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

NO: BHE/PW/PUR/WNT2-CVL PKG-1 (Leveling & Grading)/1331

Complete Leveling, grading, Land development, & Slope Protection including Excavation, Backfilling, filling with burrowed soil, disposal of unserviceable earth and all associated works, complete as per specification of entire Plant Area.

AT

WTPS 1X800MW UNIT-8WANAKBORI, GUJRAT

VOLUME-I-E

TENDER SPECIFICATIONS CONSISTS OF:

- **Notice Inviting Tender**
- **Volume 1 A - Technical Conditions of Contract,**
- **Volume 1 B - Special conditions of Contract,**
- **Volume 1 C - General conditions of Contract**
- **Volume 1 D - Forms & Procedures**

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

VOLUME: II B

SECTION – C

SPECIFIC TECHNICAL REQUIREMENTS

SITE LEVELLING AND GRADING

SPECIFICATION NO: PE-TS-J57-600-C003

Bharat Heavy Electricals Limited
Power Sector - Project Engineering Management
PPEI Building, Plot No. 25
Sector – 16A, NOIDA (U.P.) - 201301

SPECIFIC REQUIREMENTS

Section-C covers specific technical requirements of the contract and shall be read in conjunction with BOQ, Section-D and other sections of the contract. In case of any conflict between the contents of BOQ and Section-C, BOQ will prevail over Section-C. In case of any conflict between Section-C and Section-D, Section-C will prevail over Section-D.

PART-B

TECHNICAL SPECIFICATION
FOR
III) AREA GRADING AND SLOPE PROTECTION

CONTENTS

SECTION-II

TECHNICAL SPECIFICATION FOR A) AREA GRADING AND SLOPE PROTECTION

1.00.00 SCOPE

This specification shall govern all clearing, grubbing, excavating, area filling, grading and compacting soils for areas designated on the drawings. The work shall include clearing and grubbing, stripping and storage of top soil, excavation, blasting (if required), hauling, dumping and spreading of soil, undercutting to remove unstable soil areas, compacting existing soil surfaces and bottom of excavated areas to receive fills, compacting excavated areas for subgrade, placing and compacting soils in fills, dealing with surface water, pumping to keep excavated areas and areas to be filled dry, final grading of designated areas, disposing of unsuitable and excess excavated materials and incidentals thereof. For hauling of earth from approved borrow areas to site, agency shall get timely approval from all statutory authorities for right of way. GSECL will give recommendation letter to obtain the permission from appropriate authority for excavation from borrow area.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Contractor

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

a) Furnish all labour, supervision, services, earth-moving machineries and equipment, compaction plant and equipment, tools and plants, survey instruments, transportation etc. required for the work.

b) Prepare and submit working drawings showing the approaches, slopes, berms, sumps for dewatering, space for temporary stacking of spoils, disposal area, borrow pits, fencing, slope protection work etc. and all other details as may be required by the Engineer.

c) To carry out and submit to the Engineer, results of soil compaction tests whenever required by the Engineer to assess the degree of compaction.

d) If blasting is resorted to, necessary licenses to be procured from the proper authorities.

2.02.00 Work to be 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.

However, the Owner reserves the right to award the whole work to one Contractor or to split up the work for awarding to two or more Contractors.

2.03.00 **Codes and Standards**

All work under this specification, unless specified otherwise, shall conform to the latest revision and/or replacements of the following or any other relevant Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not covered specifically by Indian Standard Specification any other standard practice as may be specified by the Engineer shall be followed :

IS : 1200	:	Method of Measurement of Building and Civil Engineering work, Part-I Earthwork
IS : 2720 (Part-II)	:	Determination of Moisture Content
IS : 2720 (Part-IV)	:	Grain Size Analysis
IS : 2720 (Part-VII)	:	Determination of Moisture Content/Dry Relation using Light compaction
IS : 2720 (Part-VIII)	:	Determination of Moisture Content/Dry Relation using Heavy Compaction
IS : 2720 (Part-XIV)	:	Determination of Density Index (Relative Density) of cohesion less soils
IS : 2720 (Part-XXIV)	:	Determination of Dry Density, in place, by core cutter method
IS : 2720 (Part-XXVIII)	:	Determination of Dry Density of Soils, in place, by sand replacement methods
IS : 3764	:	Safety Code for Excavation Work
IS : 4081	:	Blasting and related drilling operations
IRC : SP-11	:	Hand book of quality control for construction of roads and runways
IRC : 36	:	Construction of Earth Embankments for Road Work.

2.04.00 **Conformity with Designs**

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

2.05.00 **Materials to be used**

2.05.01 General

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

2.05.02 Borrow Material

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

When specific borrow area can not be designated by the Engineer, necessary arrangement shall be done by the Contractor at his own cost for locating and using the borrow areas as the source of supply of filling material.

The depth of borrow pits should be so regulated that the borrow pits do not cut an imaginary line having a slope of 1 vertical in 4 horizontal projected from the edge of final section of the adjacent embankment of stack of excavated soil.

2.06.00 **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.

iii) Checking levels and slopes of the graded surface.

b) Area filling :

i) Checking the quality of fill material

ii) Checking moisture content of the fill

iii) Checking the degree of compaction.

2.06.01 Any work which fails to conform to the specifications will be subject to the issue of a Non-conformance Report in line with the Quality Control Procedure to be implemented at site. Corrective or remedial action, design modifications or product rejection will be reviewed in accordance with the site Quality Plan.

2.07.00 **Information regarding Site Conditions**

Boring and sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawings or otherwise furnished to the Contractor shall be taken as a guidance only and variation therefrom shall not affect the terms of the Contract. The Contractor must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and/or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction likely to come up during the execution of the Contract so that he may evolve a realistic programme of execution.

3.00.00 **EXECUTION**

3.01.00 **General**

The work shall be undertaken in accordance with the lines, levels, grades and details shown on the drawings, specification and the approved method of work.

The works shall be carried out in a workman like manner without endangering the safety of nearby structures, roads, railway tracks, cable, pipelines, etc. and without causing hindrance to construction activities.

Suitable approaches, fencing, area lighting and temporary works required for the works shall be provided by the contractor. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as the bottom of the fill at the surplus disposal area where damping from a high bench is in progress, if directed by the Engineer. Adequate area lighting shall be provided by the contractor, if night work is undertaken.

