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SECTION - 1**SCOPE, SPECIFIC TECHNICAL REQUIREMENTS
& QUANTITIES****1.1.0 SCOPE**

1.1.1 The scope of work under this specification is civil works for construction of Boundary wall including Gate, Site Levelling Work and Security room of 765kV/400kV Medinipur Substation, being executed by BHEL on turnkey basis. The Customer is M/s PMJTL and Consultant is M/s Powergrid Corporation of India Limited.

1.1.2 The Civil Works shall generally include, *but not limited to*, following:

- (i) Site Levelling works
- (ii) Pre-Fabricated RCC Boundary wall, Boundary wall of Brick & RCC etc
- (iii) Building Works of Security Room.
- (iv) Boundary wall Gate
- (v) Any other work required for the project.

1.1.3 The works to be performed in the above construction includes preparation of bar bending schedules, based on the drawings released for construction and getting the same approved by the Engineer-in-charge plus the execution of the work including providing of all labour, supervision, materials, scaffolding, power, fuel, construction equipment like hydraulic excavator, dozer, tipper, Power roller, Vibratory roller etc, tools and plants, supplies, transportation, all incidental items necessary for successful completion of the work including contractor's supervision and in strict accordance with the drawings and specifications and with inspection and testing standards. The nature of work shall include excavation & filling in all types of soil in open areas/nallas/ channels, to the required slopes, shapes, levels, elevations and profile, including trimming of bottom and slopes of excavation, loading/unloading, transporting excavated material, stacking serviceable material, disposal of unserviceable material in disposal areas, filling in low lying areas, bailing out rain (dewatering), pumping, removal of slush, preparing embankments/marginal banks, loosening, dressing, spreading material in layers, verification of contouring data/level of entire area/plot, excavation in all type of soil including dewatering, shoring, strutting, and filling under and around structures, backfilling with available excavated earth around completed structures, transportation & leveling and compaction of surplus earth in low lying area including clearing the land for development from plants & bush vegetation, removal of roots of trees & plants, pre-cast covers, disposal of surplus soil, steel formwork, providing necessary steel embedment and other inserts, drainage work, concreting, brickwork, flooring and finishing etc. and all other works in building all complete as per detailed specification, drawings and directions of Engineer-in-charge.

1.2.0 SPECIFIC TECHNICAL REQUIREMENT

1.2.1 All technical requirements shall be as per POWERGRID Technical Specification (Refer SECTION 3)/CPWD specification/IS Codes.

1.3.0 BILL OF QUANTITIES

1.3.1 The Bill of Quantity shall be as per page 3 to page 11

1.3.2 The quantities indicated in the 'Bill of Quantity' are indicative and can vary to any extent. Contractor shall not be entitled for any claim for any such variation in the quantities.

1.3.3 The provision of Bill of Quantity, specifications and drawings shall be read in conjunction with each other and in case of conflict amongst them, the clarification shall be obtained from the Engineer-in-charge whose decision shall be final and binding.

1.3.4 Method of measurement:

1.3.4.1 Excavation for foundation work shall be measured in cubic meters. The lateral dimensions to be considered for working out excavation quantity shall be the PCC dimension below the footing as per approved drawing. Nothing extra shall be paid for slope cutting, etc. Backfilling & disposal quantities of foundation work shall be worked out based on the above dimensions only. However the contractor shall maintain the required slope and working space as per the safety / statutory requirement and its cost is deemed to be included in the quoted rate. This clause shall be applicable for all types of soil and rock.

Where rock and soil is mixed, the measurement of the excavation shall be made as per PCC dimensions. The rock shall be stacked and measured in stack. The net quantity of the rock shall be arrived at by applying deduction of 50% to allow for voids in stacks.

Where soil, soft rock, medium rock & hard rock are mixed, the measurement of the excavation shall be made as per PCC dimensions. Excavated materials comprising of the soft rock, medium rock and hard rock shall be stacked separately, measured in stacks, and each reduced by 50% to allow for voids to arrive at the quantity payable under soft rock, medium rock and hard rock. In no case, the sum of net quantities shall exceed the total quantity of the excavated materials.

The mode of measurement for other items shall be as per POWERGRID Technical Specification (Refer SECTION 3).

For other items, unless otherwise described in method of measurement as described in 'Method of Measurement of Building and Civil Engineering Works'- IS 1200 (Part I to XXV) latest edition of BIS shall be followed.

SECTION -2

STANDARD TECHNICAL SPECIFICATION

N.A

SECTION -3

ENCLOSURES TO THE SPECIFICATION

- (a) Customer Specification: Technical Specification, Section: Civil Works-ERSS-XVIII
- (b) Standard Technical Specification for Site Levelling
- (c) Standard Field Quality Plan

SECTION: CIVIL

1.0 GENERAL

The intent of this technical specification covers the following

All civil works shall be carried out as per design/drawings provided by the Employer / Contractor and as per these specification provided by the Employer. In case any item is not covered under specification then the same shall be carried out as per CPWD specification and applicable Standards and Codes. Any item for which specification is not provided herein and is not covered under CPWD specification shall be executed as per manufacture guidelines. All materials shall be of best quality conforming to relevant Indian Standards and Codes. In case of any conflict between Standards/ Codes and technical Specification, the provisions of Technical Specification shall prevail.

The Contractor shall furnish all labour, tools, equipment, materials, temporary works, constructional plant and machinery, fuel supply, transportation and all other incidental items not shown or specified but as may be required for complete performance of the Works in accordance with drawings, specifications and direction of Employer.

All materials including cement, reinforcement steel and structural steel etc. shall be arranged by the Contractor. All testing required shall be arranged by the Contractor at his own cost. The Contractor shall execute the work as per latest field quality plan available on POWERGRID website.

The bidder shall fully apprise himself of the prevailing conditions at the Proposed site. Climatic conditions including monsoon patterns, local Conditions and site specific parameters, soil parameters, availability of construction material and shall include for all such conditions and contingent measures in the bid, including those which may not have been specifically brought out in the specifications.

Employer has standardized its technical specification for various items/ works. Specification for items which are covered in the scope and as defined in Section project & BPS need only be referred.

2.0 ~~GEOTECHNICAL INVESTIGATION~~

2.1 ~~The Contractor shall perform a detailed soil investigation to arrive at sufficiently accurate conclusion regarding general as well as specific information about the soil profile and the necessary soil parameters of the site, in order to design and construct the foundation of the various structures safely and rationally.~~

A report to the effect shall be submitted by the Contractor for Employer's specific approval giving details regarding data proposed to be utilized for the design.

2.2

SCOPE

This specification covers all the work required for detailed soil investigation and preparation of a detailed report. The work shall include mobilization of necessary equipment, providing necessary engineering supervision and technical personnel, skilled and unskilled labour etc. as required to carry out field investigation as well as, laboratory investigation, analysis and interpretation of data and results, preparation of detailed Geo-technical report including specific recommendations for type of foundations and the allowable safe bearing capacity for different size of foundations at different founding strata starting from 0.5M from existing ground level for the various structures of the substation. The Contractor shall make his own arrangement for locating the co-ordinates and various test positions in field as per the information supplied to him and also for determining the reduced level of these locations with respect to the benchmark indicated by the Employer.

All the work shall be carried out as per latest edition of the corresponding Indian standard codes.

2.3

BORE HOLES

Fifteen nos. Bore holes (for new substation) of 150 mm diameter in accordance with the provisions of IS: 1892 up to 10 meter depth into virgin soil or to refusal whichever occurs earlier shall be drilled. By refusal it shall mean that a standard penetration blow count (N) of 100 is recorded for 30 cm penetration. In case rock is encountered within five meter from existing ground level or three meter FGL, coring in all the boreholes shall be carried out to 3 meter in rock.

The contractor shall carry out Standard Penetration Tests at approximately 1.5 m interval in the borehole starting from 0.5 m below ground level onwards and at every change of stratum. The disturbed samples from the standard penetrometer shall also be collected for necessary tests.

The contractor shall collect undisturbed samples of 100/75 mm diameter 450 mm long from the bore holes at intervals of 2.5 m and every change of stratum starting from 0.5 m below ground level onwards in clayey strata.

The depth of water Table, if encountered, shall be recorded in each Borehole. In case the soil investigation is carried out in winter/summer, the Water table for rainy season shall be collected from reliable sources and Recorded in the report.

All samples, both disturbed and undisturbed, shall be identified properly with the borehole number and depth from which they have been taken.

The sample shall be sealed at both ends of the sampling tubes with wax immediately after the sampling and shall be packed properly and transported to the Contractor's laboratory without any damage or loss.

2.4 TRIAL PITS

Trial pits shall be carried out at minimum one location per hectare as directed by the Employer. Total area of substation plot (including of Switchyard, Township and Future area) shall be considered for arriving at number of bore holes to be drilled. Minimum number of trial pits shall be five and maximum number shall be ten. The trial pits shall be 2 m x 2 m in size extending to 4 m depths, or as specified by the Employer. Undisturbed samples shall be taken from the trial pits as per the direction of the Employer.

2.5 ELECTRICAL RESISTIVITY TEST

2.5.1 GENERAL

The resistivity of earth varies over a wide range depending on its moisture content, temperature, salt content and compactness. Therefore earth resistivity test shall be conducted preferably during the dry season in order to get conservative results.

2.5.2 TEST LOCATION

In the evaluation of earth resistivity for the substations, at least eight test directions shall be chosen from the centre of the substation to cover the entire area including the future area. The number of test points shall be as per approved drawing.

2.5.3 PRINCIPLE OF TEST

Wenner's four electrode method shall be used. In this method, four small electrodes shall be buried in four small holes in the earth along a straight line at equal intervals. A test current (I) by earth resistivity tester shall be passed between two outer electrodes and the voltage difference (V) between the two inner electrodes shall be measured. The test current (I) thus flowing into the earth, produces an electric field proportional to its density and to the resistivity of the soil. The voltage (V) measured between the inner electrodes is proportional to the field. Consequently, the

resistivity will be proportional to the ratio of the voltage to current. Thus the resistivity shall be calculated from the following equation.

$$\rho_a = \frac{4\pi aR}{1 + \frac{2a}{\sqrt{a^2 + 4b^2}} - \frac{a}{\sqrt{a^2 + b^2}}}$$

Where,

ρ_a is the apparent resistivity of the soil in $\Omega\text{-m}$

R is the measured resistance in Ω

a is the distance between adjacent electrodes in metres

b is the depth of the electrodes in m

2.5.4 TEST PROCEDURE

In the selected test point and chosen direction, four electrodes with insulated connecting wires shall be driven into the earth along a straight line of equal intervals (a). The depth of the electrodes in the earth shall be of the order of 15 cm to 20 cm. The megger shall be placed on a steady and approximately level base, the link between terminals P1 and C1 shall be opened and the four electrodes connected to the instrument terminals. an appropriate range on the instrument shall be selected to obtain clear readings avoiding the two ends of the scale as far as possible.

Resistivity shall be calculated by substituting the value of R in the above equation. The test shall be repeated in a chosen direction with a number of different electrodes spacing, increasing from 2m to 50m preferably in the steps of 2, 5, 10, 25 and 50m. When the spacing is increased gradually from low values, at a stage, it may be found that the resistivity reading is more or less constant irrespective of the increase in the electrode spacing. The resistivity for this spacing is noted and taken as the resistivity for that direction. In a similar manner, resistivity for at least point shall be equally spaced direction from the centre of the test points shall be measured. These measurements shall be repeated for all test points.

NOTES:-

1. Soil resistivity points shall preferably be one number in each 100mx100m grid and number of test points shall be such that the entire substation including the future area is covered.
2. Average resistivity value of all eight directions shall be considered for design of earthing system.
3. Soil resistivity measurement may be done in dry season. Small

amount of water may be applied at electrodes for marking proper contact between the electrodes and soil.

2.6 PLATE LOAD TEST

Plate load test shall be conducted to determine the bearing capacity, modulus of sub grade reaction and load/settlement characteristics of soil at shallow depths by loading a plane and level steel plate kept at the desired depth and measuring the settlement under different loads, until a desired settlement takes place or failure occurs. The specification for the equipment and accessories required for conducting the test, the procedure, field observations and reporting of results shall conform to IS: 1888. Modulus of sub grade reaction shall be conducted as per IS: 9214. Plate load test shall be conducted at two locations to be decided during detailed engineering at the proposed foundation depth below finished ground level for determining the bearing capacity.

Undisturbed tube samples shall be collected at 0.5 m and 2.5m depths from natural ground level for carrying out laboratory tests.

The size of the pit in plate load test shall not be less than five times the plate size and shall be taken up to the specified depth. All provisions regarding excavation and visual examination of pit shall apply here.

Unless otherwise specified the reaction method of loading shall be adopted. Settlement shall be recorded from dial gauges placed at four diametrically opposite ends of the test plate.

The load shall be increased in stages. Under each loading stage, record of Time v/s settlement shall be kept as specified in IS:1888.

Backfilling of the pit shall be carried out as per the directions of the Employer. Unless otherwise specified the excavated soil shall be used for this purpose. In cases of gravel-boulder or rocky strata, respective relevant codes shall be followed for tests.

2.7 WATER SAMPLE

Representative sample of ground water shall be taken when ground Water is first encountered before the addition of water to aid drilling of boreholes. The samples shall be of sufficient quantity for chemical analysis to be carried out and shall be stored in air-tight containers.

2.8 BACK FILLING OF BORE HOLES

On completion of each hole, the Contractor shall backfill all bore holes as directed by the Employer. The backfill material can be the excavated material.

2.9 LABORATORY TEST

2.9.1. The laboratory tests shall be carried out progressively during the field work after sufficient number of samples has reached the laboratory in

order that the test results of the initial bore holes can be made use of in planning the later stages of the field investigation and quantum of laboratory tests.

2.9.2. All samples brought from field, whether disturbed or undisturbed shall be extracted/prepared and examined by competent technical personnel, and the test shall be carried out as per the procedures laid down in the relevant I.S. Codes.

The following laboratory tests shall be carried out

- a) Visual and Engineering Classification
- b) Liquid limit, plastic limit and shrinkage limit for C-Ø soils.
- c) Natural moisture content, bulk density and specific gravity.
- d) Grain size distribution.
- e) Swell pressure and free swell index determination.
- f) California bearing ratio.
- g) Consolidated drained test with pore pressure measurement.
- h) Chemical tests on soil and water to determine the carbonates, sulphates, nitrates, chlorides, Ph value, and organic matter and any other chemical harmful to the concrete foundation.
- i) In case of rock samples following tests shall also be conducted:
 - Rock quality designation (RQD), RMR.
 - UCC test.
 - Point load index test.

2.10 TEST RESULTS AND REPORTS

i) The Contractor shall submit the detailed report in four (4) copies wherein information regarding the geological detail of the site, summarized observations and test data, bore logs, and conclusions and recommendations on the type of foundations with supporting calculations for the recommendations. Initially the Contractor shall submit draft report and after the draft report is approved, the final report in four (4) copies shall be submitted. The test data shall bear the signatures of the Investigation Agency, Vendor and also site representative of Employer.

ii) The report shall include, but not limited to the following:-

- a) A plan showing the locations of the exploration work i.e. bore holes, trial pits, Plate load test etc.
- b) Bore Logs: Bore logs of each bore holes clearly identifying the stratification and the type of soil stratum with depth. The values of Standard Penetration Test (SPT) at the depths where the tests were conducted on the samples collected at various depths shall be

clearly shown against that particular stratum.

