inviting the Tender)

Dear Sir,

Sub : Analysis of Unit Rates Quoted

Ref : Tender Specification No:

Analysis of Unit Rates quoted by us in respect of above Tender is as detailed

SN	DESCRIPTION	% OF QUOTED RATE	REMARKS
01	SITE FACILITIES VIZ., ELECTRICITY, WATER OTHER INFRASTRUCTURE.		
02	SALARY AND WAGES + RETRENCHMENT BENEFITS		
03	CONSUMABLES		
04	T&P DEPRECIATION & MAINTENANCE		
05	ESTABLISHMENT & ADMINISTRATIVE EXPENSES		
06	OVERHEADS		
07	PROFIT		
	TOTAL	100%	

Yours faithfully,

(Signature, Date & Seal of Authorized Representative of the Bidder)

BHARAT HEAVY ELECTRICALS LIMITED

DIVISION.....

Running Account Bill

(Para 4.31.1 of Works Accounts Manual)

Name of the Contractor:

Name of the Work:

Sanctioned Estimate:

Code No:

Contract Agreement No :

Dated:

Departmental Bill no:

Division:

Date of written order to commence the work :

Date of commencement of the Work:

Due date of completion as per Agreement:

Date:

Sub-Division:

1. ACCOUNT OF WORK EXECUTED

On account payment for work not previously previously measured**			Item No of	Description of Work	Quantity as per agree- ment	Quantity executed up to date	Rate	Unit	Payment on the basis of actual measure- ment up to date	Quantity since last running account bill	Payment on the basis of actual measurement since last running account bill	Remarks
Total	since last	Total										
As per	running	up to										
Running	account	date										
Account	bill											
bill												
Rs.	Rs.	Rs.					Rs.	P.	Rs.	P.	Rs.	P.
1	2	3	4	5	6	7	8	9	10	11	12	13

* *1. Whenever payment is made on 'on account' basis without actual measurements the amount in whole rupees should be entered in columns 1 to 3 only and not in columns 7 to 12.

2. whenever there is an entry in column 12 on the basis of actual measurement, the whole of the amount previously paid without detailed measurement should be adjusted by a minus entry in column 2 equivalent to the amount shown in column 1, so that the total up to date in column 4 may become nil.

Form WAM 6 (contd...)

1	2	3	4	5	6	7	8	9	10	11	12	13

Total value of work done up to date (A) ...

Deduct value of work shown on the last
Running Account Bill (B) ...

Net value of work done since last (C) ...

Rupees (in words) only.

II.MEMORANDUM OF PAYMENTS

		I		II	
		Rs.	P.	Rs.	P.
1. Total value of work actually measured as per Account No. I. Column 10	(A)	.....		.....	
2. Total up to date 'on account' payment for work covered by approximate Or plan measurements as per Account No. I, Column 3	(B)	.....		.....	
3. Total up to date secured advances on security of materials as per column 8 Of the enclosed Account (Form WAM 10)	(C)	.....		.....	
4. Total up to date payments [(A) + (B) + (C)]	(D)	.....		.....	
5. Total amount of payments already made as per Entry (D) of last Running Account Bill No..... Dated.....forwarded to the Accounts Office on	(E)				
6. Balance [(D)-(E)]		.....			
7. Payments now to be made:					
a) by cash/cheque			.....		
b) by deduction for value of materials supplied			.....		
c) by BHEL vide Annexure A attached			.....		
d) by deduction for hire of tools and plant vide Annexure B attached			.....		
e) by deduction for other charges vide Annexure C Attached			.....		
f) by deduction on account of security deposit			.....		
h) by deduction on account of Income Tax			.....		.....

Note: Amounts relating to items 4 to 6 above should be entered in column II and those relating to item 7 in column I. The amount shown against item 6 and the total of item 7 should agree with each other.

III.CERTIFICATE OF THE ENGINEER IN CHARGE

Form WAM 6 (contd...)

1. The measurements on which the entries in column 7 to 12 of Part I of this Bill (Account of work executed) are based were made by.....and are recorded at pages.....of

(Name and Designation)

Measurement Book No

2. Certified that the methods of measurement are correct and the work has been carried out in accordance with the terms and conditions, schedules, specifications and drawings etc, forming part of the contract agreement, subject to deviations included in the deviation statement (Annexure D).
3. Certified that in addition to and quite apart from the quantities of work actually executed as shown in column 10 of Part I, some work has actually been done in connection with several items and the value of the such work is, in no case, less than 'on account' payments as per column 3 of Part I, made or proposed to be made, for the convenience of the contractor in anticipation of, and subject to the results of, detailed measurement which will be made as soon as possible.