The Contractor shall submit a proposal covering the proposed excavation and placement of fill material for approval of the Engineer. The proposal shall include but not be limited to the following:

a) Mobilisation and demobilisation of plant

b) Proposed plant and equipment, labour resources & supervision.

c) Details of proposed method of clearing and grubbing for each area of cut and fill.

d) Drawings showing the areas for placement of material.

e) Management of excavation and filling works i.e., control of setting out, testing procedures, handling, temporary stockpiles, etc.

f) Temporary works proposals

g) Excavation, filling and compaction by mechanical plant

h) Dealing with surface water

i) Dewatering

j) Disposal of materials

k) Safety precautions, fencing and lighting

l) Calculations as appropriate to support work proposal.

3.02.00 **Setting Out**

Within 15 days of award of Contract, the Contractor will prepare and submit to the Engineer, detailed drawings of the excavation and filling work necessary, as proposed to be executed by him, showing the dimensions as per drawings and specification, adding his proposals for slopes, approaches, dewatering sumps, berms etc. On receiving the approval from the Engineer with modifications and corrections if necessary, the Contractor will set out the work from the control points furnished by the Engineer and fix permanent points and markers for future checking. These permanent points and markers will be checked by the Engineer and certified by him after which the Contractor will proceed with the work. Engineer shall be provided with necessary men, material and instruments for such checking. It should be noted that this checking by the Engineer prior to start of the work will in no way absolve the Contractor of his responsibility of carrying out the work to true lines, levels and grades as per drawing and subsequent corrections, if any. In case any errors are noticed in the Contractor's work at any stage, the same shall be remedied by the Contractor at his own cost.

3.03.00 **Initial Levels**

Initial levels 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 levels will be used for preparing cross-sections for volume measurement or for cross-checking the depths obtained from tape measurements. These initial levels and cross-sections shall be jointly signed by the Contractor and the Engineer before commencement of work and they shall form the basis of all payment in future.

3.04.00 **Clearing and Grubbing etc.**

The area to be excavated or filled shall be cleared out of fences, trees, logs, stumps, bush, vegetation, rubbish, slush, etc. and leveled up. Trees upto 300 mm girth shall be uprooted. Trees of all sizes are required to be cut and transported to owner’s store. Also all serviceable materials to be credited at owner’s store. Trees above 300mm girth which are required to be cut, shall be got identified by the Engineer and then marked.

Felling of trees shall include taking out roots upto 600 mm below ground level. After the tree is cut and roots taken out, the pot-holes formed shall be filled with good earth in 250 mm layers and compacted to acceptable degree unless directed by the Engineer otherwise. The trees shall be cut in suitable pieces as instructed by the Engineer and then shall be transported to the Owner's store or any other space as directed by the Engineer.

Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be burnt or removed from the site to approved disposal areas as may be specified. Ash shall be spread or removed as directed by the Engineer. 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.

3.05.00 **Classification**

Materials involved in earthwork shall be classified under the following categories. No distinction will be made whether the material is dry or wet. The Engineer's decision in regard to such classification shall be final and binding on the Contractor :

a) Ordinary and hard soil

This shall include clay, silt, sand, moorum, shingle, kankar, gravel, loam, peat, ash and other similar materials in soft, hard or dense state which can generally be excavated with ordinary spade, pick axe, shovel etc. and does not require the use of wedges, pneumatic breaking equipment and/or blasting for removal. It shall also include loose rock boulders present in the soil, with dimensions not exceeding 500 mm in any direction. Breaking of consolidated brick ballast and mud concrete shall be considered equivalent to excavation work under this type of soil.

b) Soft and Decomposed Rock

This shall include rocks like chalk, slate, mica schist, laterite and other similar materials which in the opinion of the Engineer is rock, but does not require blasting for removal and could be removed with picks, hammers, crow bars, wedges, pneumatic breaking equipment etc. It shall also include boulders with dimensions greater than 500 mm but not exceeding 1000 mm in any direction.

The mere fact that the contractor resorts to blasting for his own convenience shall not mean that the rock will be classified as hard rock. Excavation in macadam and tarred roads and pathways, brick work etc. shall be considered at the same rate as excavation of this type of soil.

c) Hard Rock

This shall include rocks occurring in large masses which cannot be removed except by blasting. Harder varieties of rock such as trap, with or without veins and secondary mineral which in the opinion of the Engineer require blasting for removal shall also be considered as hard rock. It shall also include boulders bigger than 1000 mm in any direction. Construction in concrete, both reinforced and unreinforced, which is required to be dismantled during earthwork, shall be measured under this item, unless a separate provision is made in the schedule of Quantities for the same.

3.06.00 Earthwork in Excavation

3.06.01 General

Before commencement of excavation the existing ground surface shall be cleared in accordance with Clause no. 3.04.00.

All excavation 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 excavation including dimension, side slopes, dewatering, disposal, etc.

This approval, however, shall not in any way make the Engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner.

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

The rough excavation may be carried upto a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the Engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up as instructed by the Engineer and the Contractor shall be paid for the extra excavation and the filling at the appropriate item rates.

If the excavation is done to a depth greater than that shown on the drawing, or directed by the Engineer, due to the Contractor's fault, the excess depth shall be filled up to the required level at the latter's cost with selected earth and compacted in accordance with the specification as specified in Clause No. 3.07.01.

3.06.02 Excavation in Ordinary Soil, Hard Soil and Soft and Decomposed Rock

The excavation in ordinary soil, hard soil and soft and decomposed rock shall be carried out as per the approved proposal, modified and corrected where necessary by the Engineer. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures or roads, railway tracks, cables, pipelines etc. if any, and without causing hindrance to other activities in the area. As the excavation reaches the required dimensions, lines, levels and grades, the work will be checked by the Engineer thoroughly & the balance 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 case where excavation in soil, soft and decomposed rock and/or hard rock are involved, the soil or soft and decomposed rock layers, shall be removed by turn and levels of the underlying rock surfaces observed to enable measurements. Further work shall be resumed after getting clearance from the Engineer.

3.06.03 Excavation in Hard Rock

Overburden, if any, consisting of top soil, ordinary and hard soil, soft and decomposed rock as per classification of soil, which do not require blasting shall be completely stripped off and the levels of the hard rock surface shall be taken to enable measurement. Further work in hard rock shall be resumed after clearance from the Engineer.