Test results of field and laboratory tests shall be summarized strata wise as well as in combined tabular form. All relevant graphs,

charts tables, diagrams and photographs, if any, shall be submitted along with report. Sample illustrative reference calculations for settlement, bearing capacity, pile capacity shall be enclosed.

- c) The report should contain specific recommendations for the type of foundation for the various structures envisaged at site. The Contractor shall acquaint himself about the type of structures and their functions from the Employer. The observations and recommendations shall include but not limited to the following:
 - i) Geological information of the area, past observations of historical data, if available, for the area and for the structures in the nearby area, fluctuations of water table etc.
 - ii) Recommended type of foundations for various structures. If piles are recommended the type, size and capacity of pile and groups of piles shall be given after comparing different types and size of piles and pile groups.
 - iii) Allowable bearing pressure on the soil at various depths for different size of the foundations based on shear strength and settlement characteristics of soil with supporting calculations. Minimum factor of safety for calculating net safe bearing capacity shall be taken as 2.5 Recommendation of liquefaction characteristics of soil and possible remedies shall be provided.
 - iv) Recommendations regarding slope of excavations and dewatering schemes, if required.
 - v) Comments on the Chemical nature of soil and ground water with due regard to deleterious effects of the same on concrete and steel and recommendations for protective measures.
 - vi) If expansive soil is met with, recommendations on removal or detainment of the same under the structure, road, drains, etc. shall be given. In the latter case detailed specification of any special treatment required including specification of materials to be used, construction method, equipments to be deployed etc. shall be furnished. Illustrative diagram of a symbolic foundation showing details shall be furnished.
 - vii) Recommendations for additional investigations beyond the scope of the present work, if considered such investigations as necessary.

viii) In case of foundation in rocky strata, type of foundation and recommendation regarding rock anchoring etc. should also be given based on RMR value.

3.0 DRAWINGS

Standard drawings have been developed for roads, road culverts, drains, cable trenches, cable trench crossing roads, sump, rain water harvesting, fire fighting pump house (Superstructure), control room building (Super structure), and fire tank by the Employer, as mentioned below, and are enclosed with the tender documents. These drawings are good for construction and are also available on POWERGIRD website. Additional prints if required can be downloaded from the website.

All foundation drawings including foundations for buildings, towers, equipments etc shall be released to the Contractor after award and after receiving the geotechnical investigation report.

Drawings that have been mentioned to be issued by the Employer to the Contractor during detailed Engineering shall be made available to the Contractor as per the agreed work schedule finalized after award.

3.1 Control room building

Standard Architectural drawings are enclosed with the tender documents. These drawings are good for construction. The construction drawings for foundation and other RCC work shall be released, in a phased manner, to the successful bidder after award of work.

3.2 FIRE FIGHTING PUMP SHED & FIRE WATER TANK

Architectural/Construction drawings of superstructure are enclosed with the tender documents. These drawings are good for construction. However, foundation drawing matching with site requirement shall be released in a phased manner to the successful bidder after award of work.

3.3 TOWER & EQUIPMENT FOUNDATIONS

Drawings for tower or equipment foundation shall be designed by the Employer and made available to the Contractor during detailed Engineering. Foundations of any miscellaneous requirements like electric poles, marshalling box, control cubicles, etc. shall be engineered by the Contractor and the design and drawings shall be submitted for Employer's approval.

Drawings for transformer, reactor foundations and fire wall are not enclosed and shall be made available to the Contractor by the Employer during detailed engineering. Firewall shall be finished with waterproofing cement paint of required shade.

In case the site conditions warrant any special type of foundations to be used, the same shall be designed and issued by the Employer to the Contractor during detailed engineering.

3.4 Roads, road culverts and rail cum Road

The roads shall be either concrete road or pre cast paver block road. The Construction drawings showing section detail for road, culverts as well as rail cum road are enclosed with the tender documents. The layout of roads shall be as per approved general arrangement drawing. The type of culverts i.e. the number and diameter of Hume pipes shall be as decided during detailed engineering.

3.5 Drains

The construction drawing for the section of drain is enclosed with the tender documents. The Contractor shall develop an overall drainage layout for the new sub-station/extension of substation during detailed engineering. The type of drains used shall be of the sections standardized and indicated in the drawings enclosed with the tender documents.

3.6 External water supply from bore-well to fire water tank-Control Building

(i) The drawing for the water supply from bore-well to fire water tank shall be developed by the Contractor. Water supply will be made available to the Contractor from a bore-well at suitable location within the sub-station. 80 mm dia GI pipe shall be provided by the Contractor from the connected by the Contractor to the roof water tank provided for the control room building.

(ii) The Contractor shall carry out all the external plumbing/erection works required for supply of water to the control room building and firewater tank.

(iii) A scheme shall be prepared by the Contractor indicating the layout and details of water supply which shall be got approved from the Employer before actual start of work including all other incidental items not shown or specified but as may be required for complete performance of the works

(iv) Bore well shall be in the scope of Contractor.

3.7 Stone spreading and antiweed treatment

The layout of the area, where anti-weed treatment and stone spreading is

to be done, shall be developed by the Contractor during detailed engineering and the same shall be submitted to the employer for approval.

3.8 Cable Trenches

The construction drawings of cable trenches, cable trench crossing road and sump are enclosed with tender documents. The Contractor shall develop an over all cable trench layout for the substation during detailed engineering. The layout should show type of cable trench, longitudinal slope and invert level calculated considering future extensions also. The types of cable trench shall be of the section indicated in the drawings enclosed with the tender documents and are also available on POWERGRID website.

4.0 EARTH WORK:

Unless mentioned otherwise in section-Project, fairly leveled site with Single level/terraces with different levels/gradual slope shall be handed over to the Contractor, in the phased manner. The finished ground level (FGL) with a tolerance of (+/-) 100mm shall be the finished formation level furnished by the Employer. The layout and levels of all structure etc shall be made by the Contractor at his own cost from the general grids of the plot and benchmarks set by the Contractor and approved by the Employer. The Contractor shall provide all assistance in instruments, materials and personnel to the Employer for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels

4.1 EXCAVATION AND BACKFILL

- a) Excavation for foundation shall be in accordance with CPWD Specification/ the relevant code. Excavation shall include removal of all materials of whatever nature at all depth and whether wet or dry necessary for the construction of foundations. The bottom of excavation shall be leveled both longitudinally and transversely unless otherwise mentioned in the drawings or as directed by Engineer-in-charge.

If required the sides of excavations should be supported in such a way as is necessary to secure these from falling in, and the shoring, if required, shall be provided and maintained in position as long as necessary. No extra payment shall be made for shoring.

- b) Whenever water table is met during the excavation, it shall be dewatered and water table shall be maintained below the bottom of the excavation level during excavation, The excavation shall be kept free from water:-
- i) When concrete and/or masonry works are in progress and till they come above the natural water level

- ii) Till the Employer considers that the concrete/ mortar is sufficiently set.
- c) Material unsuitable for foundations shall be removed and replaced by suitable fill material and to be approved by the Employer.
- d) Backfill material around foundations or other works shall be suitable for the purpose for which it is used and compacted. Excavated material not suitable or not required for backfill shall be disposed off in areas as directed by Employer up to a maximum lead of 2 km.
- e) Requirements regarding density / tests of backfilled earth shall be as specified in Field Quality Plan. The subgrade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor's density at OMC (optimum moisture content). Cohesion less material subgrade shall be compacted to 70% relative density (minimum).

4.2 REQUIREMENT FOR FILL MATERIAL UNDER FOUNDATION

The thickness of fill material under the foundations shall be such that the Maximum pressure from the footing, transferred through the fill material and distributed onto the original undisturbed soil will not exceed the allowable soil bearing pressure of the original undisturbed soil. The filling shall be done in accordance with clause 4.10 of IS: 1080. For expansive soils the fill materials and other protections etc. to be used under the foundation is to be got approved by the Employer. Cohesive Non Swelling (CNS) soil, if required, for filling under / around the foundations, cable Trenches, drains, roads etc shall conform to IS: 9451: 1994 reaffirmed 2004.

5.0 ANTIWEED TREATMENT & STONE SPREADING

5.1 Scope of work

The Contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specification and direction of the Employer.
Stone spreading over concrete layer shall be done in the areas of the switchyard under present scope of work. The cement concrete layer shall also be provided in future areas within the fenced area. However the stone spreading in future area shall be provided in case step potential without stone layer is not well within safe limits.

5.2 General requirement

The material required for site surfacing/stone filling shall be free from all types of organic materials and shall be of standard quality, and as approved by the Employer.

5.2.1 The material to be used for stone filling/site surfacing shall be stone aggregate of 40mm nominal size (ungraded single size) conforming to Table 2 of IS:383 – 1970. Hardness, flakiness shall be as required for wearing courses are given below:

(a) Sieve Analysis limits (Gradation)
(IS : 383 – Table – 2)

Sieve Size	% passing by weight
63mm	100
40mm	85-100
20mm	0-20
10mm	0-5

“One Test” shall be conducted for every 500 cu.m.

(b) Hardness

Abrasion value (IS: 2386 Part-IV) – not more than 40%

Impact value (IS: 2386 Part-IV) – not more than 30% and frequency shall be one test per 500 cu.m. with a minimum of one test per source.

(c) Flakiness Index

One test shall be conducted for every 500 cu.m. of aggregate as per IS: 2386 Part-I and maximum value is 25%.

5.2.2 After all the structures/equipments are erected, antiweed treatment shall be

applied in the switchyard where ever cement concrete is to be done and the area shall be thoroughly de-weeded including removal of roots. The recommendation of local agriculture or horticulture department may be sought where ever feasible while choosing the type of chemical to be used. The antiweed chemical shall be procured from reputed manufacturers. The doses and application of chemical shall be strictly done as per manufacturer's recommendation. Nevertheless the effectiveness of the chemical' shall be demonstrated by the Contractor in a test area of IOMXIOM (appx) and shall be sprinkled with water at least once in the afternoon everyday after forty eight hours of application of chemical. The treated area shall be monitored over a period of two to three weeks for any growth of weeds by the Engineer-in-charge. The final approval shall be given by Engineer-in-charge based on the results.

- 5.2.3 Engineer-in-charge shall decide final formation level so as to ensure that the site appears uniform devoid of undulations. The final formation level shall however be very close to the formation level indicated in the approved drawing.
- 5.2.4 After antiweed treatment is complete, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by Engineer-in-charge. The sub grade shall be consolidated by using half ton roller/surface vibrator with suitable water sprinkling arrangement to form a smooth and compact surface. The roller shall run over the sub grade till the soil is evenly and densely consolidated and behaves as an elastic mass.
- 5.2.5 In areas that are considered by the Engineer-in-Charge to be too congested with foundations and structures for proper rolling of the site surfacing material by normal rolling equipments, the material shall be compacted by hand rammer, if necessary. Due care shall be exercised so as not to damage any foundation structures or equipment during rolling 1 compaction.
- 5.2.6 The sub grade shall be in moist condition at the time the cement concrete is placed. If necessary, it should be saturated with water for not less than 6 hours but not exceeding 20 hours before placing of cement concrete. If it becomes dry prior to the actual placing of cement concrete, it shall be sprinkled with water and it shall be ensured that no pools of water or soft patches are formed on the surface.
- 5.2.7 Over the prepared sub grade, 75mm thick base layer of cement concrete in 1:5:10 (1 cement: 5 fine/coarse sand: 10 burnt brick aggregate 40mm nominal size) shall be provided in the area excluding roads, drains, cable trenches as per detailed engineering drawing. The Contractor shall have option to use graded stone aggregate 40mm nominal size in place of brick aggregate without any extra cost to employer. For easy drainage of water, the slope of 1:1000 is to be provided from the ridge to the nearest drain. The ridge shall be suitably located at the centre of the area between the nearest drains. The above slope shall be provided at the top of base layer of cement concrete in 1:5:10. A layer of cement slurry of mix 1:6 (1 cement: 6 fine sand) shall be laid uniformly over cement concrete layer. The cement consumption for cement slurry shall not be less than 150 kg for every 100 sq.m.
- 5.2.8 A final layer of 100mm thickness of stone aggregate of 40mm nominal size (conforming to clause 5.2.1) shall be spread uniformly over cement concrete layer after curing is complete.

6.0 ROADS AND CULVERTS

- 6.1 All the roads in the scope of contract shall be 3.75 M wide excluding shoulder of width 1.2 M on either side of road. There shall be two types of road – concrete road and pre-cast paver block road.
- 6.2 Layout of the roads shall be as shown in the approved General Arrangement drawing for the substation. Adequate turning space for vehicles shall be provided and bend radii shall be set accordingly. Road to the Autotransformer/Reactor shall

be as short and straight as possible. Roads which are to be used for carrying transformers / reactors shall be provided with turning radius preferably 19.5M or more but not less than 16.5M. Turning radius of other roads may be decided at site depending on layout constraints.

- 6.3 The section details of roads is furnished in the drawing enclosed with tender document.
- 6.4 The location of culverts, diameter of RCC Hume pipes shall be decided by the Contractor during detailed engineering while finalising drainage layout. The invert level of Hume pipes of culverts shall match with the invert level of drain meeting the culvert.

7.0 FOUNDATION / RCC CONSTRUCTION

7.1 General

a). Work covered under this Clause of the Specification comprises the construction of foundations and other RCC constructions for switchyard structures, equipment supports, trenches, drains, jacking pad, pulling block, control cubicles, bus supports, Autotransformer/Reactors, marshalling kiosks, auxiliary equipments & systems buildings, tanks or for any other equipment or service and any other foundation required to complete the work. This clause is as well applicable to the other RCC constructions.

b). Reinforced cement concrete shall be of grade M-25 conforming to IS: 456. All the tests shall be conducted as per relevant Indian Standard Codes as mentioned in Standard field quality plan appended with the specification. Type and grade of cement shall conform to CPWD specification and reinforcement steel shall be thermo mechanically treated reinforcement bars of grade Fe 500 conforming to IS: 1786.

c). If the site is sloping, the foundation height will be adjusted to maintain the exact level of the top of structures to compensate such slopes.