Signature of Contractor

Date:

Signature of Engineer in charge

Designation:

Date:

IV. CERTIFICATE OF THE SENIOR ENGINEER

1. Certified that measurements have been check measured to the prescribed extent by at site and also by the undersigned and the relevant entries have been intialled in the Measurement book. (vide pages.....)

(Name and Designation)

2. Certified that all the measurements recorded in the measurement book have been correctly billed for
3. Certified that all recoberable amounts in respect of materials tools and plant etc, and other charges have been correctly made vide

Annexures A to C attached.

Certified for payment * of Rs.....(Rupees.....only)

To be paid in cash/by cheque in the presence of

ALLOCATION

The expenditure is chargeable as under and to be included in the accounts for.....20.....

Ledger Head

Debit (Gross amount)

Credit (Deductions)

Rs. P.

Rs. P.

Total

* Here specify the net amount payable.

Signature of Senior Engineer

Date:

V.ENTRIES TO BE MADE IN THE ACCOUNTS OFFICE

Accounts Bill No Dated.....
 Entered in Journal Book vide entry No.....Dated.....
 Passed for.....Rs.....
 Less Deductions.....Rs.....
 Net Amount Payable.....Rs.....
 (Rupees.....only)
 Payable to Shri/M/s.....by cheque/cash
 Entered in Contractor's Ledger No.....Page.....

ALLOCATION				
Estimate No:			Code no:	
Name of the Work:				
Ledger Head	Debit		Credit	
	(Gross amount)		(Deductions)	
	Rs.	P.	Rs.	P.
-----	-----	-----	-----	-----
	-----	-----	-----	-----
Total	-----	-----	-----	-----

Assistant Accountant Account Officer
 Date: Date: Date:

VI. Received Rs.....(Rupees.....only) as per
 Memorandum of Payments on account of this work.

Signature of witness
 Address :

Date:

Revenue
 Stamp
 Signature of Contractor
 Date:

VII. ENTRIES TO BE MADE BY TREASURY SECTION

Cash Book entry No. and date:

Amount paid Rs.....
 Amount unpaid Rs.....
 Total Rs.....

Signature of Cashier
 Date:

ANNEXURE A

Statement showing details of materials issued to the contractor Shri/M/s.....

In respect of Contract Agreement No Dated.....

Sl. No.	Stores issue Voucher No. and date	Issue voucher No. and date allotted by stores to the SIV	Description of material issued to the contractor	Quantity issued	Quantity actually incorporated in the work	Whether recoverable from the contractor or supplied free	If recoverable from the contractor				R E M A R K S
							Rate at which recoverable	Amount recoverable	Amount recovered up to previous bill	Balance now recovered	
							Rs. P.	Rs. P.	Rs. P.	Rs. P.	
1	2	3	4	5	6	7	8	9	10	11	12

Total

Signature of contractor
Date:Signature of Engineer in Charge
Date:Signature of Senior Engineer
Date:

ANNEXURE B

Statement showing tools and plant issued to the contractor Shri/M/s.....

In respect of Contract Agreement No Dated.....

Sl. No	Description of tools and plant issued	Period for which Issued	Rate at which recovery Is to be Made		Amount recover- able		Amount recovered upto previous bill		Balance now recovered		Remarks
			Rs.	P.	Rs.	P.	Rs.	P.	Rs.	P.	
1	2	3	4	5	6	7	8	9	10	11	12

Total

Signature of contractor

Date:

Signature of Engineer in Charge

Date:

Signature of Senior Engineer

Date:

ANNEXURE C

Statement showing details of other recoveries to be made from the contractor Shri/M/s.....
 In respect of Contract Agreement No Dated.....