Personnel deployed for rock excavations 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 supports, props, bracings or bulkheads shall be provided and maintained during the period of construction. Where danger exists of loose rock/boulder falling from the excavated surfaces deeper than 2 metres, steel mesh anchored to the lower edge of excavation and extending over and above the rock face, adequate to retain the dislodged material shall be provided and maintained.

In case where blasting, though otherwise required, is prohibited for any reasons, the excavation shall be carried out by chiseling, wedging or any other approved method. All loose or loosened rock in the sides shall be removed by barring, wedging, etc. The unit rate for excavation in hard rock shall include the cost of all these operations.

3.06.04 Blasting

3.06.04.01 General

Excavation shall be continued in hard rock to such widths, lengths, depths and profiles as are shown on the drawings or such other lines and grades as may be specified by the Engineer. As far as possible all blasting shall be completed prior to commencement of construction. At all stages of excavation, precautions shall be taken to preserve the rock below and beyond the lines for the excavation, in the soundest possible condition. The quantity and strength of explosive used, shall be such as will neither damage nor crack the rock outside the limits of excavation. All precautions, as directed by Engineer, shall be taken during the blasting operations and care shall be taken that no damage is caused to adjoining buildings or structure as a result of blasting operations. In case of damage to permanent or temporary structures, Contractor shall repair the same to the satisfaction of Engineer at his cost. As excavation approaches its final lines and levels, the depth of the charge holes and amount of explosives used shall be progressively and suitably reduced.

Unless otherwise stated herein, I.S. Specification IS:4081 "Safety Code for Blasting & Related Drilling Operation" shall be followed.

Specific permission of Engineer will have to be taken by Contractor for blasting rock and he shall also obtain a valid Blasting license from the authorities concerned.

Contractor shall obtain necessary license for storage of explosives, fuses and detonators issued to him from owner's stores or from supplier arranged by him, from the authorities dealing with explosives.

The fees, if any, required for obtaining such license, shall be borne by Contractor. Contractor shall have to make necessary storage facilities for the explosives etc. as per rules of local, State and Central Govt. authorities and statutory bodies / regulations.

In no case shall blasting be allowed closer than 30 metres to any structure or to locations where concrete has just been placed. In the latter case the concrete must be at least 7 days old.

Contractor shall employ a competent experienced supervisor and licensed blaster in-charge of each set of operation, who shall be held personally responsible to ensure that all safety regulations are carried out.

Before any blasting is carried out, Contractor shall intimate Engineer and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.

The blasting of rock near any existing buildings, equipments or any other property shall be done under cover and Contractor has to make all such necessary muffling arrangements. Covering may preferably be done by M.S. plates with adequate dead weight over them. Blasting shall be done with small charges and where directed by Engineer, a trench shall have to be cut by chiseling prior to the blasting operation separating the area under blasting from the existing structures.

When excavation has almost reached the desired level, hand trimming shall have to be done for dressing the surface to the desired level. Any rock excavation beyond an over break limit of 75 mm shall be filled up as instructed by Engineer, with concrete of strength not less than M 10. The cost of filling such excess depth shall be borne by Contractor and the excavation carried out beyond the limit specified above will not be paid for. Stepping in rock excavation shall be done by hand trimming.

Contractor shall be responsible for any accident to workmen, public or Owner's property due to blasting operations. Contractor shall also be responsible for strict observance of rules, laid by Inspector of Explosives, or any other authority duly constituted under the State and/or Union Government.

Storage, handling and use of explosives shall be governed by the current explosive rules laid down by the Central and the State Governments. The Contractor shall ensure that these rules are strictly adhered to. The following instruction, wherever found in 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 nor they shall be allowed to handle the explosives.

3.06.04.02 Material

All materials such as explosives, detonators, fuses tamping materials etc. are proposed to be used in the blasting operations shall have the prior approval of the Engineer.

Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used.

The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for thirty minutes. The rate of burning of the fuse shall be uniform and not less than 4 seconds or inch of length with 10% tolerance on either side.

Before use, the fuse shall be inspected and moist damaged or broken ones discarded. The rate of burning of fuses or when they have been in stock for long shall be tested before use.

The detonators used shall be capable of giving an effective blasting of the explosives, moist; and damaged detonators shall be discarded.

3.06.04.03 Storage of Explosive

Storage of explosives shall be governed by the current Explosive Rules. Explosives shall be stored in a clean, dry, well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400 m 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 clear and free from trees, bushes etc. The admission to this fenced space shall be by one gate only and no person shall be allowed inside this fence without permission of the Officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be perfectly well drained.

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

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

Persons entering the magazine, must put on the magazine shoes which shall be provided at the magazine for this purpose and should be careful :

- Not to put their feet on the clean floor unless they have the magazine shoes on.

- Not to allow the magazine shoes to touch the ground outside the clean floor.

- Not to allow any dirty or grit to fall on the clean floor.

Persons with bare feet, shall before entering the magazine dip their feet in water and then step direct from the tub over the barrier (if there be one) on to the clean floor.

A brush broom shall be kept in the lobby of the magazine for cleaning out the magazine, on each occasion if it is opened for the receipt, delivery or inspection of explosives.

No matches or inflammable materials shall be allowed inside the magazine. Illumination shall be obtained from an electric storage battery lantern. No smoking shall be allowed within 100 m of a magazine.

No person having article of steel or iron on him shall be allowed to enter the magazine.

Oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine.

Workmen shall be examined before they enter the magazine to see that they have none of the prohibited articles on their person.

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 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 keep the floor free from grains of powder or portions of explosive matter fallen on the floors due to leakage of cases etc.

The magazine shall not be opened during any dust storm 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.

3.06.04.04 Carriage of Explosives

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 person 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 effectually covered with lead, leather, wood, cloth or 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.

3.06.04.05 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 never be removed from explosive cartridges. Only wooden rods shall be used for loading and stemming shotholes. 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 300 m 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 an electric detonator attached to its side with adhesive tape, connecting wire or string.

All connections shall be made by the 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.

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 metres radius from the firing point, or as required by statutory regulations, 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 and shall compare the number of blasts planted/fired to the actual number of shorts heard and satisfy himself that all blast have exploded. Withdrawal unexploded charges shall not be permitted. The unexploded charges shall be flooded with water and the hole shall be marked in a distinguishable manner. Another hole shall be made by drilling a parallel fresh hole not less than 450 mm from misfired hole and fired in the usual way. The process shall be continued till the original blast is exploded. The engineer shall also be informed by the Contractor of all the cases of misfired/unexploded charges, their causes and steps taken. The authorised shot firer shall be present during removal of the debris liable to contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until atleast half an hour after firing.