The switchyard foundation's plinths and building plinths shall be minimum 300mm and 500mm above finished ground level respectively.

d). Minimum 75mm thick lean concrete (1:4:8) shall be provided below all underground structures, foundations, trenches etc. to provide a base for construction.

e). Concrete made with OPC grade 53 and PPC shall be carefully cured and special importance shall be given during the placing of concrete and removal of shuttering

f). The design and detailing of foundations shall be done based on the approved soil data and sub-soil conditions as well as for all possible critical loads and

the combinations thereof. The Spread footings foundation or pile foundation as may be required based on soil/sub-soil conditions and superimposed loads shall be provided.

g). If pile foundations are adopted, the same shall be cast-in-situ bored or pre-cast or under reamed type as per relevant parts of IS: 2911. Only RCC piles shall be provided. Necessary initial load test shall be carried out by the Contractor at their cost to establish the pile design capacity. Only after the design capacity of pile has been established, the Contractor shall take up the job of piling. Routine tests for the pile shall also be conducted as per IS-2911. All the testing work shall be planned in such a way that these shall not cause any delay in project completion. RCC for pile works shall be Design Mix of minimum grade M-25 and also minimum cement content shall be 400Kgl cu.m as per IS-2911 (Latest revision)

7.2 DESIGN

The following clauses shall be applicable only for the foundation 1 structure which the Contractor may have to design

a. All foundation shall be of reinforced cement concrete. The design and construction of RCC structures shall be carried out as per IS: 456. designed concrete mix of grade M-25 or higher as specified in BPS or section- Project of Technical Specification.

- b. Limit state method of design shall be adopted unless specified otherwise in the specification.
- c. thermo mechanically treated reinforcement bars of grade Fe 500 conforming to IS: 1786 shall be used as reinforcement. Detailing of reinforcement shall be done in accordance with IS: 2502 and SP: 34. Ductile Detailing shall conform to IS: 13920. Two layers of reinforcement (on inner and outer face) shall be provided for wall & slab sections having thickness of 150 mm and more. Clear cover to reinforcement shall be as per IS: 456 (latest).
- d. RCC water retaining structures like storage tanks, etc. shall be designed as uncracked section in accordance of the steel structure and or equipment and/or method. However, water channels shall be designed as cracked section with limited steel stresses as per IS: 3370 (Part I to IV) by working stress method.
- e. The procedure used for the design of the foundations shall be the most critical loading combination of the steel structure and or equipment and/or superstructure and other conditions which produces the maximum stresses in the foundation or the foundation component and as per the relevant IS Codes of foundation design. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used.
- f. Design shall consider any sub-soil water pressure that may be encountered

following relevant standard strictly.

- g. Necessary protection to the foundation work, if required shall be provided to take care of any special requirements for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental/harmful to the concrete
- h. RCC columns shall be provided with rigid connection at the base.
- i. All sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factors of safety for these cases shall be taken as mentioned in relevant IS Codes or as stipulated elsewhere in the Specifications. For checking against overturning, weight of soil vertically above footing shall be taken and inverted frustum of pyramid of earth on the foundation should not be considered.
- j. Earth pressure for all underground structures shall be calculated using co-efficient of earth pressure at rest, co-efficient of active or passive earth pressure (whichever is applicable). However, for the design of substructures of any underground enclosures, earth pressure at rest shall be considered.
- k. In addition to earth pressure and ground water pressure etc., a surcharge load of $2T/Sq.m$ shall also be considered for the design of all underground structures including channels, sumps, tanks, trenches, substructure of any underground hollow enclosure etc., for the vehicular traffic in the vicinity of the structure.
- l. Following conditions shall be considered for the design of water tank in pumps house, channels, sumps, trenches and other underground structures:
 - i) Full water pressure, from inside and no earth pressure & ground water Pressure & surcharge pressure from outside (application only to structures Which are liable to be filled up with water or any other liquid).
 - ii) Full earth pressure, surcharge pressure and ground water pressure from Outside and no water pressure from inside.
 - iii) Design shall also checked against buoyancy due to the ground water during construction and maintenance stages. Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the superimposed loadings.
- m. Base slab of any underground enclosure shall also be designed for empty condition during construction and maintenance stages with maximum ground water table (GWT). Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the super-imposed loadings.
- n. Base slab of any underground enclosure like water storage tank shall also be designed for the condition of different combination of pump sumps being empty during maintenance stages with maximum GWT. Intermediate dividing piers of such enclosures shall be designed considering water in one pump sump only and the other pumps sump being empty for maintenance.

- o. The foundation shall be proportioned so that the estimated total and differential movements of the foundations are not greater than the movements that the structure or equipment is designed to accommodate.
- p. The tower and equipment foundations shall be checked for a partial factor of safety of 2.2 for normal condition and 1.65 for short circuit condition.

q. Transformer and Reactor Foundation:

The foundation of Transformer & Reactor shall be of block type foundation. Minimum reinforcement shall be governed by IS: 2974 and IS:456. In any case of Reactor Plan dimension of block should not be less than size of base of reactor.

The contractor shall provide a RCC Rail cum road system integrated with The Autotransformer / Reactor foundation to enable installation and the Replacement of any failed unit. The transfer track system shall be suitable to Permit the movement of any failed unit fully assembled (including OLTC, bushings) with oil. This system shall enable the removal of any failed unit from its foundation to the nearest road. If trench/drain crossings are required then suitable R.C.C. culverts shall be provided in accordance with I.R.C. standard/ relevant IS.

The contractor shall provide a pylon support system for supporting the fire Fighting

Each Autotransformer/Reactor including oil conservator tank and cooler banks etc. shall be placed In a self-sufficient pit surrounded by retaining walls (Pit walls). The clear distance of the retaining wall of the pit from the Autotransformer/Reactor shall be 20% of the Autotransformer/Reactor/ cooler Bank height or 0.8m whichever is higher. The oil collection pit thus formed shall have a void volume equal to 200% volume of total oil volume in the Autotransformer/Reactor.

The minimum height of the retaining walls of pit shall be 20cm above the Finished level of the ground to avoid outside water pouring inside the pit. The bottom of the pit shall have a uniform slope towards the sump pit. While designing the oil collection pit, the movement of the autotransformer / reactor must be taken into account.

The grating shall be made of MS flat of size 30mm x 5mm placed at 30mm Centre to centre and 6mm dia MS bar at spacing of 150mm at right angle to Each other. Maximum length of grating shall be 2000mm and width shall not Be more than 500mm. the gratings, supported on ISMB 150 mm, shall be Placed at the formation level size 40mm to 60mm. All steel work used for grating And supports shall be painted with epoxy based zinc phosphate primer (two Packs) confirming to IS: 13238- 1999. Contractor shall have option to provide Factory made electro forged MS grating made of specified size MS flat and Round bars without any extra cost to employer.

Each oil collection pit shall be drained towards a sump pit of size 1000x750mm and 500mm deep below the floor level within the collection pit Whose role is to drain water and oil due to leakage within the collection pit so That collection pit remains dry.

r. FIRE PROTECTION WALLS

Fire protection walls shall be provided, if required.

The firewall shall have a minimum fire resistance of 4 hours. The walls of the building, which are used as firewalls, shall also have a minimum fire resistance of 4 hours.

The firewall shall be designed to protect against the effect of radiant heat and flying debris from an adjacent fire.

The firewall shall extend 600 mm on each side of the Autotransformer / Reactors and 600 mm above the conservator tank or safety vent. A minimum of 2.0 meter clearance shall be provided between the equipments e.g. Autotransformer/Reactors and firewalls. In case of space constraints, these dimensions can be reduced as per the approval of Employer.

The building walls, which act as firewalls, shall extend at least 1 m above the roof in order to protect it.

The firewall wall will be made of reinforced cement concrete and shall be finished with water proofing cement paint of grey colour.

7.3 ADMIXTURES & ADDITIVES

- a). Only approved admixtures shall be used in the concrete for the Works. When more than one admixture is to be used, each admixture shall be batched in its own batch and added to the mixing water separately before discharging into the mixer. Admixtures shall be delivered in suitably labelled containers to enable identification.
- b). Admixtures in concrete shall conform to IS: 9103. The water proofing cement additives shall conform to IS: 2645. Concrete Admixtures/ Additives shall be approved by Employer (Engineer in charge).
- c). The Contractor may propose and the Employer may approve the use of a water-reducing set-retarding admixture in some of the concrete. The use of such an admixture will not be approved to overcome problems associated with inadequate concrete plant capacity or improperly planned

placing operations and shall only be approved as an aid to overcoming unusual circumstances and placing conditions.

- d). The water-reducing set-retarding admixture shall be an approved brand of Ligno-sulphonate type admixture.
- e). The water proofing cement additives shall be used as required / advised by the Employer.

8.0 GIS Building

GIS building shall be of pre-engineered steel structure. The building Consists of GIS hall, Room for control, protection & communication panels And AHU room. Dimensions of the building shall be as specified in bib Price schedule (BPS). The base plate of steel columns shall be mounted On the RCC foundation by means of foundation bolts at plinth level. The Building consists of brick up to a height of 3.0M (approximate) from Plinth and above brick work, PUF insulated panels shall be provided.

Foundation, brickwork, doors, windows in brickwork, plaster, painting of Plastered surface, glazed partitions are in the scope of contract.

Pre-engineered building consisting of steel work, windows, ventilators & Other openings placed above brick work in PUF panels and rolling shutter Shall be in the PEB contractor's scope under separate package.

8.1 INTERNAL FINISH SCHEDULE

The finishing schedule is given in subsequent clauses and table-1.

8.2 FLOORING

Flooring in various rooms GIS hall shall be as per detailed schedule given In table -1.

8.3 WALLS

In GIS building and the attached relay room 230mm thick brick brick wall shall Be provided a height of 3.0M (approximate) from plinth.

8.4 CABLE TRENCH IN GIS HALL

All cable trenches in GIS hall shall be covered with minimum 6mm thick Steel chequered plate with suitable stiffeners. Chequered plate shall be Painted with two or more coats of Epoxy paint as per item 13.52 of DSR'2013.

8.5 EXTERNAL PLASTER AND PAINTING

External plaster 18mm thick shall be of 1:6 cement sand plaster in two Layers. External surface of the GIS building (brick wall portion) shall be Painted with Premium acrylic smooth exterior paint with silicon additives Over and including priming coat of exterior primer as per item 13:47.1 of DSR'2013.

8.6 INTERNAL FINISH SCHEDULE

Internal finish Schedule for GIS hall is given in Table – 1 below:

Table - 1

S.No.	LOCATION	FLOORING & SKIRTING 150MM HIGH	WALL(INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
1.	GIS Hall	62mm thick cement Concrete flooring with Metallic hardener Topping (DSR item code 11.5)	Oil bound washable Distemper (DSR Item 13.41.1) on Smooth surface Applied with plaster Of paris putty (DSR Item 13.26)	-----	Windows/ventilator shall be of power coated aluminium with 5.5 thick glazing. All doors shall be flush door shutters with powder coated aluminium frame.
2.	Panel/Relay Room	Virifield tiles 8mm thick Size 600 x 600mm	Premim Acrylic emulsion paint on smooth surface applied with plaster of paris (2 mm thick)	False Ceiling	Windows shall be of powder Coated aluminium with 5.5mm Thick glazing. All doors shall be Glazed powder coated aluminium doors with 5.5mm thk. Glazing
3.	AHU Room	62mm thick cement Concrete flooring with Metallic hardener Topping (DSR item code	Premium Acrylic Emulsion paint on Smooth surface Applied with plaster	Acrylic emulsion paint over a coat of cement primer on smooth surface applied with	Windows/ventilator shall be of Powder coated aluminium with 5.5mm thick glazing. All doors Shall be flush door shutters with
S.No.	LOCATION	FLOORING & SKIRTING 150MM HIGH	WALL(INTERNAL)	CEILING	DOOR, WINDOWS & VENTILATOR
		11.5	Of paris(2 mm thick)	Readymade putty 1 mm thick (DSR item no. 13.80 & 13.83)	Powder coated aluminium frame.

8.7 DOORS AND WINDOWS

The details of doors and windows of the GIS building shall be as per finish schedule table -1 conforming to relevant IS code.

8.8 PARTITION

Partitions shall be made of power coated aluminium frame provided with 5.5 mm thick clear glass or pre- laminated board depending upon the Location of partition.

8.9 FALSE CEILING

Fifteen millimeter thick densified tegular edged eco friendly light weight

Calcium silicate false ceiling as per item 12.53 of DSR'2013 shall be Provided in the areas specified in Finish Schedule.

9.0 BUILDINGS (AS PER EMPLOYER'S DRAWING)

This clause is applicable for Buildings, which are to be constructed as per Drawings provided by employer such as control room building, switchyard panel room and fire water pump house with fire water tank. Standard architectural drawings of buildings covered in the scope, are enclosed with the tender documents. These drawings are good for construction except for foundation drawings of the buildings which will be issued to the successful bidder after award of work and after receipt of soil investigation report.

The details like size, finish details etc shall be as mentioned in the drawings enclosed with tender documents. However, descriptions of some of the items to be used in the buildings are given below:

Windows/ventilators shall be sliding or openable or partially openable/partially fixed or fixed type. The type of windows shall be as per approved drawings or to be decided during detailed engineering.

Powder coated aluminium (minimum thickness of powder coating 50 micron) for doors, windows, ventilators, fixed glazing and partitions with extruded built up standard tubular sections/ appropriate sections of approved make conforming to IS: 733 and IS: 1285 shall be used including fixing with dash fasteners, hinges, pivots, glazing plate, EPDM rubber/ neoprene gasket, snap beading, cleat angles, handles, C.P. brass / stainless steel screws, filling up the gaps at junctions etc required to complete the work as per the directions of Engineer-in-charge. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically.

The minimum sizes of aluminum sections are tabulated below. Contractor may also use higher thickness aluminium section without any financial implication to POWERGRID.

Aluminium section number mentioned here are of Jindal Aluminum for reference only. Contractor shall source aluminium sections from any approved manufacturer.