Sl. No	Particulars	Unit	Quantity	Rate	Amount recover-able	Amount recovered upto pre-vious bill	Amount now recovered	Remarks
				Rs. P.	Rs. P.	Rs. P.	Rs. P.	
1	2	3	4	5	6	7	8	9
1.			Water Charges					
2.			Electricity charges					
3.			Seignorage charges					
4.			Medical charges					
5.			Cost of empty gunny bags and					
	Empty containers not returned							
6.								
7.								
8.								
9.								
10.								
				Total	-----			
Signature of contractor			Signature of Engineer in Charge			Signature of Senior Engineer		
Date:			Date:			Date:		

ANNEXURE D

Name of the Contractor:

Contract Agreement No:

Name of the Work:

Date:

Sl. No.	Description of item	Unit	Quantity as per Agreement	Quantity as executed	Quantity further anticipated	Total quantity anticipated on completion	Rate as per agreement Rs. P.
1	2	3	4	5	6	7	8

Rate as executed	Amount as per agreement	Amount as executed	Amount further anticipated	Total amount anticipated on completion	Difference				Reason for the deviation with authority, if any
Rs. P.	Rs. P.	Rs. P.	Rs. P.	Rs. P.	Excess Rs. P.	savings Rs. P.			
9	10	11	12	13	14	15			16

Signature of Engineer in Charge

Date:

Signature of Senior Engineer

Date:

QUESTIONNAIRE TO BE ANSWERED BY ENGINEER IN CHARGE AND SENIOR ENGINEER	
(Correct particulars and answers to be recorded)	
Name of the work :	
Name of the Contractor :	
Date of commencement of the work:	
Contract agreement/work ordered no. and date:	
Reference to supplementary agreement no,if any :	
Whether administrative approval and technical sanction has been accorded by the competent authority ? If so ,cite reference	
Whether sanction of the competent authority and financial concurrence of the Accounts Department for award of the work has been accorded ? If so,cite reference.	
Whether the work has been completed in time ? If not ,whether penalty has been levied or sanction of the competent authority for extension of time granted and communicated to the Accounts Department with reasons for grant of extension? (Due and actual date of completion of the work and reference to letter no. and date granting the extension of time should be given)	
(a) Whether the rates allowed in the bill have been checked with the contract agreement ? (b) Whether the rates for extra/supplemental items have been approved by the competent authority and the sanction communicated to the accounts Department together with rate analysis? If so,cite reference.	
Whether deviations have been approved by the competent authority? If yes, give reference to the approval; if not, give reasons.	
Whether the rates of recovery of stores issued to the contractor which are not provided for in the Contract Agreement have been settled in consultation with Finance?	
Whether discrepancies pointed out by the Accounts Department in the store statement have been reconciled and accepted by the Accounts Department?	

QUESTIONNAIRE TO BE ANSWERED BY ENGINEER IN CHARGE AND SENIOR ENGINEER	
(Correct particulars and answers to be recorded)	
Whether materials issued to the contractor in excess of the theoretical requirements have been returned to the Stores Department and the no. and date of such returned stores vouchers have been shown in stores statement? If not, whether the cost of such excess material has been recovered at the prescribed rate? Whether consumption statements in respect of materials chargeable to the work have been attached to the bill?	
Whether consumption of materials shown has been technically checked by Senior Engineer?	
Whether materials issued and used in the work is not less than that required for consumption in work according to our specification? If consumption is less, whether necessary recovery has been made in the bill?	
Whether measurements have been checked by the Engineer and Sr. Engineer to the extent required and certificates of check recorded in the measurement books?	
Whether contractor has signed the bill and the measurement books without reservations? If not; whether reasons have been intimated to the Accounts Department?	
Whether arithmetical calculations have been checked and certificate recorded in the measurement books by a person other than the one who calculated initially	
Whether any work was done at the risk and cost of the contractor and whether such cost has been recovered from him? Give particulars.	
Whether all advance payments on running Accounts have been recovered?	
Whether all the recoveries due to services given to the contractor like rent of accommodation, water charges, electricity charges etc. have been recovered and whether payments made by the company on behalf of the contractor have been adjusted?	
Whether the files containing abstracts from measurement books/ standard measurement books have been completed/ updated?	
Whether hire charges of tools and plant have been recovered and the statement of hire charges with full details attached?	