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

3.06.05 Disposal

The excavated spoils will be disposed off within the specified lead in any or a combination of some of the following manners, as directed by the Engineer :

a) By stacking separately the materials suitable for area filling and materials not suitable.

b) By stacking it temporarily for use in backfilling at a later date.

c) i) By either spreading

or

ii) Spreading and compacting at designated filling areas and/or disposal areas.

d) By selecting the useful material and stacking it neatly in areas designated by the Engineer for use in back-filling or other purposes by some other agency.

e) Disposal of debris, earth, mill rejects, (if not useful) excavated spoils will be disposed off outside plant area by bidder. Disposal area shall be identified by the bidders.

The rate for excavation in soil should include the cost of filling and compaction in case (c) (ii). The rate for excavation in rock should include the cost of disposal as per (d).

3.06.06 Dewatering

All areas shall be kept free of water. 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 rain water and subsoil water accumulated in the area without any extra cost. Method of dewatering shall be got approved by the Engineer.

3.06.07 Dealing with Surface Water

All working areas shall be kept free of surface water as far as reasonably practicable. Works in the vicinity of cut areas shall be controlled to prevent the ingress of surface water.

Working surfaces shall be formed to such falls to shed water and prevent ponding.

No works shall commence until surface water streams have been properly intercepted, redirected or otherwise dealt with.

Where works are undertaken in the monsoon period, the Contractor may need to construct temporary drainage systems at his own cost to drain surface water from working areas.

3.07.00 **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, and control of ground water should cause no slips to occur. If however slips do occur due to causes beyond 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 backfilled later by him at his own expenses.

3.08.00 **Earthwork in Filling**

3.08.01 Area Filling for Grading

The material to be used for area filling shall be selected material capable of being compacted to the requirements stated herein below and approved by the Engineer, obtained directly from excavation for area grading, from nearby areas where excavation work by the same agency is in progress, from temporary stacks of excavated spoils or from borrow pits in selected areas designated/approved by the Engineer. The quality of the material shall conform to that mentioned in clause 2.5.2 of this specification.

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

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

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

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

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

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

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

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

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

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

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

moisture content shall be determined by laboratory tests prior to commencement of work.

Field compaction test shall be carried out at different stages of filling and also after the fill to the entire height has been completed.

When density measurements reveal soft areas in the construction, further compaction shall be undertaken at the contractor's cost as directed by the Engineer. If the required compaction is then not achieved the material in the soft area shall be removed and replaced by approved material and compacted in accordance with this specification all to the contractor's account.

The fill shall be carried out to such dimensions and levels as indicated on the drawings after the stipulated compaction. The fill will be considered as incomplete if the desired compaction has not been obtained.

If so specified, the rock as obtained from excavation may be used for filling and levelling to indicated grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cms approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone, etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation carried out by a 12 tonne roller. No less than 12 passes of the roller shall be accepted before subsequent similar operations are taken up.

3.08.02 Filling in Disposal Areas

Excavated materials if not used in area filling, will be disposed of in designated disposal areas as directed or as indicated in the drawings. The earth shall not be dumped haphazardly but shall be spread in horizontal layers not exceeding 500 mm in thickness and nominal compaction done to the satisfaction of the Engineer. All clods shall be broken before placing the fill. Earthmoving machinery including dumpers, dozers and trucks shall be allowed to ply over the fill to permit compaction to take place.

In wide areas rollers may be employed and nominal compaction done to the satisfaction of the Engineer. No payment for compaction shall be made for such nominal compaction.

3.09.00 **Compaction Control**

The density of each layer of compacted soil shall be ascertained by testing a number of samples. For this purpose the necessary arrangements for soil testing at the site shall be made by the Contractor in accordance with these specifications at the Contractor's expense and as directed by the Engineer.

The Contractor shall arrange the provision of the field laboratory including the testing equipment and a suitable motor vehicle. He shall also supply all

consumable materials such as kerosene, spirit, gas and sample bags as required.

All soil testing is to be carried out by a competent and suitable qualified engineering testing firm. The Contractor is to obtain the Engineer's approval for the firm to be used. The Contractor may undertake this work with the Engineer's approval.

All density testing shall be carried out on a lot by lot basis. A lot shall be considered to be a portion of work which is essentially homogeneous with respect to material type general appearance response during compaction, moisture condition during compaction, compaction process and state of underlying material.

All fill testing shall be carried out in accordance with the recent editions of relevant Indian Standards. The chainage and the off-set from the centre line of the fill of each test sample shall be recorded and presented along with the test results.

Each test lot shall be classified as cohesionless or cohesive. The classification shall be determined by the Engineer based upon particle size distribution. Cohesionless fill shall have 10% or less by mass of particles finer than 0.075 mm. Otherwise fill shall be treated cohesive.

For cohesionless fill material, a representative laboratory sample obtained from three field samples from each test lot shall be tested to determine its maximum and minimum dry density. These reference values of dry density shall be used to compute the density index (relative density) of each of the field density test samples taken from the test lot.

For cohesive fill material, a representative laboratory sample obtained from three field samples from each test lot shall be tested to determine its maximum dry density and optimum moisture content (OMC). These reference values of dry density and moisture content shall be used to compute the dry density ratio of each of the field density test samples taken from that test lot.

The degree of compaction shall be determined by considering the mean density of the samples in each test lot. The mean dry density shall be equal to or exceed the minimum specified density. In no individual case shall density be less than the minimum value specified by more than 2 percent, otherwise further rolling shall be done at the appropriate locations.

The contractor shall lay a further layer or fill only after compaction or a particular layer has been found and approved by the Engineer.

3.10.00 Protection of Side Slopes

The side slopes of the embankment shall be protected against slippage caused by rain cuts, erosion by wind etc. The surface treatment to be adopted will be by turfing, by lining, or by other means as shown in the drawings and also as directed by the Engineer.

3.10.01 Turfing

3.10.01.01 General

The provision of turfing involves the plantation of grass on the top and/or side slopes of the embankment as shown on the drawing or as directed by the Engineer. The work of turfing shall be taken up immediately after the construction of embankment, provided the season is favourable for the establishment of sod, preferably well before monsoon, but not during the monsoon.