<u>DOORS</u>	
Description	Section nos. and its weight/meter
Frame plain	14057 (0.828 kg/m)
Shutter top	19582 (1.300 kg/m)
Shutter-bottom	19517 (2.376 kg/m)
Shutter-vertical	19560 (1.417 kg/m)
Shutter-middle	20002 (2.779 kg/m)
<u>Door with top fix ventilator</u>	
Description	Section nos. and its weight/meter
Frame plain	14057 (0.828 kg/m)

Frame –single groove	20059 (1.394 kg/m)		
Frame-double groove	20081 (1.456 kg/m)		
Shutter top	19582 (1.300 kg/m)		
Shutter-bottom	19517 (2.376 kg/m)		
Shutter-vertical	19560 (1.417 kg/m)		
Shutter-middle	20002 (2.779 kg/m)		
<u>Door cum fixed glazing and Door cum partition.</u>			
Description	Section nos. and its weight/meter		
Frame plain	14057 (0.828 kg/m)		
Frame –single groove	20059 (1.394 kg/m)		
Frame-double groove	20081 (1.456 kg/m)		
Shutter top	19582 (1.300 kg/m)		
Shutter-bottom	19517 (2.376 kg/m)		
Shutter-vertical	19560 (1.417 kg/m)		
Shutter-middle	20002 (2.779 kg/m)		
<u>Door cum fixed glazing and openable window</u>			
Description	Section nos. and its weight/meter		
Frame plain	14057 (0.828 kg/m)		
Frame –single groove	20059 (1.394 kg/m)		
Frame-double groove	20081 (1.456 kg/m)		
Shutter top	19582 (1.300 kg/m)		
Shutter-bottom	19517 (2.376 kg/m)		
Shutter-vertical	19560 (1.417 kg/m)		
Shutter-middle	20002 (2.779 kg/m)		
Window frame	20903 (0.522 kg/m)		
Window glazed shutters	20719 (0.575 kg/m)		
Window mullion	20720 (0.729 kg/m)		
Window glazing clip	19376 (0.188 kg/m)		
<u>Sliding Window</u>			
<u>Description</u>	<u>Series-2 track</u>	<u>Series-3 track</u>	<u>Series-4 track</u>
Shutter Top & bottom	20506 (0.717 kg/m)	20506 (0.717 kg/m)	20506 (0.717 kg/m)
Shutter side	20507 (0.642 kg/m)	20507 (0.642 kg/m)	20507 (0.642 kg/m)
Shutter inter lock	21145 (0.985 kg/m)	21145 (0.985 kg/m)	21145 (0.985 kg/m)
Frame bottom	21146 (1.308 kg/m)	21148 (1.842 kg/m)	20797 (1.667 kg/m)
Frame top & side	21147 (1.073 kg/m)	21149 (1.539 kg/m)	20796 (1.434 kg/m)

<u>Partial Openable/partially fixed window</u>	
Description	Section nos. and its weight/meter
Main frame	20903 (0.522 kg/m)
Glazed shutters	20719 (0.575 kg/m)
Mullion	20720 (0.729 kg/m)
Glazing clip	19376 (0.188 kg/m)

1. 12mm cement plaster of mix 1:6 (1 cement: 6 fine sand) shall be provided on the smooth side of internal walls. However rough side of walls shall be provided with 15mm cement plaster of mix 1:6 (1 cement: 6 fine sand)
2. 6mm cement plaster of mix 1:3 (1 cement: 3 fine sand) to all ceiling.
3. External plaster in two coats – 18mm Cement plaster in two coats under layer 12mm thick cement plaster 1:5 (1 cement: 5 coarse sand) finished with a top layer 6mm thick cement plaster (1 cement: 6 fine sand).
4. Internal walls shall be painted with minimum two coats of premium Acrylic emulsion paint having VOC (volatile organic compound) Content less than 50gm per litre of approved brand and manufacture Including applying additional coats wherever required, to achieve Even shade and colour over and including water thinnable priming coat with cement primer.
5. Providing and applying white cement based putty of average thickness one mm, of approved brand and manufacture, over the plaster surface to prepare the surface even and smooth complete.
6. Painting with synthetic enamel paint of approved brand and Manufacture of required colour to given an even shade shall be provided on the steel doors and rolling shutter in various buildings as specified in the drawings. Two or more coats over an under coat of suitable shade with primer paint of approved brand and manufacture.
7. Deleted
8. Cement plaster skirting (up to 15 cm height) with cement mortar 1:3 (1 cement: 3 coarse sand) mixed with metallic concrete hardener in Same ratio as for floor finished with a floating coat of neat cement. 21 mm thick in ACDB/DCDB room
9. Polished vitrified tiles in 60x60 cm size (thickness to be specified by the manufacturer) in flooring and skirting, with water absorption's less than 0.08% and conforming to IS: 15622 of approved make in all colours and shades, for skirting 1:4 (1 cement: 4coarse sand) including grouting the joints with white cement and matching pigments etc., complete.
10. Glazed Ceramic floor tiles 300x300mm (thickness to be specified by the manufacturer) of 1st quality conforming to IS:15622 of approved

make in colours as approved by Engineer-in-charge in toilet and pantries area on 20mm thick cement mortar 1:4 (1 cement: 4coarse Sand) including grouting the joints with white cement and matching pigments etc., complete.

11. Ceramic glazed wall tiles of 1st quality conforming to IS: 15622 (thickness to be specified by the manufacture) of approved make in all colours, shades as approved by Engineer-in-Charge in skirting, risers of steps and dados over 12mm thick bed of cement mortar 1:3 (1 Cement: 3 coarse sand) and jointing with grey cement slurry @ 3.3kg per sqm including pointing in white cement mixed with pigment of matching shade complete.
12. 230mm thick brickwork shall be provided with cement mortar 1:6 (1 cement: 6 coarse sand). Half brick (115mm thick) work masonry Shall be provide with cement mortar 1:4 (1cement: 4coarse sand) And two no 6mm dia MS bar at every third course. FPS Bricks of Clay/Fly ash used shall be of class-75.
13. Anti termite treatment shall be carried out for all buildings as per DSR item no. 2.34 & 2.35.
14. M.S. rolling shutters as per drawing shall be provided and fixed interlocked together through their entire length and jointed together at the end by end locks mounted on specially designed pipe shaft with brackets along with ball bearing for rolling shutter, side guides and arrangements for inside and outside locking with push & pull operation including the cost of providing and fixing necessary 27.5 cm long wire springs grade No. 2 and M. S laths with 1.25 mm thick top cover. In case area of rolling shutters exceeds 10 sq.m, mechanical device chain and crank operation for operating shutters shall be provided.
15. Circular/hexagonal M.S. sheet ceiling fan box shall be provided in the ceiling with clamp of internal dia. 140 mm, 73 mm height, 3 mm thick rim, top and bottom lid of 1.5 mm M.S. sheet. Lids shall be screwed in to M. S. box by means of 3 mm round headed screws, clamps shall be made of 12 mm dia. M.S. bar bent to shape as per standard drawing with overall length as 80 cm.
16. Powder Coated (minimum thickness 50 micron) aluminium work for doors, windows, ventilators and partitions shall be provided and fixed in – building with extruded built up standard tubular and other sections of approved make, fixed with rawl plugs and screws or with fixing clips, or with expansion hold fasteners including necessary filling up of gaps at junctions at top, bottom and sides with required PVC/neoprene felt etc and joined mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass/ stainless steel screws including glazing and fittings as specified. All doors except for toilet and kitchen shall have 100mm 6 lever CP Brass mortice latch and lock with a pair of lever

handle. Sliding door bolt of ISI marked (300x16mm) size shall be provided for toilet, kitchen and main door of control room/residential buildings. All works shall be carried out as per drawings.

17. Cement based water proofing treatment of roofs, balconies, terraces etc. shall be provided with average thickness of 120mm and minimum thickness at Khurra as 65mm and laid consisting of following operations:
- a) Applying a slurry coat of neat cement using 2.75 kg/sqm. of cement admixed with water proofing compound conforming to IS. 2645 and approved by Engineer-in-charge over the RCC slab including adjoining walls upto 300mm height including cleaning the surface before treatment.
 - b) Laying brick bats with mortar using broken bricks/brick bats 25 mm to 115 mm size with 50% of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge over 20 mm thick layer of cement mortar of mix 1:5 (1 cement :5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs
 - c) After two days of proper curing applying a second coat of cement slurry using 2.75 kg/ sqm of cement admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge.
 - d) Finishing the surface with 20 mm thick joint less cement mortar of mix 1:4 (1 cement :4 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge including laying glass fibre cloth of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300x300 mm square 3 mm deep.
 - e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Engineer-in-Charge
 - f) With average thickness of 120mm and minimum thickness at khurra as 65 mm.
18. unplasticised rigid PVC rain water pipes of 110mm dia shall be Provided and fixed on the wall face conforming to IS:13592 type A as per drawing including jointing with seal ring conforming to IS: 5382 leaving 10mm gap for thermal expansion single socketed pipes including all fittings like bends, bat clamps gratings etc..
19. unplasticised PVC Moulded fittings/accessories including 110mm bend and 110mm shoes shall be provided and fixed for unplasticised rigid PVC rain water pipes conforming to IS:13592

type A including jointing with seal ring conforming to IS: 5382 leaving 10mm gap for thermal expansion.

20. unplasticised PVC pipe clips of approved design shall be provided and fixed to unplasticised 110mm PVC rain water pipes by means 50x50x50mm hard wood plugs, screwed with MS screws of required length including cutting brick work and fixing in cement mortar 1:4 (1 cement: 4 coarse sand) and making good the wall etc.
21. Double action hydraulic floor spring of approved brand and manufacture IS: 6315 marked "hardwyn" make (Model 3000) or equivalent for doors shall be provided and fixed at the following door including cost of cutting floors as required, embedding in floors and cover plates with brass pivot and single piece MS sheet outer box with slide plate etc. as per the direction of Engineer-in-charge. with stainless steel cover plate.
 - a. Main Entrance to Control Room Building
 - b. Substation in charge room.
 - c. Office
 - d. Control room
22. Plinth protection 50 mm thick of cement concrete 1:2:4 (1 cement : 2 ce laid over 75 mm bed of dry brick ballast 40 mm nominal size well rammed and consolidated and shall be grouted with fine sand including finishing the top smooth.
23. Coloured vitreous china pedestal type water closet (European type) shall be provided with seat and lid, 10 litre low level vitreous china flushing cistern & C.P. flush bend with fittings and C.I. brackets, 40mm flush bend, overflow arrangement and mosquito proof coupling of including painting of fittings and brackets, cutting and making good the walls and floors wherever required.
24. Deleted
25. All urinals shall be coloured vitreous china flat back half stall urinal of 580x380x350mm with 10 litre PVC automatic flushing cistern, parryware/ Hindware/ Seabird/ Orient (Coral) with fittings, standard size C.P. brass) with waste fitting as per IS: 2556 C.I. trap with outlet grating and other couplings in C.P. brass including painting of fittings and cutting and making good the walls and floors wherever required.
26. Following fittings shall be provided in the toilet as per the drawings:
 - i) Toilet paper roll holder.
 - ii) Double type coat & hat hooks with flanges, fixed to wall / shutter, etc. with necessary screws, washers & plugs.

- iii) CP liquid soap holder of approved make fixed with each wash basin to the wall with necessary CP brackets, CP screws, washers, plugs etc.
 - iv) 100mm dia vitreous chinaware half round channel of approved make fixed to correct grade, level, opening for floor trap below urinals set in CM 1:3 & pointed using white cement etc.
 - v) CP brass bib cock 15mm nominal bore of approved quality conforming to IS: 8931.
 - vi) CP press angle valve of 15mm nominal and fixed in position for positions for basin and cistern points of approved quality conforming IS :8931.
 - vii) Best quality marble partition slab provided and fixed in position for urinals, of size 610x1150mm, 20mm thick, polished on both sides & machine cut, exposed corners rounded etc.
 - viii) Towel rail of approved make of 600mm length, 25mm dia with a pair of brackets or flanges provided and fixed to wall beside each wash basin/set of wash basin with necessary screws, plugs, etc.
 - ix) 6mm thick beveled edge mirror 1000x600mm shall be provided and fixed mounted on 12mm thick water proof plywood backing and hardwood beading all-round and mirror fixed to the backing with 4 nos. of CP cap screws & washers, including fixing the mirror to the wall with necessary screws, plugs & washers etc, with each wash basin.
31. Internal and External water supply works:
- a) All CPVC pipes and fittings shall conform to IS:15778
 - b) All internal CPVC pipe shall be concealed including cutting of chases and making good the wall.
 - c) Wherever CPVC pipes are buried the same shall be provided and laid in position including trenching, sand cushion and refilling, etc. For trenching, sand cushion and refilling refer CPWD specification applicable for external piping work.
 - d) All internal CPVC pipe shall be concealed including cutting of chases and making good the wall.
 - e) ISI approved CPVC ball valve, non-return valves shall be provided and fixed in position as per requirement and direction of Engineer-in-charge.

27. Masonry chamber for sluice valve shall be 600x600mm size in plan and depth 750mm, or matching with the site condition inside with 50 class designation brick work in cement mortar 1:5 (1 cement : 5 fine sand) with CI surface box 100mm. Top diameter, 160 mm bottom dia and 180 mm deep (inside) with chained lid and RCC top slab 1:2:4 mix (1 cement :2 coarse sand: 4 graded stone aggregate 20 Mm nominal size) necessary excavation foundation concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) and inside plastering with cement mortar 1:3 (1 cement : 3 coarse sand) 12 mm thick finished with a floating coat of neat cement complete as per standard design with FPS bricks of class 75.
28. Polyethylene water storage tanks conforming to ISI: 12701 shall be provided of approved brand and manufacture with cover and suitable locking arrangement, float valve and making necessary holes for inlet, outlet and overflow pipes. Capacity of water tank shall be 2x1000 litres for control room
29. PVC floor traps of self cleansing design shall be provided & fixed in position with outlet size of 75mm diameter of approved make, including making connection with PVC soil/waste pipes using rubber gaskets, embedding the trap in 150 mm thick PCC 1:2:4, providing & fixing of top tile & strainer of CP or PVC on top of the trap etc.
30. square-mouth SW gully trap grade 'A' 100x100mm size P type with FPS Bricks class designation 75 shall be provided and fixed complete with CI grating brick masonry chamber with water tight C.I. cover with frame of 300x300mm size (inside) the weight of cover to be not less than 4.5 Kg and frame to be not less than 2.70 Kg as per standard design.
31. Brick Masonry road gully chamber of 50x45x60cm shall be provided with brick with cement mortar 1:4 including 500x450mm pre cast RCC Horizontal/vertical grating with frame complete.
32. Glazed stoneware pipes of 150mm diameter grade 'A' shall be provided, laid and jointed with stiff mixture of cement mortar in the proportion of 1:1 (1 fine sand) including testing of joint etc. complete.
33. Cement concrete 1:5:10 (1 cement: 5 coarse sand: 10 graded stone aggregate 40 mm nominal size) shall be provided and laid around S.W pipes including bed concrete.
34. Brick masonry manhole shall be constructed in cement mortar 1:4 (1 cement: 4 coarse sand) RCC top slab with 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) foundation concrete 1:4:8 mix (1 cement : 4 coarse sand :8 graded

stone aggregate 40 mm nominal size) inside plastering 12 mm thick floating coat of neat cement and making channels in cement concrete 1:2:4 (1 cement: 2 coarse sand :4 graded stone aggregate 20 mm nominal size) finished with a floating coat of neat cement complete as per standard design.

- a) Inside size shall be 90 x 80 cm and 60 cm deep including CI cover with frame (light duty) 455 x 610 mm internal dimensions total weight of cover and frame shall not be less than 38 kg (weight of cover 23 kg and weight of frame 15 kg) and shall be constructed with F.P.S./fly ash bricks with class designation 75.
 - b) Inside size shall be 120 x 90 cm and 90 cm or more deep including CI cover frame (medium duty) 500mm internal diameter total weight of cover and frame to be not less than 116 kg (weight of cover 58 kg and weight of frame 58 kg) with FPS bricks class designation 75.
35. MS foot of 20 x 20mm square rest shall be provided and fixed in manholes with 20 x 20 x 10 cm cement concrete blocks 1:3:6 (1 cement :3 coarse sand :6 graded stone aggregate 20 mm nominal size) as per standard design.
 36. GS corrugated sheets of 0.80 mm thick with zinc coating not less than 275 gm/sqm. and fixed with G, I, J or L hooks, bolts and nuts 8mm diameter G, I plain and bitumen washers complete excluding the cost of purlins, rafters and trusses for water tank.
 37. Wash basin flat back wash basin (550x 400mm) shall be provided with CI. Brackets 15mm C.P. brass pillar taps, close hole basin mixer 32mm C.P. brass waste and bottle trap of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever required. Other details shall be as per the drawings.
 38. All doors except toilet and kitchen shall have 100mm 6 liver mortice

10.0 MODE OF MEASUREMENT

10.1 Earthwork

This shall include excavation in all kinds of soil including rock, all leads and lifts including back filling, compacting, dewatering (if required) and disposal of surplus earth/ rock to a suitable location within a lead up to two km. The quantity of excavation for foundations of towers, equipment structures, all transformers, firewall, cable trenches, water tank, reactors, buildings, marshalling kiosks, underground water tank and covered car parking shall only be measured. The quantity of excavation for roads, rail cum road, drains, culverts, rainwater harvesting, septic tank, soak pit, external water supply system, site surfacing, shall not be measured separately and shall be deemed to be included in the composite rates quoted by the bidder

for the respective works. All other excavation required for the completion of the work including fixing of lamp posts/ electric poles, plinth protection, flooring, sewerage system, manholes, pipes, earth mat, pipe support etc. shall also not be paid for. The measurement of excavation for all concrete works shall be made considering dimension of the pit keeping 150mm gap around the base pad (lean concrete) or actually excavated pit, whichever is less. the quantity shall be measured in cubic metres.