QUESTIONNAIRE TO BE ANSWERED BY ENGINEER IN CHARGE AND SENIOR ENGINEER	
(Correct particulars and answers to be recorded)	
Whether the certificate of workmanship and completion of work according to specifications, drawings etc. is recorded by Engineer/ Sr. Engineer and whether recoveries have been made for defective works, if any?	
Whether all corrections in the bill/measurement books etc. have been neatly made and attested and there are no overwriting?	
Whether final measurements have been taken as soon as possible after completion of work and the certificate of completion issued? If not, whether reasons for delay have been recorded and communicated to Accounts?	
In respect of Quantities reduced in the final bill as compared to the running payment, whether adequate reasons have been recorded and communicated to Accounts?	
Whether the Expenditure has been classified correctly according to heads of Account recorded in the sanctioned estimate?	
Whether the work has been completed within the estimated cost? If not, what is the percentage of excess over the sanctioned estimate/ administrative approval? In case the excess is beyond the competency of Sr. Engineer, what action has been taken for the obtaining the approval of the authority competent to sanction the excess?	
(a) If the contractor has furnished bank guarantee in lieu of cash security deposit towards proper execution of works and guarantee against defects during the maintenance period, whether the period of currency of the bank guarantee covers the entire maintenance period? (b) If not, whether security deposit has been proposed to be recovered from the final bill?	
Whether all the previous audit objections raised on running Account bills have been settled? If so, cite reference.	
Signature of Engineer in Charge	Signature of Engineer in Charge
Date:	Date:

BHARAT HEAVY ELECTRICALS LIMITED DIVISION..... And Final bill (Para 4.3.2 Of Works Accounts Manual)												
Name of Contractor						Departmental Bill no				Date		
Name of the Work						Division				Division		
Sanctioned Estimate						Date of written order to commence the work						
Contract Agreement/work Order No						Date of commencement of work						
						Due date of completion as per agreement						
						Date of actual completion of the work						
I. ACCOUNT OF WORK EXECUTED												
On Account payment for the work not previously measured **			Item No of the agreement/work order	Descripti on of work	Quantity as per agreement	Quantity executed up to date	Rate Rs. P	Unit	Payment on the basis of actual measurement up to date Rs P	Quantity since last running account bill	Payment on the basis of actual measurement since last running account bill Rs P	Remarks
Total as per last running account bill Rs.	Since last running account bill Rs	Total up to date Rs										
1	2	3	4	5	6	7	8	9	10	11	12	13

1	2	3	4	5	6	7	8	9	10	11	12	13

Total Value of Work Done up to date	(A)	
Deduct Value of work shown on the last running account bill	(B)	
Net value of work done since last running account bill	(C)	

Rupees (In Words).....Only

II MEMORANDUM OF PAYMENT

		Rs.	P
1	Total Value of work actually measured as per Account no I coloumn 10	(A)	
	Deduct amount of paym,ents already made as per last running account bill No Dated.....		
2	Forwarded to the Accounts Office on	(B)	
3	Payments now to be made { (A) - (B)}	(C)	
4	Deduct ammounts recoverable from the contractor on account of :	Rs	P
	a Material suplied by BHEL vide annexure A attached		
	b Hire of Tools & Plants vide Annexure B attached		
	c Other charges vide Annexure C attached		
	d Income Tax		
	Total deduction		
5	Balance		
6	Refund of 50% of security deposite on completion of work		
7	Net amount to be paid to the Contractor		

III. CERTIFICATE OF THE ENGINEER IN CHARGE

The measurement on which the entries in coulmns 7 to 12 of Part I of this bill (Account of work executed) are based were made by

- 1 (Name and designation)
- 2 A statement showing the quantities of stores issued to the contractor (whether free or on recovery basis) and their disposal is attached.

Date:

Signature of Engineer in charge
Designation

IV CERTIFICATE OF THE SENIOR ENGINEER

1 Certified that I have personally inspected the work and that the work has been physically completed on the due date in accordance with the terms and
Cretified that the measurements have been check measured to the prescribed extent by
..... (Name & designation). And by the the undersigned at site and relevent entries have been initiated in the measurement book
2 (vide pages.....)

3 Certified that the methods of measurement are correct

4 Certified that the measurements have been technically checked with reference to contract drawings, deviations etc

5 Certified that all the measurements recorded in the measurement book have been correctly billed for at the contract rates or approved rates.

6 Certified that all the recoverable amounts in respect of stores, tools and pallant, elwater, electricity charges etc, have been correctly made vide Annexures A

7 Certified that the issues of all stores as per statement atytached (whether charged to the contractor or direct to the work) have been technically checked and

Certified for payment of * Rs (Rupees..... (Only). To be paid in
cash/by cheque in the presence of

ALLOCATION

The expenditure as under and to be included in the accounts for 19

Ledger Head	Debit		Credit	
	(Gross Amount)		(Deduction)	
	Rs.	P	Rs.	P
.....				
Total				