The sod shall consist of dense, well-rooted growth of permanent and desirable grasses, indigenous to the locality. Thickness of sod shall be between 5cm & 8cm, so that all the dense root system is retained in the sod strip. The sods shall be of rectangular strips of uniform width, not less than about 25cm x 30cm in size but not so large that it is inconvenient to handle. During wet weather, the sod shall be allowed to dry sufficiently to prevent rearing during handling and during dry weather shall be watered before lifting to ensure its vitality.

3.10.01.02 Preparation of Bed

After the embankment has been constructed to shape and well compacted, the surface earth shall be loosened to a depth of 75 mm for receiving the sod. If the soil is not suitable for grass growth, suitable top soil shall be spread over the slopes and worked into the already loosened soil. Where required, fertilizer shall be spread and incorporated in the soil.

3.10.01.03 Placing of Sod

The prepared sod bed shall be moistened to the loosened depth and the sod shall be placed within 24 hours after the same has been cut. Each sod strip shall be placed edge to edge and such that the joints caused by abutting ends are staggered. The sod shall be lightly tamped with wooden or metal tampers to press it into the underlying soil. The strips are to be placed on the prepared embankment surfaces starting at the bottom. When the top is reached, the edge of the sod shall be turned into the surface and a thin layer of earth placed over the edge and compacted so as to divert water above the edge onto the top of the sod.

Where the side slope is 2 to 1 or steeper and the distance along the slope is more than 2 metres, the sod shall be staked with pegs or nails spaced approximately 50 to 100 cm along the longitudinal axis of the sod strips. Stakes shall be driven approximately plumb through the sods to be almost flush with them.

The sods shall be watered until the seeds or roots have sprouted. The preferable system of watering is by spraying rather than by flowing.

3.10.02 Geo-textile Membrane

Refer Volume IIG/3 Section XXXII for Technical Specification.

3.10.03 Earth/Soil

The excavated soil, selectively taken from the stacks of the same Contractor and/or stacks left by other agencies shall be used for covering geo-textile membrane and shall be free from pebbles, stones, vegetation and sieved to segregate stones, etc. present in it, if directed by the Engineer. The minimum clay-content of this soil shall be 25%. No fine sand layer excavated shall be used as cover over films.

3.10.04 Pre-cast Concrete

Ingredients used in pre-cast concrete blocks (to be used for covering geo-synthetic/geo-textile membrane) shall conform to the relevant provisions in IS:456, latest revision.

All precast work shall be carried out in a yard made for the purpose. This yard shall be dry properly levelled and having a hard and even surface. If the ground is to be used as a soffit form of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:3 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer casting will have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 7 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 installation.

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 installation of the precast units. All minor defects shall be touched up with a paste of 1 part cement and 3 parts sand.

3.10.05 Bricks and Brick Tiles

Bricks and brick tiles shall be of first class (class A) quality, well burnt, of uniform size, shape and colour, free from cracks, flaws or nodules of free lime and emit clear ringing sound when struck. Fractured surface shall show uniform texture free from grits, holes etc. compressive strengths shall be 50 Kg/sq.cm minimum for common bricks. Water absorption after 24 hours immersion shall not exceed 15% by weight for common bricks. Dimensional tolerance shall not exceed 8% of the size shown in drawings for common bricks. All bricks shall have rectangular faces and sharp straight edges. The bricks shall show no efflorescence after soaking in water and drying in shade.

If the Tenderer can not arrange for such quality bricks during execution, he should clearly indicate it in his offer. Samples of bricks/brick tiles have to be got approved by the Engineer. Any brick or consignment of bricks not found upto the specification shall be outright rejected and shall be removed immediately from site at the Contractor's own cost.

3.10.06 Execution of Slope Protection

The Work shall be strictly executed according to the provisions of this specification, final drawings to be issued, instructions of the Engineer at site, and/or catalogues of the approved manufacturer of Geo-textile membrane films.

3.10.06.01 Preparation of Sub-grade

The side slope shall be well compacted and free from undulations. All sharp objects such as rock pieces, boulders, stones, pebbles, roots and weeds shall be cleared to prevent puncturing of the membrane, and holes are to be filled up with proper material and compacted as directed by the Engineer. If the sides of excavation is a rock-cut terrain, sharp protrusions shall be levelled off. It is important that the sloping sides are well compacted to the satisfaction of the Engineer.

3.10.06.02 Treatment of Weed- Infested Areas

For safe guarding Geo-textile membrane against the growth of weeds, weedicides (such as Biodex-C, Grammaxene, Fernoxene or equivalent products) should be mixed with water in accordance with the manufacturer's instructions (3 litres of weedicide mixed with 200 litres of water is a standard practice) and this solution should be spread over the earth with a chemical spraying pump on side slopes.

The anti-weed treatment should be given only after moisture content of the soil is brought below 29%. After completion of the spraying of anti-weed chemicals and before taking up the next activity, a period of 24 hours should be allowed for penetration of the chemical into the soil.

3.10.06.03 Anti-Termite Treatment

The danger of termites at the side slope is rather remote. However in the case of infested areas, suitable insecticide slurries with insecticides such as BHC may be used over the side slope and before laying the film to prevent termite attack.

The tenderer, in his offer, shall quote separately for spraying suitable insecticide slurries in each square metre of treated area, and shall clearly indicate the type of insecticide, he proposes to use, manufacturer's name, proportion of ingredients in the slurry, and method of application, etc.

3.10.06.04 Not used.

4.00.00 TESTING AND ACCEPTANCE CRITERIA

4.01.00 Soil Testing

The following tests shall be undertaken by the Contractor and results and reports shall be submitted to the Engineer for approval. Test failures are to be immediately notified to the Engineer, otherwise results to be submitted within 24 hours of testing. Each layer of material shall be tested for compaction. Each layer is to be tested in a manner that is representative of its full depth. The Engineer may at his discretion instruct the Contractor to increase or decrease the frequency of testing.

a) Minimum one test per 500 cu.m of soil coming out of the borrow pits for determination of natural moisture contents in order to evaluate how far the natural moisture content tallies with the optimum value and whether further addition or reduction of water content would be necessary. Test to be done in accordance with IS : 2720 (Part-II).

b) Minimum two sets of laboratory tests per 8000 cu.m of soil coming out of the borrow pits for determination of dry density at optimum moisture content. Test to be done in accordance with IS : 2720 (Part-VII, XIV, XXVIII, XXIV) as applicable.

c) Minimum two sets of test per 500 cu.m of loose fill for determination of moisture content just prior to compaction of area filling. Test to be done in accordance with IS : 2720 (Part-II).

d) For each compacted layer, minimum one test per 2000 sq.m of compacted area for determination of moisture content and dry density.

e) Minimum two tests per 8000 cu.m of soil for determination of soil classification. Test to be done in accordance with IS : 2720 (Part-IV).

f) Minimum 10 (ten) density measurements shall be plotted to establish moisture content-dry density relationship.