10.2 PCC

Providing and laying Plain Cement Concrete of all type and at all locations including all leads and lifts. The quantity shall be measured in cubic meters as per lines and levels indicated in the drawings.

10.2.1 Deleted

10.2.2 PCC 1:2:4 (1 cement: 2 coarse sand: 4 coarse aggregate 20 mm nominal size) shall be measured in flooring of buildings, plinth protection, fencing, transformer foundation, reactor foundation, rail track, drain, culverts, septic tank, etc. as indicated in the drawings.

10.2.3 PCC 1:3:6 (1 cement : 3 fine sand : 6 stone aggregate, 40mm nominal size) shall be measured below all foundations including buildings, underground water tanks, covered car parking cable trench, roads, under flooring, rail-cum-road, transformer foundation, reactor foundation, drain, water tank, culverts, gate, tower/equipment etc. as indicated in the drawings.

10.2.3 PCC 1:4:8 (1 cement : 4 fine sand : 8 stone aggregate, 40mm nominal Size) shall be measured below all foundations including buildings, underground water tanks, covered car parking cable trench, roads, under flooring, rail-cum-road, transformer foundation, reactor foundation, drain, water tank, culverts, gate, tower/equipment foundation etc. as indicated in the drawings.

10.2.4 PCC 1:5:10 (1 cement: 5 fine sand: 10 brick aggregate/ stone aggregate 40mm nominal size) shall be provided for site surfacing in switchyard. This shall include providing and laying cement slurry in case of site surfacing in switchyard.

All other PCC required for the completion the work including hold fasts of doors/windows/rolling shutters, fixing of plumbing pipes, bedding concrete for sewer lines, embedment of electrical conduits, water proofing of roof etc. shall not be measured and deemed to be included in the composite rates quoted by the bidder for respective works. Water proofing compound wherever specified shall be added without any extra cost.

10.3 RCC

Measurement of reinforced cement concrete at all locations shall be made and shall include all leads lifts, formwork, grouting of pockets and underpinning, but shall exclude reinforcement. This shall also include precast RCC work and addition of water proofing compound & admixtures wherever required for which

no additional payment shall be made. The quantity shall be measured in cubic meters as per lines and levels indicated in the drawings. No deduction shall be made for volume occupied by reinforcement/inserts/sleeves and for openings having cross-sectional area up to 0.1 sq.m.

10.4 Steel Reinforcement

Reinforcement shall be measured in length (actual or theoretical as per drawing whichever is less) including hooks, if any, separately for different diameters as actually used in work, excluding overlaps. From the length so measured, the weight of reinforcement shall be calculated in tones on the basis of sectional weights as adopted by Indian Standards. Wastage, overlaps, couplings, welded joints, spacer bars, chairs, stays, hangers and annealed steel wire or other methods for binding and placing shall not be measured and cost of these items shall be deemed to be included in the rates for reinforcement.

10.5 Stone filling

Measurement of stone (40-60mm size) for transformer/ reactor foundations shall be made as per theoretical volume of the space to be filled in the transformer foundation as per drawings. This shall be measured in cu.m.

10.6 Miscellaneous structural steel

Measurement for Supply, fabrication, transportation and erection of all miscellaneous structural steel work for mono rails (RS joists), rails for transformers/ reactors, trusses, frame work, purlins, gratings including factory made electro forged gratings, steel tubes, built up sections along with all other steel fittings and fixtures, inserts and embedment in concrete shall be made as per drawings. Quantity shall be measured in MT.

The unit rate for this item shall be inclusive of cutting, grinding, drilling, bolting, welding, pre- heating of the welded joints, applying a priming coat of steel primer / anti corrosive bitumastic paint/ synthetic enamel paint / epoxy zinc phosphate primer etc wherever specified, setting of all types of embedment in concrete, etc. Gratings in transformer / reactor foundations and its supports shall be painted with epoxy zinc phosphate primer.

Steel required for foundation bolts & fasteners (other than towers and equipment support structures), doors, windows, ventilators, louvers, rolling shutters, chain link fencing, barbed wires, gratings in drains, soil pipes, plumbing pipes, floor traps, embedment's required for rainwater harvesting, septic tank, soak pit, roof truss and purlins required for fire water tank, etc. shall not be considered for payment and measurements.

10.7 Roads

The measurement of concrete or pre cast paver block road shall be made on the basis of area in square metres (m²) of top completed surface of the road and shall be deemed to include all items such as excavation, compaction, rolling, watering, WBM, sub-base course, shoulder, kerb stone etc. complete in all respect. However PCC, RCC and steel reinforcement shall be measured under respective clauses mentioned above.

10.8 Antiweed Treatment

The measurement shall be done for the actual area in square metres of antiweed treatment which will include supplying required chemicals and doing the treatment complete in all respect as per the specification for the specified area.

10.9 Stone spreading in switchyard

The measurement shall be done for the actual area in square meters of stone spreading in the switchyard which will include supplying and laying-of 100mm thickness of stone aggregate as per specification for the specified area.

10.10 Cable Trench Crossing and Road Culverts through Hume Pipes

Cable trench crossings and road culverts shall be measured by length (in running meters) of individual Hume pipe which will be laid as per the drawings. The item shall be inclusive of excavation, laying, back filling, jointing, brickwork, plastering etc complete in all respect but excluding concrete which will be measured and paid separately under respective items.

10.11 Buildings

a) Control Room Building/Auxiliary Building/FFPH: Payment for this item shall be made on plinth area basis for each building including internal foundations, cable trenches, internal & external finishes, etc complete in all respect. However, the quantity of excavation, PCC, RCC, reinforcement steel and steel inserts in foundation & cable trenches shall be measured and paid separately as per clause nos. 10.1, 10.2, 10.3, 10.4 & 10.6 described above. Plinth area shall be calculated based on IS 3861-2002.

b) GIS Buildings (Pre-engineered Buildings): All items of civil works shall be measured and paid. Excavation, PCC, RCC, reinforcement steel and steel inserts in foundation & cable trenches shall be measured and paid as per clause nos. 10.1, 10.2, 10.3, 10.4 & 10.6 described above. All other items shall be measured and paid as per CPWD specification.

c) Internal Electrification and Fire Fighting: Payment for Internal

electrification as well as internal Fire fighting works is not included in items covered in clause 10.11 a, & b.

10.12 Rail cum Road

The measurement for the rail cum road shall be made in square metres of top concrete completed surface of the rail cum road and shall include all items such as excavation, compaction, rolling, watering, WBM etc. complete as per drawing but excluding concrete, steel reinforcement, structural steel and rails.

10.13 Septic Tank and Soak Pit for Control room building

This is a lump sum item. The Contractor shall be required to complete the work in all respect as per drawings furnished by the Employer. All the clause including excavation, masonry work, all types of fillings, all types of pipes including plumbing and vent pipes, all type of fittings etc. shall be deemed to be included in this lump sum rate. However, the concrete (all types) and the reinforcement shall be measured and paid under the clause no. 10.2, 10.3 & 10.4 mentioned above.

10.14 Fire Water Tank

This is a lump sum item. The Contractor shall be required to complete the work in all respect as per drawings furnished by the Employer. All the items including excavation, compaction, brick work, roof truss, purlins, roofing, all types of miscellaneous steel, internal and external plastering, painting etc. shall be deemed to be included in this lump sum cost. However, concrete (all types) and reinforcement shall be measured and paid under the clause no. 10.2, 10.3 and 10.4 mentioned above.

10.15 External water supply from Bore-well to Fire water tank, Control Room Building and Transit camp.

The external water supply from Bore-well shall be measured in running meters of GI pipe of various diameters. It shall include all the items such as excavation, piping, pipe fittings, painting, brickwork, sand filling, concrete, valves, chambers cutting chases in walls, openings in RCC and repairs, etc. required to complete the job.

10.16 External Sewage System of the control room building shall be measured diameter wise in running meters. It shall include all the items such as excavation, piping, pipe fittings, manholes, gully trap, gully chamber, encasing in concrete and repairs etc required to complete the job. Any modification in the existing sewage system, if required, shall be done by the Contractor without any extra cost implicated to Employer.

10.17 Cable Trenches

Various items like earthwork, PCC, RCC, reinforcement steel and miscellaneous steel required for construction of cable trenches shall be measured under respective clauses mentioned above.

10.18 Drains

For RCC drains: Various items like earthwork, PCC, RCC, reinforcement steel and miscellaneous steel required for construction of drains shall be measured under respective clauses mentioned above.

For Brick drains: the items PCC (1:2:4 and 1:4:8) for drains shall be measured under respective clauses mentioned above. All other items required for completion of drains shall be deemed to be included in the rate of items quoted for drain.

10.19 Soil Treatment

CNS or sand filling or boulder packing with interstices filled with sand under or sides of the foundations, roads, cable trenches, drains etc shall be measured in cubic meters.

10.20 Pile Foundation

- a). For payment purpose pile of different diameter shall be measured separately in length (running meter) from bottom of pile cap to the lowest point of pile. The rate shall include boring, providing, installing etc complete in all respect except for concrete and reinforcement steel which will be paid separately under respective items.
- b). In case pile foundation is not envisaged originally in the LOA then concrete and reinforcement steel shall be measured and paid as per items mentioned under clause 10.3 & 10.4 and boring installing including casing and bentonite treatment etc of pile will be paid as an extra item. In case extra quantity of cement is required to meet the provisions of IS: 2911, it will be paid as an extra item.

10.21 Contractor Designed Foundations

Contractor designed foundations shall be measured and paid as per clause 10.1, 10.2, 10.3, 10.4, 10.5 and 10.6 unless otherwise specified.

- 10.22 Billing break up of Lump sum items for payment purpose shall be decided at site by Engineer in charge for the work.

11.0 MISCELLANEOUS GENERAL REQUIREMENTS

- 11.1** Reinforced cement concrete with controlled water cement ratio as per IS-code shall be used for all underground concrete structures such as pump-house, tanks, and water retaining structures for achieving water-tightness.
- 11.2** All joints including construction and expansion joints for the water retaining structures (RCC tank for Fire Fighting and underground water tank) shall be made water tight by using PVC ribbed water stops with central bulb. The minimum thickness of PVC water stops shall be 5 mm and minimum width shall be 230 mm.
- 11.3** All mild steel parts used in the fire fighting water tank and under ground water tank shall be hot-double dip galvanised. The minimum coating of the zinc shall be 750 gm/sq. m. for galvanised structures and shall comply with IS:2629 and IS:2633. Galvanizing shall be checked and tested in accordance with IS: 2633. The galvanizing shall be followed by the application of an etching primer and dipping in black bitumen in accordance with BS: 3416.
- 11.4** FPS Bricks of clay having minimum 75 kg/cm² compressive strength can only be used for masonry work. Contractor shall ascertain himself at site regarding the availability of bricks of minimum 75 kg/cm² compressive strength before submitting his offer. However, Contractor can propose to use of fly ash based bricks/ hollow concrete blocks or solid concrete blocks of compressive strength not less than 75kg/cm². for which no extra payment shall be made.
- 11.5** Anti termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS: 6313 and other relevant Indian Standards.
- 11.6** The material specification, workmanship and acceptance criteria shall be as per approved standard Field Quality Plan attached with this document. In case certain item is not covered in FQP, it shall be constructed as per CPWD specification.
- 11.7** Ready mix concrete pertaining to M25 grade of reputed manufacturer such as Lafarge, ACC, Ultra Tech, RMC Readymix India etc. or manufacturer of similar reputé shall also be accepted for use in construction activity. Materials specification shall conform to IS: 456 and acceptance criteria of readymix concrete shall be as per IS: 4926-2003.

11.8 Items/ components of buildings not explicitly covered in the specification but required for completion of the project shall be deemed to be included in the scope.

12.0 INTERFACING

The proper coordination & execution of all interfacing civil works activities like fixing of conduits in roofs/walls/floors, fixing of foundation bolts, fixing of lighting fixtures, fixing of supports/embedment, provision of cut outs etc. shall be the sole responsibility of the Contractor. He shall plan all such activities in advance and execute in such a manner that interfacing activities do not become bottlenecks and dismantling, breakage etc. is reduced to minimum.

13.0 STATUTORY RULES

- Contractor shall comply with all the applicable statutory rules pertaining to factories act (as applicable for the State), Fire Safety Rules of Tariff Advisory Committee, Water Act for pollution control etc.
- Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.
- Requirement of sulphate resistant cement (SRC) for sub structural works shall be decided in accordance with the Indian Standards based on the findings of the detailed soil investigation.
- All building/construction materials shall conform to the best quality specified in CPWD specifications if not otherwise mentioned in this specification.
- All tests as required in the standard field quality plans have to be carried out.

STANDARD TECHNICAL SPECIFICATION FOR SITE LEVELLING

1.0 GENERAL

1.1 Introduction

These Specifications shall apply to all such works as are required to be executed under the Contract or otherwise directed by the Engineer-in-Charge. In every case the work shall be carried out to the satisfaction of the Engineer-in-Charge and conform to the location, lines, grades and cross-sections shown on the drawings or as indicated by the Engineer-in-Charge. The quality of work and materials shall comply with the requirements set forth in the succeeding sections. Where the drawings and Specifications describe a portion of the work only in general terms, and not in complete details, it shall be understood that only the best general practice is to prevail, materials and workmanship of the best quality are to be employed and the instructions of the Engineer-in-Charge are to be fully complied with.

1.2 Scope of Work

The scope of work covered under this specification is as follows:

- (i) Site Clearance
- (ii) Site levelling;

The work to be performed under these specifications consists of providing all labour, supervision, materials, planking and strutting, power, fuel, construction equipments, tools and plants, supplies, transportation, storage, insurance, royalty and all incidental items not shown or specified by reasonably implied or necessary for successful completion of work including contractor's supervision and in strict accordance with drawing and specifications.

The scope may however vary based on the specific requirement of various works/site, which shall be specified by the Owner in the form of addendum/modifications.

1.3 Definition:

The words like Contract, Contractor, Engineer-in-Charge, Drawings, Corporation, works, Site used in these Specifications shall be considered to have the meaning as understood from the definition of these terms included in the General Conditions of Contract.