* Here specify the net amount payable

Signature of Senior Engineer
Date

V. ENTRIES TO BE MADE IN THE ACCOUNTS OFFICE

Account Bill no..... Dated
 Entered in Journal book vide entry No.....Dated.....
 Passed for.....Rs.....
 Less Deductions.....Rs.....
 (Rupees.....Only)
 Payable to Shri/M/s..... by cheque/cash
 Entered in contractors' Ledger no..... Page

ALLOCATION
 Estimate No: Code No
 Name of the Work

Ledger Head	Debit (Gross Amount) Rs P	Credit (Deduction) Rs
.....		
Total		

Assistant Accountant Accounts officer
 Date: Date: Date:

VI. Received Rs.....(Rupees.....Only) in full and final settlement of all moneys due under this contract and I / we have no further claims of this contract.

Signature of Witness
 Address

Revenue Stamp
 Signature of Contractor
 Date:

VII . ENTRIES TO BE MADE BY TREASURY SECTION

Cash book entry no and date :

Amount Paid Rs.....
 Amount unpaid Rs.....
 Total Rs.....

Signature of Cashier
 Date:

ANNEXURE A

Part I

Statement showing details of material issued to the contractor Shri/M/s..... In respect of Contract

Agreement/Work Order No..... Dated

SI No	Stores Issue voucher No and date	Issue voucher No and date alloted by stores to the SIV	description of material issued to the contractor	Quantity issued	Quantity actually incorporated in the work	Whether recoverabl e from the contractor or supplied free	Rate at		Amount		Amount		Balance		Remarks
							Rs	P	Rs	P	Rs	P	Rs	P	
1	2	3	4	5	6	7	8		9		10		11		12

Total

Signature of Contractor
Date

Signature of Engineer in charge
Date

Signature of Senior Engineer
Date

ANNEXURE A
Part II

Statement showing details of material issued to the contractor Shri/M/s..... in respect of Contract Agreement/Work Order No..... Dated and not covered by the agreement

SI No	Stores Issue voucher No and date	Issue voucher No and date alloted by stores to the SIV	description of material issued to the contractor	Quantity issued	Quantity actually incorporated in the work	Issue Rate		Amount Recoverabl e		Amount recoverable upto previous bill		Balance Now recovered		Remarks
						Rs	P	Rs	P	Rs	P	Rs	P	
1	2	3	4	5	6	7		8		9		10		11

Total

Add Departmental Charges

Add Sales Tax (wherever applicable)

Total

Signature of Contractor
Date

Signature of Engineer in charge
Date

Signature of Senior Engineer
Date

ANNEXURE B

Statement showing TOOLS & PLANTS issued to the contractor Shri/M/s..... in respect of Contract Agreement/Work Order No..... Dated and not covered by the agreement

Sl No 1	Description of tools & plants issued 2	Period for which issued 3	Rate at which Recovery is to be made 4	Amount recoverabl e Rs P 5		Amount recoverable upto previous bill Rs P 6		Balance Now recovered Rs P 7		Remarks 8

Total

Signature of Contractor
Date

Signature of Engineer in charge
Date

Signature of Senior Engineer
Date

ANNEXURE C

Showing detail of other recoveries to be made from the contractor Shri/M/s.....
 Client/Work Order No.....Dated.....

Sr.No	Particulars	Unit	Quantity	Rate Rs. P.	Amount recoverable Rs. P	Amount recovered upto previous bill Rs. P.	Amount now recovered Rs. P.	Remarks
1	2	3	4	5	6	7	8	9
	1 Water Charges							
	2 Electricity Charges							
	3 Seignorage Charges							
	4 Medical Charges							
	Cost of empty gunny bags and empty containers not 5 returned							
	6							
	7							
	8							
	9							
	10							
Total								

Signature of Contractor
Date

Signature of Engineer Incharge
Date

Signature of Sr. Engineer
Date

ANNEXURE F

Statement showing detail of materials issued to the contractor Shri/M/s.....

of Contract Agreement/Work Order No.....Dated.....

Name of work; FREE OF COST											
Sr.No	Stores issue voucher No.	Description of ma	Unit	Quantit y issued	Quantity required as per data	Quantity consume d in the work	Balance(If any)	Nature of disposal for the balance	Rate chargeable for material not returned Rs.P.	Amount recovera ble for material not returned Rs. P	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
Total											
Signature of Contractor Date				Signature of Engineer Incharge Date				Signature of Sr. Engineer Date			
Note:Data statement of therotical consumption should be attached in support of the quantity specified in coloumn 6											