4.02.00 Acceptance Criteria

4.02.01 Excavation

On completion of excavation, the dimensions of the area will be checked as per the drawings after the area is 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, at the Contractor's cost.

Over excavation of the sides will be made good free of cost by the Contractor. The excavation work will be accepted after the above requirements are fulfilled & all temporary approaches encroaching inside the required dimension of the excavation have been removed.

4.02.02 Area-filling

The degree of compaction required will be as per the stipulations laid down in appropriate sections of this specification. The actual method for measuring the compaction achieved will be as decided by the Engineer. The work of area filling will be accepted after the Engineer is satisfied with the degree of compaction achieved.

5.00.00 INFORMATION TO BE SUBMITTED

5.01.00 With Tender

Following details of Machineries, transport vehicles, equipment proposed to be used for excavation, area-filling and compaction have to be submitted along with the tender :

i) Equipment, machinery & earthmoving vehicles, available with the Contractor and proposed to be used for excavation and haulage giving details regarding make, model, capacity, year of manufacture, numbers available for this contract and general condition.

ii) Equipment proposed to be used for area filling and compaction giving similar details as in item 5.01.00 (i) above.

iii) Method of transportation.

5.02.00 After Award

After award of contract the successful tenderer shall submit the following for approval and adoption :

a) Within 15 days of Award of the contract, the Contractor shall submit a detailed programme of work as proposed to be executed giving completion dates of excavation of the various areas and the time required for area-filling and compaction. The programme should also show how the excavation and area- filling quantities will be balanced, minimising temporary stacking of spoils. It is to be noted that the Engineer even after initial approval of the programme, may instruct to enhance or retard the progress of work during the actual execution, in order to match with overall construction schedule 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 15 days of award, the Contractor shall submit drawings showing details of slopes, approaches, sump pits, dewatering lines, borrow pits, if any, fencing etc. for approval of the Engineer for adoption.

TECHNICAL SPECIFICATION
FOR
XXXII) GEO-TEXTILE FABRIC

CONTENTS

TECHNICAL SPECIFICATION FOR XXXII) GEO-TEXTILE FABRIC

1.00.00 SCOPE

The supply, design and construction of Geo-synthetic/Geo-textile lining system with protective earth cover and turfing (or precast concrete blocks/ Brick tiles) shall be under the scope of Contractor. The design of Geo-synthetic lining system shall be done by approved manufacturer or specialized agencies and to be submitted to owner for approval. Laying of Geo-textile grid and covering the same with soil shall be done by the agencies specialized for this type of work.

2.00.00 GENERAL

2.01.00 Work to be provided by the Contractor

Work to be provided by the Contractor unless specified otherwise will include, but not limited to the following:

a) Furnish all labour, supervision, services, materials, scaffolds, equipment, tools and plant, transportation, necessary approaches etc. required for the work.

b) Prepare detail drawing, if needed, for the work, fencing of area for protective measure, provide dewatering arrangement by pumping, if required, etc.

2.02.00 Work to be provided by others

No work under this specification will be provided by any agency other than the contractor unless specifically mentioned elsewhere in the contract or prior approval of the Owner is taken in this respect.

2.03.00 Conformity with Designs

The Contractor is to carry out the work as per the specification, drawings issued to him and/or Contractor's drawings which are approved by the Engineer and/or Engineer's instructions. If any deviation is likely to occur, then the Contractor should take Engineer's prior approval before starting of such work. Under no circumstances, the work to be performed should deviate from the specification or drawings unless approval of Engineer is taken.

2.04.00 **Materials to be used**

2.04.01 **General**

All materials to be used for the Work, must meet the specification requirements or the provisions of IS Code and should be of best quality available and approved by the Engineer. In case of bought-out items, certificate from the supplier or its deputed agency must be produced along with samples and approval taken from the Engineer before the items are bought.

Decision of the Engineer in cases of bought-out items shall be final.

2.04.02 **Geo-textile**

Property	**Test Method**
Non-woven Geo-textile :	
Tensile Strength	ASTM D1682
Puncture Strength	ASTM D751
Woven Geo-textile :	
Tensile Strength	ASTM D4595
Tensile Elongation	ASTM D5035
Thickness	ASTM D1777
Mass per Unit Area	ASTM D5621
Resiliency	ASTM D1777
UV Resistance at 1,000 hours	ASTM D4355

3.00.00 **EXECUTION**

The Work shall be strictly executed according to the provisions of this specification, final drawings, instructions of the Engineer at site, and/or catalogues of the approved manufacturer of Geo-textile.

All equipments necessary for the placing of Geo-textile fabric shall be approved before the work will be permitted to begin.

The installation of geo-textile shall be in accordance with the manufacturer's recommendation. Overlaps at ends of rolls and at roll widths shall be in accordance with the manufacturer's recommendations or as directed by the Engineer.

4.00.00 **ACCEPTANCE CRITERIA**

The installations shall present a neat appearance and shall be checked for water tightness. The following shall be specifically checked :

a) Geo-textile fabric against mechanical damage if any.
b) Laying of Geo-textile fabric.
c) Method of jointing (Heat sealing).
d) End sealing or, anchoring of Geo-textile fabric.
e) Laying and joints of cover tiles/blocks.

VOLUME – II B
CIVIL, STRUCTURAL & ARCHITECTURAL WORKS

SPECIFICATION NO. PE-TS-999-600-C025

SECTION - D

GENERAL TECHNICAL SPECIFICATION

SITE LEVELING AND GRADING

Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301

C 0 N T E N T

GENERAL TECHNICAL SPECIFICATION FOR SITE LEVELLING AND GRADING

1.00 GENERAL

This specification cover the works to be carried out for **"Site Levelling and Grading Works including Slope Protection"** etc for the entire plant and associated areas. The specified formation level(s) shall be achieved either by excavation or by raising with controlled fill with excavated/borrowed earth as the case may be.