1.4 General Rules for the measurement of works for payment

All measurements shall be made in the metric system. Different items of work shall be measured in accordance with the procedures set forth in the relevant sections read in conjunction with the General Conditions of Contract.

All measurements and computations, unless otherwise indicated, shall be carried nearest to the following limits:

(i) Length and breadth	...	10 mm
(ii) Height, depth or thickness of work.	...	5 mm
(iii) Areas	...	0.01 Sq. metres.
(iv) Cubic contents.	..	0.01 Cu. metres.

In recording dimensions of work the sequence of length, width and height or depth or thickness shall be followed.

1.5 Scope of Rates for Different Items of Work:

The contract unit rates for different items of work shall be for payment in full for completing the work to the requirements of the Specifications including full compensation for all the operations detailed in the relevant sections of these Specifications under 'Rates'. The rates are to be considered as the full inclusive rate for finished work covering all labour, tools, equipments, materials, wastage, temporary work, plant, overhead charges and profit as well as the general liabilities, obligations and risks arising out of the General Conditions of Contract.

2.0 SITE CLEARANCE:

2.1 Jungle Clearance (Clearing and Grubbing)

2.1.1 Description:

The work shall consist of numbering of trees, removing and disposing of all materials such as trees, bushes, woods, shrubs, grass, stumps, rubbish, rank vegetation, roots, foreign materials, etc., which in the opinion of the Engineer-in-Charge are unsuitable for incorporation in the works, from within the limits and areas as may be specified on the drawings or directed by the Engineer-in-Charge. Clearing and grubbing item is

payable for the location not covered under the area of earth work in excavation and filling as decided by the Engineer In-Charge in accordance with the requirements of these Specifications.

2.2 Cutting of Trees:

All trees up to a girth (perimeter) of 30 cm measured at one metre above the ground level shall also be cut and useful portion of the trees so cut shall be stacked at a suitable place as directed by the Engineer-in-Charge and shall be considered incidental to clearing and grubbing operations. Trees having girth above 30 cm are also to be cut and stacked separately as directed by Engineer-in-charge

The roots of trees shall be dug up to 60 cm below the ground level or 15 cm below formation level whichever is lower and after removal of all vegetable and organic matter from the holes so formed by removal of the roots, holes and hollows shall be filled with good earth in layer of 20 cm, well rammed, consolidated and levelled.

Where roots still exists at 60 cm depth, the same shall be excavated and further removed completely as directed by the Engineer-in-Charge. The serviceable and unserviceable materials obtained from the site clearance shall be removed from the area and disposed of to a place as per the directions of the Engineer-in-Charge. All unserviceable and serviceable materials obtained from the site clearance shall be the property of Power Grid.

Trees of girth larger than 30 cm shall be numbered with white paint on a black background and the number shall be such that the trees are easily identifiable. After the numbering, the Engineer-in-Charge shall indicate the trees which are to be cut and removed. After the written approval of the Engineer-in-Charge, all such trees which are required to be felled shall be cut by using suitable instruments and the trees so cut shall be stacked at suitable locations as directed by the Engineer-in-Charge. The roots of the trees cut shall be completely removed. This item shall include removal of roots up to 100 cm below the ground level or 50 cm below the formation level whichever is lower. After the trees are cut and roots are taken out, holes and hollows shall be cleaned of all organic and vegetable matter and shall be filled with good earth in layers of 20 cm well rammed, consolidated and levelled. The trunk and branches of trees shall be cut into suitable pieces and removed to stack at suitable locations as directed by the Engineer-in-Charge.

2.3 Preservation of Property/Amenity:

Trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all facilities within or adjacent to the works being carried out which are not to be disturbed shall be protected from injury or damage. The Contractor shall provide and install at his own expenses, suitable safeguards approved by the Engineer-in-Charge for this purpose.

2.4 Methods, Tools, and Plants:

Only such methods, tools and plants as are approved by the Engineer-in-Charge and will not effect the property to be preserved shall be adopted for the work. All trees, stumps, etc. falling within excavation and fill lines shall be cut to such depth below ground level that in no case these fall within 0.5 metre of the ground level. Also, all vegetation such as roots, undergrowth, grass and other deleterious matter unsuitable for incorporation in the filling shall be removed between fill lines to the satisfaction of the Engineer-in-Charge. On areas beyond these limits, trees and stumps required to be removed shall be cut down to below ground level so that these do not present on unsightly appearance.

All excavations below the general ground level arising out of the removal of trees, stumps, etc. shall be filled with suitable material and compacted thoroughly so as to make the surface at these points conform to the surrounding area.

2.5 Disposal of Materials:

All materials arising from clearing and grubbing operation shall be the property of Power Grid and be disposed of by the Contractor as hereinafter provided or directed by the Engineer-in-Charge within a lead of 1000 m beyond the periphery of area cleared.

Trunks and branches of trees shall be cleaned of limbs and tops and stacked neatly at places as indicated by the Engineer-in-Charge. Also boulders, stones and other materials usable shall be neatly stacked.

All products of clearing and grubbing which in the opinion of the Engineer-in-Charge cannot be used or auctioned shall be cleared away to waste areas and burnt, if so desired, at locations away within a lead of 1000 m beyond the periphery of area cleared in a manner as directed by the Engineer-in-Charge. Care shall be taken to see that unsuitable waste materials are disposed of in such a manner that there is no likelihood of these getting mixed up with the materials meant for

filling.

2.6 Measurement for Payment:

Clearing and Grubbing as described above, includes removal of trees up to a girth of 30 cm, bushes, woods, shrubs, grass, stumps, rubbish, rank vegetation, roots, other organic matter, etc. The unit of measurement shall be in Sq. m. Cutting of trees equal to or less than 30 cm in girth shall be considered incidental to the clearing and grubbing operations.

Cutting of trees above 30 cm in girth shall be paid for in terms of number according to the girth sizes given below:

- (i) Above 30 cm to 60 cm
- (ii) Above 60 cm; to 120 cm
- (iii) Above 120 cm to 240 cm
- (iv) Above 240 cm.

For this purpose, the girth shall be measured at a height of one metre above the ground level. The useful portion of the trees so cut shall be stacked at a suitable place as directed by the Engineer-in-Charge.

2.7.0 Rates:

2.7.1 The contract unit rates for the various items of clearing and grubbing Shall be paid in full for carrying out the required operations including Cutting of trees with a girth up to 30 cm, removal and stacking at a Place as directed by the Engineer-in-Charge, full compensation for all Labour, materials, tools, equipment and incidentals necessary to Complete the work. These will also include excavation and Backfilling of holes so formed for removal of roots wherever Necessary, and for handling, salvaging, piling and disposing of the Cleared materials within all lifts and up to a lead of 1000 metres Beyond the area under clearing and grubbing.

2.7.2 The trees above 30 cm in girth shall be enumerated girth wise under 4 Categories mentioned above in Para 2.6. The contract unit rate for cutting, removal and stacking of trees above 30 cm in girth shall Includes removal of stumps as well.

3.0 SITE LEVELLING WORK:

3.1 Description:

Before the earth work is started, the area coming under cutting and filling shall be cleared of shrubs, rank vegetation, grass, bush, wood, tress and sapling of girth up to 30 cm at a height of one meter above ground level, stacking of trees/saplins cut and rubbish removed up to 1000 meter beyond levelling boundary, the roots of trees and saplings shall be removed and the holes and hollows filled up with the earth, rammed and levelled. The aforesaid activities shall be deemed to be included in the item of earth work and nothing extra shall be payable on this account. Site levelling work shall consist of excavation, filling and other levelling operations, removal and satisfactory disposal of all materials necessary for achieving desired formation level, if required, in accordance with the requirements of these specifications and the lines, grades and cross-sections shown in the drawings or indicated by the Engineer-in-Charge. The work shall include the hauling and stacking of or the hauling to levelling site, of suitable materials as required, as also the disposal of unsuitable materials in specified manner; and the trimming and finishing of works.

The work to be performed under the specification consist of providing all labour, supervision, materials, planking and strutting, power, fuel, mechanical implements, tools and plants, supplies, transportation, storage, insurance, royalty,taxes and all incidental items not shown or specified but reasonably implied or necessarily implied for successful completion of the work, and in strict accordance with the drawings and specifications. The nature of work shall generally involve clearance of site, excavation in all kinds of soils, soft/disintegrated rock, hard rock, dewatering, transporting of excavated earth, filling, consolidation of earth, levelling benching, giving slopes and making formations as per drawings and instructions of the Engineer-in-Charge. This work also includes cutting of diversion channel to prevent the area from flooding and construction of kuchcha surface drains for drainage of the area. The drawing attached to the tender document provides a general idea about the work to be performed under the scope of this contract. This is a preliminary drawing for tender purpose only and is by no means the final drawings or show the full range of the work under the scope. The work shall be executed according to "Released for Construction", drawings with additions, alterations and modifications made from time to time as required or approved by the Engineer-in-Charge and also according to any other drawings that would be supplied to the Contractor progressively during the execution of the Contract.

3.2 Classification of Excavated Materials:

All materials involved in excavation shall be classified by the Engineer-in-Charge in the following groups:

3.2.1 All kind of Soils and soft/disintegrated rock

The material which can be quarried/ excavated with pick , shovel, jumpers, scarifiers, crowbars and other mechanical implements. All materials involved under this classification are as below:

All kind of soils : It includes various types of soils, plain concrete below ground level, shingle and river or nallah bed boulders, soling of road, paths and hard core, macadam surface of any description, stone masonry below the ground level, soft conglomerate and laterite stone which can be detached from the matrix with picks and shovel.

Soft/disintegrated Rock (Not requiring blasting): Rock and boulders which may be quarried and split with crow bars and other mechanical implements etc. It includes lime stone, sand stone, hard conglomerate.

3.2.2 Hard Rock:

All kind of rocks which can be excavated by machines and requires blasting chiselling in edging or in another agreed method. This can be classified under the following categories:

(a) Hard Rock (Requiring Blasting)

This shall comprise:

- (i) Any rock for the excavation of which the use of mechanical plant *or* blasting is required;
- (ii) Reinforced cement concrete (reinforcement cut through but not separated from the concrete) below ground; and
- (iii) Boulder requiring blasting.

(b) Hard Rock (Blasting Prohibited)

Hard rock requiring blasting as described under (a) above but where blasting is prohibited for any reason and excavation has to be carried out by chiselling, wedging *or* any other agreed method.

3.3 Authority for Classification:

The classification of excavation shall be decided by the Engineer-in-Charge and his decision shall be final and binding on the Contractor. Merely the use of explosives in excavation will not be considered as a reason for higher classification unless blasting is clearly necessary in the opinion of the Engineer-in-Charge. All the excavated material shall be the property of the Power Grid.

3.4 Site Levelling Operations:

3.4.1 Setting out and marking profiles.

After the site has been cleared, the limits of site levelling shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer-in-Charge. The Contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboos, stones, lime, mortar, concrete, etc., required in connection with the setting out of works and establishment of bench marks. A grid system of co-ordinates shall be established by the Contractor at the site. The Contractor shall be responsible for the maintenance of permanent reference pillars, bench marks and other marks and stakes as long as in the opinion of the Engineer-in-Charge they are required for the work. All such marks/pillars shall be removed by the Contractor at his own cost as soon as the purpose is over.

Masonry pillars shall be erected at suitable places in the area to serve as bench marks for the execution of the work. These bench marks shall be connected with G.T.S. of any other permanent bench mark approved by the Engineer-in-Charge. Necessary profiles with pegs, bamboos and strings or "*Burgeis*" shall be made to show the correct formation levels before the work is started and the same shall be approved by the Engineer-in-Charge. The contractor shall supply all labour, tools, equipment, materials, safeguards and incidentals necessary for setting out and making profiles and *burgeis* & pillars for the work at his own cost. The profiles and *burgeis* shall be maintained during the execution of the work.

Marks/pillars shall invariably be diagonal unless other wise directed, and should be such that their average height is representative of average depths. Payments will be made on the basis of volume measurement after with-holding the amount corresponding to 5% of the volume of earth work on account of non-removal of marks/pillars. The Contractor shall have to remove the marks/pillars and utilise the earth spoils as per the directions of the Engineer-in-Charge. The withheld amount as stated in the above paragraph may be paid after

certification of the Engineer-in-Charge; regarding his full satisfaction and to the effect that the mark/pillars, etc. have been removed and soils/earth thereof has been utilised as directed by him.

If the contractor fails to remove, partly or fully the marks/pillars in the manner and within the period as aforesaid double the amount spent by the owner for removal of marks/pillars will be recovered from dues payable to the contractor.

3.4.2 Excavation and Filling -General

All excavations shall be carried out in conformity with the directions laid Here in under and in a manner approved by the Engineer-in-Charge. The work shall be so done that the suitable materials available from excavation are satisfactorily utilised as decided upon before disposal.

While planning or executing excavation, the Contractor shall take all adequate precautions against soil erosion, water pollution, air pollution etc.

The excavations shall conform to the lines, grades, side slopes and levels shown on the drawings or directed by the Engineer-in-Charge. The Contractor shall not excavate outside the slopes or below the established grade or loosen any material outside the limits of excavation. Subject to the permitted tolerances, any excess depth excavated below the specified levels shall be made good at the cost of the Contractor with suitable material of similar characteristics and compacted to the required density and to the satisfaction of the Engineer-in-Charge.

All debris and loose material on the slopes of cuttings shall be removed.

Cutting shall be done from top to bottom. Under no circumstances undermining or undercutting shall be allowed. Final surface shall be neatly dressed. The earth from cutting shall be directly used for filling and no extra claim for double handling of earth shall be admissible to the contractor.

All cutting shall be done to the required slopes/shapes, levels and profiles as indicated in the construction drawing with a negative tolerance of 100 mm. If cutting be taken deeper, it shall be brought to the required level as per the instructions of the Engineer-in-Charge, by filling in with the earth and duly Consolidating at the Contractor's cost.

Filling shall be done in regular horizontal layers not exceeding 20 cm. in

depth. The earth shall be free from all roots, grass, rubbish and humps and clods exceeding 80mm in any direction shall be broken. Each layer shall be consolidated by breaking clods and Compacting each layer with wooden /steel rammer or movement of dozers, trucks or 8/10 tonne power road rollers, sheep foot roller and vibratory compactors etc. so that compaction of 95% of the maximum dry density is achieved at optimum moisture content. The surface finished shall be neatly dressed to the required formation levels with tolerance of (±) 100 mm.

Tests for Compaction are to be performed as per the procedures laid down in the relevant I.S. Codes of practice and Standard Field Quality Plan of Power Grid. In cases of compaction below the stipulated percentage, the contractor shall adopt proper techniques as directed by the Engineer in-Charge and to his satisfaction to ensure the specified degree of compaction. The cost of tests to be performed shall be borne by the Contractor.

During the execution of work, natural drainage of the area shall be maintained by the contractor.

3.4.3 Hard Rock Excavation.

Hard Rock, when encountered during excavation, shall be removed up to the finished ground level *or* as indicated on the drawings. In all cases, the excavation operations shall be so carried out that at no point on cut formation the rock protrudes above the specified levels, provided, however, that a negative tolerance of 150 mm shall be permissible.

Slopes in rock cutting shall be finished to uniform lines corresponding to slope lines shown on the drawings *or* as directed by the Engineer-in-Charge. Notwithstanding the foregoing, all loose pieces of rock on excavated slope surface which move when prised by a crowbar shall be removed.

Blasting shall be carried out as per clause 3.9 and all precautions indicated therein to be observed.

3.4.4 Dewatering

If water is met with in the excavation due to stream flows, springs, seepage, rain or other causes, it shall be removed by suitable diversions, pumping or bailing out and other excavation kept dry whenever so required or directed by the Engineer-in-Charge, Care shall be taken to so discharge the drained water as not to cause damage to the works, crops or any other property. No extra payment

shall be admissible to the contractor on this account.

3.4.5 Disposal of excavated Materials.

All the excavated materials shall be the property of Power Grid. Where the excavated material is directed to be used in the filling area, it shall be directly deposited at the required location complying with the total requirements. All disposed material other than hard material shall be spread in layers at the places within specified leads. All hard materials, such as hard moorum, rubble, etc., not intended for use in the filling, shall be stacked neatly on Corporation land as directed by the Engineer-in-Charge within the lead specified for the item, for future use such as pitching. Unsuitable and surplus materials not intended for use in any part of the works shall be disposed of as directed by the Engineer-in-Charge.

3.4.6 Plying of Construction Traffic.

Construction traffic shall not use the levelled area without prior permission of the Engineer-in-Charge. Any damage arising out of such use shall be made good by the Contractor at his own expense.

3.4.7 Preservation of Property

The Contractor shall undertake all reasonable precautions for the protection and preservation of any or all existing roadside trees, drains, sewers or other subsurface drains, pipes, conduits and any other structures under or above ground, which may be affected by construction operations and which in the opinion of the Engineer-in-Charge shall be continued in use without any change. Safeguards taken by the Contractor in this respect, shall be got approved by him from the Engineer-in-Charge. However, if any of these objects is damaged by reason of the Contractor's negligence, it shall be replaced or restored to the original condition at his expense.

3.4.8 Finishing Operations.

Finishing operations shall include the work of properly shaping and dressing all excavated surfaces. When completed, no point on the slopes shall vary from the designated slopes by more than 150 mm measured at right angles to the slope, except where excavation is in rock where no point shall vary more than 600 mm from the designated slope. In no case shall any portion of the slope encroach on the road way.

3.5 Earth Fill

3.5.1 Suitable Material

The borrowed earth used in filling shall be free from all roots, grass, shrubs, rank vegetation, brush wood, tree sapling and rubbish.

3.5.2 Unsuitable Material

Unsuitable material shall mean materials unsuitable for placing as fill in the works and shall comprise:

- (1) Material from swamps, marshes and bogs;
- (2) Peat, logs, stumps and perishable materials;
- (3) Material susceptible to spontaneous combustion;
- (4) Any natural material or industrial and domestic produce which will adversely affect other materials in the work;
- (5) Clay with liquid limit exceeding 80% and/or plasticity index exceeding 5570.

3.5.3 Spreading and Compaction of Filling.

For the earth works contractor shall satisfy the Engineer-in-Charge that the entire specified requirement regarding compaction can be achieved.

The Final formation shall be correct in level and profile after compaction.

In the case of earth work consolidated under optimum moisture conditions, each layer of earth shall be carefully moistened to give field moisture content of about + 1% to - 2% of the optimum moisture content (OMC). The OMC shall be determined according to IS: 2720 (Pt.VII &VIII) Methods of Tests for Soils.

Each layer shall then be compacted by rolling with wooden/ steel rammer or movement of dozers, trucks, 8/10 tonnes power road roller, sheep foot roller and vibratory compactors . The required amount of water shall be added during consolidation to keep the moisture content of the soil at the optimum as per test. The density to be achieved for each layer of the material shall not be less than 95% of the density obtained in the laboratory (Proctor Method).

Control on compaction in the field shall be exercised through frequent moisture content and density determinations. A systematic record of these shall be maintained. At all times during construction the top of the embankment shall be maintained at such cross fall as will shed water and prevent pounding.

3.6 Testing shall be carried out as per standard field quality plan of Power--Grid.

3.7 Measurement for Payment.

The ground levels shall be taken at every 5 metres distance and at closer distances where pits, undulations, etc. are met with. The ground level shall be recorded in field book, plotted on plans and shall be signed by contractor and the Engineer-in-Charge before the earth work is started.

The levels of the area after excavation shall be recorded in the field book duly signed by the Engineer-in-Charge and contractor. The labour, materials, tools, equipment, safeguards and incidentals required for taking levels shall be supplied by the contractor at his own cost.

In case of filling with borrowed earth, the measurement shall be based on levels of area under filling only.

3.7.1 Earth work in Excavation and filling.

The quantity of excavation in all types of soil and soft/disintegrated rock shall be worked out by using initial and final levels. No void deduction shall be made to calculate net quantity of earth work. Only Excavation/cutting will be measured for payment purpose. The unit of measurement shall be in cubic metre.

In case hard rock is encountered during excavation, the level of rock surface before start and completion of rock excavation shall be recorded for calculating the quantity of excavation of hard rock. The volume of hard rock shall be computed on the basis of stacks of excavated rubble after making 50 % deduction for voids. The item of excavation in hard rock shall be payable separately.

The quantity of earth work in excavation in all kinds of soil & soft/disintegrated rock shall be arrived by reducing quantity of hard rock from the gross excavated quantity.

The unit rate shall include all lifts and all leads within levelling boundary. It also includes disposal of surplus earth and stacking of unusable material up the lead of 1000 meters beyond the levelling boundary

3.7.2 Earth work in excavation in all types of Soils and Soft /disintegrated rocks, Hard Rocks and disposal.

Quantity of excavation in all type of soils and soft/disintegrated rocks shall be worked out based on initial level before start of excavation and final levels after excavation. No void deduction shall be made to calculate net quantity of earth work in excavation. The excavated soil and soft/disintegrated rock shall be used for filling in lower areas of the substation. The unit rate shall include disposal of excavated material for leads up to 1000 meters beyond the levelling boundary.

For hard rock excavation, the volume of hard rock shall be computed on the basis of stacks of excavated rubble after making 50 per cent deduction for voids. The unit of measurement shall be in cubic meter. The unit rate shall include stacking, disposal of excavated material for leads up to 1000 meters beyond the levelling boundary.

Where soil, soft/disintegrated rock and hard rock are mixed, The quantity of earth work in excavation in all kinds of soil & soft/disintegrated rock shall be arrived by reducing quantity of hard rock from the gross excavated quantity.

3.7.3 Filling using earth borrowed from outside the substation land.

The quantity of earth shall be worked out based on initial and final levels of levelling area. No void deduction shall be made to calculate net quantity of earth work. The unit of measurement shall be in cubic meter. The rate shall include arrangement of borrow area, payment of royalty, transportation, laying compaction, all leads and lifts etc.

3.8 Rate:

Rate for each item shall include all operations specified in the respective clause of technical specification of Site Levelling Work.

3.9 Blasting Operations.

3.9.1 General.

Blasting shall be carried out only with the written permission of the Engineer-in-Charge. All the statutory laws, regulations, rules, Indian Standards, etc., pertaining to the acquisition, transport, storage,

handling and use of explosives shall be strictly followed.

The Contractor may adopt any method or methods of blasting consistent with the safety and job requirements, after approval from the Engineer-in-Charge and shall muffle the blasting adequately to the satisfaction of the Engineer-in-Charge. Blasting should be carried out as far as possible with the help of Ammonium Nitrate mixed with proper proportions of fuel oil which is a safer method. However, in the event of its non-availability the convenient practice of using gelatine with detonators can be resorted to.

The magazine for the storage of explosives shall be built to the designs and specifications of the Explosives Department concerned and located at the approved site. No unauthorised person shall be admitted into the magazine which when not in use shall be kept securely locked. No matches or inflammable material shall be allowed in the magazine. The magazine shall have an effective lightning conductor. The following shall be hung in the lobby of the magazine.

- (a) A copy of the relevant rules regarding safe storage both in English and in the language with which the workers concerned are familiar.
- (b) A statement of up to date stock in the magazine.
- (c) A certificate showing the last date of testing of the lightning conductor, (d) A notice that smoking is strictly prohibited.

In addition to these, the Contractor shall also observe the instructions in following clauses and any further additional instructions which may be given by the Engineer-in-Charge and shall be responsible for damage to property and any accident which may occur to workmen or the public or the materials on account of any operations and blasting. The Engineer-in-Charge shall frequently check the Contractor's compliance with these precautions.

3.9.2 Materials, tools and Equipment.

All the materials, tools and equipment used for blasting operations shall be of approved type and shall be arranged by the contractor from any authorised dealer of such approved material. Necessary assistance in the form of approval for procurement of the material shall be given by the Corporation. The contractor shall be fully responsible for entering into the agreement with any authorised magazine contractor in respect of rates, regularity of supply, etc. the Engineer-in-Charge may specify the type of explosives to be allowed in special cases. The fuse to be used in wet locations 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 definitely known to permit such a safe length being cut as will permit sufficient time to the firer to reach safety before explosion takes place. Detonators shall be capable of giving effective blasting of the explosives. The blasting powder, explosives, detonators fuses, etc., shall be fresh and not damaged due to damp, moisture or any other cause. They shall be inspected before use and damaged articles shall be discarded totally and removed immediately.

3.9.3 Personnel

The blasting operation shall remain in the charge of competent and experienced supervisor and workmen who are thoroughly acquainted with the details of handling explosives and blasting operations.

3.9.4 Blasting Operations.

The blasting shall be carried out during fixed hours of the day preferably during the mid-day lunch hour or at the close of the work as ordered in writing by the Engineer-in-Charge. The hours shall be made known to the people in the vicinity. All the charges shall be prepared by the man in charge only. Proper precautions for safety of persons and property shall be taken.

Red danger flags shall be displayed prominently in all directions during the blasting operations. People, except those who actually light the fuse shall be prohibited from entering this area. The flags shall be planted 200 metres from the blasting site in all directions and all persons including workmen shall be excluded from the flagged area at least 10 minutes before the firing, a warning whistle being sounded for the purpose.

The charge holes shall be drilled to required depths and in suitable places. Blasting should be as light as possible consistent with thorough breakage of the material necessary for economic loading and hauling. Any method of blasting which leads to overshooting shall be discontinued.

When blasting is done with powder, the fuse cut to the required length shall be inserted into the hole and the powder dropped in. The powder shall be gently tamped with copper rods with rounded ends. The explosive powder shall then be covered with tamping material which shall be tamped lightly but firmly.

At a time, not more than 10 such charges will be prepared and fired. The man in charge shall blow a whistle in a recognised manner for cautioning the people. All the people shall then be required to move to safe distances. The charges shall be lighted by the man in charge only. The man in charge shall count the number of explosions. He shall

satisfy himself that all the charges have been exploded before allowing the workmen to go back to the work site.

When blasting is to be carried out in the proximity of other existing structures, sand/earth bags, etc. shall be used on the top of the blast holes to prevent the rock fragment from causing damage to the structures.

However, when blasting is prohibited for any reasons the excavation shall be carried out by chiselling, wedging or any other agreed method.

3.9.5 Misfire

In case of misfire, the following procedure shall be observed: (i) Sufficient time shall be allowed to account for the delayed blast. The man in charge shall inspect all the charges and determine the missed charges, (ii) If it is the blasting powder charge it shall be completely flooded with water. A new hole shall be drilled at about 45 cm. from the old hole and fired. This should blast the old charge. Should it not blast the old, the procedure shall be repeated till the old charge is blasted. If a misfire has been found to be due to defective detonator, the whole quantity in the box from which defective article was taken must be sent to the authority directed by the Engineer-in-Charge for inspection to ascertain whether all the remaining materials in the box are also defective.

3.9.6 Account.

A careful and day to day account of the explosives shall be maintained by the Contractor in an approved register and manner which shall be open to inspection by the Engineer-in-Charge at all times.

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1.	Detailed Soil Investigation	a) Bore log	1. Depth of bore log 2. SPT Test 3. Collection of samples	As per POWERGRID Specification	Contractor	100% at Field	To witness 20% at Field	Site Engineer
		b) Tests on samples	As per tech. Specs.	As per POWERGRID Specification	Contractor (Testing in POWERGRID accepted Lab)	100% by testing lab (Reports to be signed by Testing person & Checking person)	Review of lab test results (All soil reports to have signature of POWERGRID executive reviewing the report)	Site In-charge based on the guide line issued by CC Engg. as Annex-6
2.	Earth Work (site leveling)							
		1. Mandatory testing for filling						
			1. Proctor compaction test for maximum dry density 2. Optimum Moisture Content	IS:2720(part-7) & Specification do	Contractor from Powergrid approved Lab. Contractor/ From Powergrid approved Lab.	One sample per 25000 Cu. m. for each type & source of filling material. do	100% review of lab test results do	Site In charge do
		2. Field Compaction Test	1. Field dry density & Moisture content test for each layer of compaction.	IS:2720 (part-29), & POWERGRID Specification	Contractor Field lab / Powergrid approved Lab.	One sample for every 2500 sqm. or part there of for compacted soil for each compacted layer.	do	do



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					Agency	Agency		
3.	Checking of foundation Material							
	A. Materials	1. Cement	1. Brand approval	Cement of approved brands according to the COV in POWERGRID web site may be procured.	Contractor	As proposed by Contractor	Any new brand cement proposed by Contractor shall be assessed by RHQ-FOA and approved by Regional Head. After approval, details shall be forwarded to CC-QA&I for uploading in COV.	FOA-RHQ
			2. Physical tests	As per document at Annexure-I of this FQP	Contractor Samples to be taken jointly with POWERGRID and tested at POWERGRID accepted lab	Review of 100% MTC's and one sample for every Batch No. of Manufacturer.	100% review of lab test results and MTC. Test results shall be sent by the Lab, by E mail directly to POWERGRID; further, hard Copy of Test Certificate shall also be sent by the Lab directly to POWERGRID by Postal Address.	Site in charge
			3. Chemical Tests composition of Cement	-do-	Contractor to submit MTC	Review of all MTC's	100% review of MTC results	Site In charge
		2. a) Reinforcement Steel	1. Source approval	May be procured either from main producers directly or through the authorized dealers who can produce MTC from main producers with traceability. Refer COV in POWERGRID web site, for List of Main Producers of Re-enforcement Steel.	Contractor	As proposed by contractor.	Material shall be supplied from Main producers / authorized dealers.	Site in charge.