2.00 SCOPE

2.01 The scope include all works involved in levelling the site to the lines, grades, cross sections and dimensions as shown on the approved drawings and/or as directed by the engineer including site clearance, setting out, earth work in excavation, stacking, loading, transportation, unloading, dewatering, drainage, filling, watering, compaction, turfing on slopes (if required), lighting, disposal of residual/surplus earth etc. It also include supplying and providing all labour, materials, supervision, services, equipments, tools and plants, testing and all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work etc.

2.02 All tools and plants, equipments and machineries to be used in this work shall be of standard quality and manufactured by reputed concerns conforming to Indian Standard (IS) codes or equivalent thereof.

2.03 Work to be provided by the Contractor

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

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

b) Preparation and submission of detailed scheme of all operations required for executing the work (material handling, placement, services, approaches etc) to the engineer for approval.

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

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

2.04 Work to be provided by others

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

2.05 Codes and Standards

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

IS: 1200 Methods of measurement of building and civil engineering works, Part-1: Earthwork

IS: 2720 Method of test for soils (Relevant parts)

IS: 3764 Excavation work- Code of safety

IS: 4081 Safety code for blasting and related drilling operations

IS: 4701 Code of practice for earthwork on canals

IS: 6922 Criteria for safety and design of structures subject to underground blasts

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

2.06 Conformity with Designs

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

3.00 MATERIALS

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

3.01 Materials for Excavation

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

a) Soil

It include all type of soil including laterite, moorum etc with/without any percentage of kankars which can be excavated by normal means such as shovel, pick axe, crow bar, spade etc and those which do not fall under **clause** 3.01 (b) and (c) etc.

b) Soft Rock

It include the rocks (including weathered rock) which are removable by splitting with the help of crow bar, pick axe, wedges, pavement breakers, pneumatic tools, hammers or such implements etc and not requiring blasting (for excavation) in the opinion of the engineer.

c) Hard Rock

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

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

3.02 Materials for Filling

Any coarse grained or fine grained low plastic soil free from vegetation, roots, shingle, salts, organic matters, sod and any other harmful chemicals shall be used for filling. The contractor shall test the fill material to establish its suitability and submit the results to the engineer for approval. Fill material shall be got approved by the engineer. The following type of materials shall not be used for filling.

a)Materials from swamps, marshes and bogs
b)Expansive clays
c)Peat, logs, sod and perishable materials
d)Materials susceptible to combustion
e)Any material or industrial and domestic produce which will adversely affect other materials of work
f)Materials from prohibited areas

The earth available by cutting the high grounds within the project site and the materials (if) available from the road excavation or any other excavation under the same contract shall be used for filling depending upon its suitability as fill material. Filling with excavated rock (in the project site) shall be done only with

the written permission of the engineer in the following manner. The boulders shall be broken into pieces not exceeding 150mm size in any direction and mixed with fine materials consisting of decomposed rock, moorum or any approved earth to fill the voids as for as possible and the mixture shall then be used for filling. In case the earth required for filling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc shall be borne by him. He shall obtain and submit the necessary clearances/permissions from the concerned authorities to the engineer for the borrow areas/materials acquired.

4.00 QUALITY CONTROL

All works shall conform to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

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

5.00 EXECUTION

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

5.01 Site Clearance

Before the commencement of earthwork, the entire area of cutting and filling shall be cleared of all trees, stumps, bushes, grasses, vegetation etc with their roots, fences, logs, rubbish, water, slush etc. It is not necessary to remove all the soil containing fine hair like roots but only the rather heavy mats are to be removed. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below the existing ground level or 300mm below the formation level whichever is deeper. After the removal of roots of trees, the pot holes formed shall be filled with good earth in 250mm

layers (loose thickness) and compacted unless otherwise directed by the engineer. The trees shall be cut in to suitable pieces as instructed by the engineer. Before earthwork is started, all the spoils, unserviceable materials and rubbish shall be burnt or removed and disposed off to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timbers, fire woods etc shall be the property of owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

5.02 Setting Out

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for the ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the contractor at his own risk and cost shall rectify the same. The contractor shall take spot levels of the area (with respect to the bench mark/ available source as provided by the engineer) to be excavated or to be filled at an interval of not more than 10m or as directed by the engineer before starting any earth work and shall be submitted to the engineer for prior approval.

5.03 Excavation

Levelling by excavation shall be carried out where the existing ground levels are higher than the specified formation level. Excavation shall include removal of all materials whatever nature as may be and whether wet or dry shall be carried out exactly in accordance with the line, levels, grades and curves shown on the approved drawings and/or as directed by the engineer. All excavations shall be done to the minimum dimensions as required. The contractor shall obtain prior approval of the engineer for the method he proposes to adopt for excavation in different types of strata including dimensions, side slopes and dewatering if any, stacking or disposal etc. This approval however shall not in any way make the engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to any other activities in the area. **Prior to starting the excavation, the ground level at the location shall be checked jointly with the engineer.**

The rough excavation may be carried up to a maximum depth of 150mm above the final formation level. The balance shall be excavated with special care and the final surface shall be compacted by rolling with 6 passes of 8 to 10 tonne

roller. If directed by the engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The contractor shall be paid for the extra excavation and filling at the appropriate items of work.

If the excavation is done to a depth greater than that shown on the drawing or as directed by the engineer due to the contractor's fault, the excess depth shall be filled up to the required level with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer at the own risk and cost of the contractor.

Suitable slope in cutting as per the requirements and as directed by the engineer shall be adopted to withhold the face of earth. The contractor shall be held responsible for any damage to any part of the work caused by the collapse of the side of excavations.

5.03.01 Excavation in Hard Rock

Excavation in hard rock shall normally be done with blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces.

5.03.02 Blasting

a) General

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

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

transport the explosives as and when required for the work in a safe manner to the work spot.

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

b) Materials

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

c) Storage of Explosives

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

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

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine.

Illumination shall be obtained from an electric storage battery lantern. No smoking shall be allowed within 100m distance from any magazine.

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

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

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

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

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.
The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

d) Carriage of Explosives

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

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

e) Use of Explosives

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

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

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

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

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

present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

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

5.03.04 Restrictions on Blasting

a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted.
b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted.
c) Progressive blasting shall be limited to two third of the total remaining depth of excavation.
d) No large scale blasting operations will be resorted to when the excavation reaches the last one metre and only small charge preferably black powder may be allowed so as not to shatter the parent rock.
e) The last blast shall not be more than 0.50 m in depth.
f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiselling or any other suitable method as approved by the engineer.

5.04 Sorting of Excavated Materials

The excavated material shall be carefully sorted for use in filling the areas in the project site by removing roots, grasses, organic matters and other objectionable materials and be sorted out into different types of materials for use and as directed by the engineer. The excavated material which is not considered fit for filling purpose shall be immediately removed and disposed at such a place and in such a manner as will be directed by the engineer. The material found unusable should be got approved by the engineer before actually disposing it off. The useful materials that cannot be used directly shall be heaped in separate area as stock piles. Stockpiles shall be of regular size as for as possible for ease of measurement. The materials heaped shall be utilised as and when required and as directed by the engineer. The cost of complete item of earthwork includes the cost of rehandling of the materials and temporarily heaped and reused.

5.05 Disposal of Surplus/ Waste Materials

Surplus and other waste materials shall be removed and disposed of from the construction site to the area demarcated by the engineer. No material shall be wasted unless approved by the engineer.

5.06 Earth Work in Filling

Levelling by raising with controlled fill of approved excavated/borrowed earth shall be carried out where the existing ground levels are lower than the specified formation level. After clearing site as per clause 5.01, the original ground shall be compacted by rolling subject to a minimum 6 passes of 8 to 10 tonne roller. The approved earth/fill material shall then be spread in horizontal layers not exceeding 300mm in compacted thickness. Each layer shall be watered and thoroughly compacted with proper moisture content and such equipments as may be required to obtain a minimum of 95% of its maximum dry density as determined by standard Proctor's test as per IS: 2720 part-VII or 85% of relative density as per IS:2720 part-XIV as specified. Moisture content of the fill material shall be controlled near optimum moisture content during compaction

The fill material shall be tested for its optimum moisture content and maximum dry density as per IS: 2720, part-VII. Moisture content shall be checked at the source of supply in accordance with IS:2720 part- II and if found less than that required for proper compaction, the same shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from the hose line or from the truck-mounted water tank etc making due allowance for evaporation losses and the fill material be thoroughly mixed by means of harrows, rotary mixers or by any other suitable approved method until the layer is uniformly wet. **Flooding shall not be permitted for watering purpose under any circumstances.** If the material delivered is too wet, it shall then be dried by aeration and exposure to the sun till the moisture content is suitable for compaction. Should circumstances arise owing to wet weather the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended. Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the layers before compaction. For each of the above tests on the fill material, one sample for every 10,000cu.m shall be tested. Additional samples shall be tested whenever there is a change of source or type of material.

Before start of filling, the contractor shall submit the engineer his proposal for the methodology to be adopted for compaction. The compaction equipments as approved by the engineer shall only be employed to compact the different type materials encountered during construction. If directed by the engineer, the contractor shall demonstrate the efficacy of the plant he intends to use by carrying out compaction trials. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The compacted layer shall be tested for its dry density as per IS:2720**,** part-XXVIII or XXIX as directed by the engineer. Samples shall be taken at the rate

of one sample for every 10,000sq.m area of each compacted layer. In addition random checks shall be carried out in compacted layers by means of Proctor needle penetration test. Contractor shall submit all the test results to the engineer immediately after completion of the tests. A sample shall be deemed to have passed the test when the dry density of the compacted fill is equal to or more than 95% of its maximum dry density. When field density measurements reveal any soft areas in the fills, further compaction shall be carried out as directed by the engineer. If in spite of that, the specified compaction is not achieved, the material in the soft areas shall be replaced with approved material compacted to the density requirements and satisfaction of the engineer.

Subsequent layers shall be placed only after the finished layer has been tested and accepted by the engineer.

Where the filling is to be done across low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed layer of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

5.07 Dewatering and Drainage

It shall be ensured that the area to be excavated/filled shall be free from water. The contractor shall remove the water (if any) by pumping or by any other means as approved by the engineer. At all times, the surface of cutting/filling during execution shall be maintained at such a cross fall as will shed water and prevent ponding. All existing drains/channels (if any) in the work area shall be suitably diverted by the contractor before taking up any excavation or filling. These diversions shall be such that it shall ensure effective disposal of water without any accumulation or flooding within the project site and in adjoining areas.

5.08 Finishing Operations

Finishing operation shall include the work of shaping and dressing the excavated/filled ground to the required grades, levels, lines, side slopes, cross-sections and dimensions as shown on the approved drawings or as directed by the engineer.

5.09 Turfing

Turfing shall be provided at the slopes and other locations as shown on the drawings or as directed by the engineer. The turf shall be of approved quality of grass. The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically free from weeds or other undesirable matter. The grass on the sod shall have a length of approximately 50mm and the sod shall be free of any

debris. Thickness of the sod shall be as uniform as possible with 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that all the dense root system of the grasses are retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than about 300mm x 250mm size but not so large so that it is convenient to handle and transport without damage.

The area to be sodded shall be previously constructed to the required slope and cross section. Prior to placing the sods, the slopes shall be **roughned** and wetted in order to have a satisfactory bond. The strips of sod shall be laid in close contact with each other and be tamped firmly in place so as to fill and close the joints between them. The turfing so laid shall be well watered and protected until final acceptance.

5.10 Approaches

The contractor shall provide proper approaches for workmen and inspection.

5.11 Lighting

Full scale lighting are to be provided if night work is permitted or directed by the engineer. If no night work is in progress, red warning lights should be provided at the edges of excavations and fills.

6.00 RATES AND MEASUREMENTS

6.01 Rates

a) The item of work in the schedule of quantities describe the work very briefly. The various items of the schedule of quantities shall be read in conjunction with the corresponding sections in the technical specification including amendments and additions if any. For each item in the schedule of quantities, the bidder's rate shall include all the activities covered in the description of the items as well as for all necessary operations in detail as described in the technical specification.

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

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

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

6.02 Measurements

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

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

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

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

d) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rocks so arrived shall be taken as soil.

e) For earth work in filling, the actual measurements of fill shall be calculated by taking levels of the original ground before start of the work but after site clearance and after compaction of fills. The quantity of earth work in filling shall be computed from these levels in cubic meter.

f) For turfing, the measurement shall be made on the finished work in square meter.