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			2. Physical and Chemical analysis test	As per annexure-2 of this FAQ	Contractor to submit MTC	100% MTC's One sample* / 500 MT / Manufacturer shall be jointly sealed by POWERGRID and tested at POWERGRID approved Lab. *Note: All sizes of 10mm and above shall be taken for testing in every 500MT.	100% review of MTC, and embossing. 1) Review of lab test results. Test results shall be sent by the Lab, by E mail directly to POWERGRID; further, hard Copy of Test Certificate shall also be sent by the Lab directly to POWERGRID by Postal Address. 2) Unit weight of three samples to be witnessed. #	site In charge
# # Three samples of each size of Reinforcement steel (all sizes of 10mm & above) out of 100MT steel Lot need to be physically weight at site in presence of POWERGRID to ascertain their acceptance as per technical specification. The weighted samples at site may be kept under custody for three months for further examination by any auditing authority (if required).								
	2. b) Miscellaneous structural steel excluding cable trench, transformer & reactor fdn.	Source to be proposed by contractor.	Source with material meeting POWERGRID Specification	contractor	As proposed by contractor	100%	To verify documents.	site In charge
		1. Dimensional check 2. Visual check for damages rusting pitting etc	POWERGRID specification and approved drawing	Contractor			random	Site Engr
	2.c) Structural steel used in cable trenches , transformer	Source to be proposed by contractor.	POWERGRID Specification	Contractor	As proposed by contractor		To verify documents.	

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				1. Dimensional check	POWERGRID specification and approved drawing	Contractor	100%	random	Site Engr
				2. Visual check for damages rusting pitting etc.	POWERGRID specification and approved drawing	Contractor	100%	random	Site Engr
				3. Visual check for welding defects primer coating and painting/ galvanizing as applicable	POWERGRID specification and approved drawing	Contractor	100%	Random	Site Engr
				4. Physical properties of Structural steel	IS:2062 POWERGRID specification and approved drawing	Contractor	1 sample per lot of 40MT or part thereof for tensile tests and 1 sample per lot of 20MT or part thereof for bend test of each size.	Review of lab test results by POWERGRID.	Site Engr
				3. Coarse Aggregates	1. Source approval Source meeting POWERGRID Specification	Contractor	Proposed by the Contractor, indicating the location of the quarry & based on the test results of Joint samples tested in POWERGRID accepted lab	To review the proposal based on the documents	Site In-charge. Once approved, the particular source shall be used for all the running contracts under various Packages.

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			2. Physical tests	As per document at Annexure-3 of this FQP	Samples to be taken jointly and tested in POWERGRID accepted lab	One sample per 500 cum or part thereof per source, Samples to be tested by Contractor in POWERGRID accepted lab.	100% review of lab test results. Out of these 100% samples, POWERGRID shall witness at TPL, 5 samples selected at random, spread during the overall execution period of contract.	Site In charge
	4. Fine aggregate	1. Source approval	Source meeting POWERGRID Specification	Contractor	Proposed by the Contractor, indicating the location of the quarry and based on the results of Joint samples tested in POWERGRID accepted lab.	To review the proposal based on the documents.	Site In-charge. Once approved, the particular source shall be used for all the running contracts under various Packages.	
		2. Physical test	As per Annexure-4 of this FQP	Samples to be taken jointly and tested in POWERGRID accepted lab	One sample per 500cum or part thereof per source, Samples to be tested by Contractor in POWERGRID accepted lab.	100% review of lab test results. Out of these 100% samples, POWERGRID shall witness at TPL, 5 samples selected at random, spread during the overall execution period of contract.	Site In charge	
	5. Water	1. Cleanliness	POWERGRID Specification (Water shall be fresh and clean)	Contractor	100% visual check at Field	Verification at random	Site Engineer	

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			2. PH Value	- do -	Contractor	One sample per source	100% review of the test results	Site Engineer
		6.Finishing materials of building	Physical verification of Different items as per specification	As per Spec.	Contractor	100%	MTC/Manufacturer catalogue To be reviewed by POWERGRID.	Site In charge.
	B. Concrete Works a) Before concreting							
		1. Dimensions of excavation	Dimension & Depth of foundation	Appd. Drgs.	Contractor	100% at Field	100% check by POWERGRID	Site. Engr.
		2. Stub setting/Setting of Foundation Bolts, Embedments etc.	1) Centre Line 2) Diagonals 3) Level of stubs./ Foundation bolts	-do- -do- -do-	-do- -do- -do-	-do- -do- -do-	-do- -do- -do-	*.-*-do- *.-*-do- *.-*-do-



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		3. Reinforcement steel	Placement	Bar bending schedule	-do-	-do-	-do-	*-At least 5% locations shall be cross verified by immediate Reporting officer/ Site In charge, at Random with respect to stub setting and reinforcement steel placement
	b) During concreting	1. Workability	Slump test	Range 25 mm to 75 mm refer document at Annexure-5 of this FQP	Contractor	Minimum 01 sample per day	20% check at random	Site Engr.




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					Agency	Agency		
		2. Concrete Strength	Cubes Comp Strength	CPWD SPEC as referred in document at annexure-5 of this FQP	<p>Contractor</p> <p>Casting of cubes at site. Cubes to be tested for 28 days strength at POWERGRID appd. Lab /POWERGRID Lab/At site (if testing machine installed by contractor is duly calibrated by NABL Lab.)</p> <p>Cubes at 100% location are to be taken in presence of POWERGRID officials.</p>	<p>One sample of 3 cubes for every 20 Cum or part thereof. (Mini. Qty. required for testing is 5 cu. m. for each day of concrete).</p>	<p>100% review of Lab test results. Cubes at 100% location are to be taken in presence of POWERGRID officials. Normally testing shall be carried out at the Cube Testing Facility installed at POWERGRID premises, in the witness of POWERGRID. Alternatively, samples shall be tested at POWERGRID approved Labs.</p> <p>In this case, test results shall be sent by the Lab, by E mail directly to POWERGRID; Further, hard Copy of Test Certificate shall also be sent by the Lab directly to POWERGRID by Postal Address.</p> <p>Further, POWERGRID to witness testing on 20% samples and also to review 100% test results.</p>	<p>Site Engineer. 10% samples to be witnessed at TPL by POWERGRID Site Engineer and at least 5% samples at random, shall be witnessed by Site In-charge. In-case of Site / POWERGRID Lab, 100% witnessed by POWERGRID representative.</p>
c) Backfilling	Watering & Ramming for compaction		a) Visual	POWERGRID Spec	Contractor	100%	Random	 <p>Site Engr.</p>


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					Agency	Extent		
			b) Compaction Test	POWERGRID Spec	Contractor At Site/ Power grid Accepted Lab	a) One Sample of three specimen for 50% of tower location b) One Sample of three specimen for 20% of Equipment Foundation location c) 3 Samples (three specimen for one sample) for every Building (The depth of sampling and the locations shall be decided by Site Engineer)	Physically at Random & 100% review of Test results	Site In charge
4.	Pile foundations	REFER SFQP OF SWITCHYARD PILE WORK						
5.	Brick Masonry							
	a) BRICKS	1. Dimensional tolerance	POWERGRID Specification/enclosed annexure 6	Contractor (samples to be taken jointly and tested in POWERGRID accepted lab)	Enclosed Annexure 6	Review 100% of test results	Site Engineer	



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					Agency	Extent		
			2. Compressive strength	POWERGRID Specification/enclosed annexure 6	-Do-	-Do-	-do-	Site Engineer
			3. Water Absorption	POWERGRID Specification/enclosed annexure 6	-Do-	-Do-	-do-	Site Engineer
			4. Efflorescence	POWERGRID Specification/enclosed annexure 6	-Do-	-Do-	-do-	Site Engineer
		b) Mortar Mix	Cement sand Proportion	As per POWERGRID Spec	Contractor	100%	random	Site Engr
6.	P.C.C	Grade, thickness, plan dimension	completeness	IS:456 and POWERGRID approved foundation drawings & specification	Joint Inspection by POWERGRID and CONTRACTOR	For all locations	Joint Inspection by POWERGRID and CONTRACTOR	Site Engr.
7.	PLASTERING							
		1. Plastering	thickness and evenness	As per POWERGRID Spec.	Contractor	100%	Random	Site Engr
		2. Ingredients	Mortar Mix/Proportion	As per POWERGRID Spec.	Contractor	100%	Random	Site Engr
8.	Switchyard earthing							
		1. Check for dimension of earth mat	Physical check	POWERGRID spec & approved drawings	contractor	100%	Random	Site Engr



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					Agency	Extent		
		2. Depth of excavation	Physical check	POWERGRID spec & approved drawings	Contractor	100%	Random	Site Engr
		3. Check for weld joints and anti corrosion treatment	Physical check	POWERGRID spec & approved drawings	Contractor	100%	Random	Site Engr
9.	Site surfacing	1. Leveling, Level & Height & evenness 2. Soil sterilization : spraying of chemicals	Physical Check Physical Check	POWERGRID spec & approved drawings POWERGRID spec & manufacturers recommendations	Contractor Contractor	100% 100%	Random random	Site Engr Site engineer
		'3.P.C.C (Grade, thickness & Size) 'a) PCC 1:5:10 (1 cement:5 coarse/fine sand:10 burnt brick aggregates)	Completeness	POWERGRID specifications	Joint Inspection by POWERGRID and Contractor	100%	Random	Site Engr
		-Burnt brick aggregate of nominal size 40 mm	Grading	As per Annexure-8	Samples to be taken jointly & tested in POWERGRID accepted lab	1 sample per 500 cu.mtr	100% review of lab test results	Site In-charge
		4. 20/40mm stone aggregate	Grading	IS 383, IS 2386 and POWERGRID Speci. The grading shall be as per single sized nominal size	Contractor (POWERGRID accepted lab)	1 sample per lot of 500 Cubic Meter or part thereof from each source for each size.	100% review of test report	Site Engineer



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					Agency	Extent		
		5. Resistivity of 20/40mm stone aggregate.	Electrical Check	POWERGRID Technical Specification. (resistivity of the stone for spreading over the ground shall be minimum 3000 ohm-m under wet condition)	Contractor	1 sample of stone from each source (in case stones are supplied from more than one source)	100% review of test report.	Site Engineer
		6. Compacted thickness of 20/40mm stone layers as applicable	Physical	POWERGRID spec & approved drawings	Contractor	100%	Random	Site Engineer
10	Road (WBM layers)							
		1. Alignment & Level	Physical check	Power grid spec & approved drawings	Contractor	100%	100%	Site In charge
	Material	A. Coarse Aggregates	1. Source approval	Source with materials meeting POWERGRID Specification	Contractor	Proposed by the Contractor, indicating the location of the quarry and based on the test results of Joint samples tested in POWERGRID accepted lab	To review the proposal based on the documents	Site In charge
			2. Physical tests	As per document at Annexure-7 of this FQP	Samples to be taken jointly and tested in POWERGRID approved lab	One sample per lot of 200 cum or part thereof per source	100% review of lab test results	Site In charge



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					Agency	Extent		
		B) Stone Screening						
			1. Source approval	Source with materials meeting POWERGRID Specification	Contractor	Proposed by the Contractor, indicating the location of the quarry and based on the test results of joint samples tested in POWERGRID accepted lab	To review the proposal based on the documents	Site In charge
			2. Grading	As per document at Annexure-7 of this FQP	Samples to be taken jointly and tested in POWERGRID accepted lab	One sample per lot of 200 cum or part thereof	100% review of lab test results	Site In charge
		C) Binding Material	Plasticity index	As per document at Annexure-7 of this FQP	Contractor	One sample per lot of 25 cum or part thereof	100% review of lab test results	Site In charge
		D) Laying of sub base Course	Physical check	As per CPWD spec clause 17.7.2	Contractor	100%	Random	Site Engr
		E) Laying of base Course	Physical check	As per CPWD spec clause 17.8.1	Contractor	100%	Random	Site Engr
11	Drain	Alignment and invert level	Physical	POWERGRID spec and approved drawing	Contractor	100%	Random	Site Engr



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ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR CEMENT

ORDINARY PORTLAND CEMENT

S. No.	Name of the test	Ordinary Portland Cement 33 grade as per IS 269	Ordinary Portland Cement 43 grade as per IS 8112	Ordinary Portland Cement 53 grade as per IS 12269	Remarks
a)	Physical tests				To be conducted in Appd. Lab
(i)	Fineness	Specific surface area shall not be less than 225 sq.m. per Kg. or 2250 Cm ² /gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 Cm ² /gm.	Specific surface area shall not be less than 225 sq.m. per Kg or 2250 Cm ² /gm.	Blaine's air permeability method as per IS 4031 (Part-2) / Sieve analysis as per IS 4031 (part-3)
(ii)	Compressive strength	72 ± 1 hour : Not less than 16 Mpa (16 N/mm ²) 168 ± 2 hour : Not less than 22 Mpa (22 N/mm ²) 672 ± 4 hour : Not less than 33 Mpa (33 N/mm ²)	72 ± 1 hour : Not less than 23 Mpa (23 N/mm ²) 168 ± 2 hour : Not less than 33Mpa (33 N/mm ²) 672 ± 4 hour : Not less than 43 Mpa (43 N/mm ²)	72 ± 1 hour : Not less than 27Mpa (27 N/mm ²) 168 ± 1 hour : Not less than 37Mpa (37 N/mm ²) 672 ± 1 hour : Not less than 53 Mpa (53 N/mm ²)	As per IS 4031 (Part-6)
(iii)	Initial & Final setting time	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes	As per IS 4031 (Part-5) -do-
(iv)	Soundness	Un-aerated cement shall not have an expansion of more than 10mm when tested by Le Chatlier and 0.8% by Autoclave test.	Un-aerated cement shall not have an expansion of more than 10mm when tested by Le Chatlier and 0.8% by Autoclave test	Un-aerated cement shall not have an expansion of more than 10mm when tested by Le Chatlier and 0.8% by Autoclave test.	Le Chatlier and Autoclave test as per IS 4031 (Part-3)

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S. No.	Name of the test	Ordinary Portland Cement 33 grade as per IS 269	Ordinary Portland Cement 43 grade as per IS 8112	Ordinary Portland Cement 53 grade as per IS 12269	Remarks
b)	Chemical composition tests				Review of MTC only
	a)	Ratio of percentage of lime to percentage of silica, alumina & iron oxide 0.66 to 1.02	a) Ratio of percentage of lime to percentage of silica, alumina & iron oxide 0.66 to 1.02	a) Ratio of percentage of lime to percentage of silica, alumina & iron oxide 0.80 to 1.02%	
	b)	Ratio of percentage of alumina to that of iron oxide Minimum 0.66%	a) Ratio of percentage of alumina to that of iron oxide Minimum 0.66	a) Ratio of percentage of alumina to that of iron oxide Minimum 0.66%	
	c)	Insoluble residue, percentage by mass Max. 4.00%	c) Insoluble residue, percentage by mass Max. 2.00%	c) Insoluble residue, percentage by mass Max. 2.00%	
	d)	Magnesia percentage by mass Max. 6%	d) Magnesia percentage by mass Max. 6%	d) Magnesia percentage by mass Max. 6%	
	e)	Total sulphur content calculated as sulphuric anhydride (SO ₃), percentage by mass not more than 2.5 and 3.0 when tri-calcium aluminate percent by mass is 5 or less and greater than 5 respectively.	e) Total sulphur content calculated as sulphuric anhydride (SO ₃), percentage by mass not more than 2.5 and 3.0 when tri-calcium aluminate percent by mass is 5 or less and greater than 5 respectively.	e) Total sulphur content calculated as sulphuric anhydride (SO ₃), percentage by mass not more than 2.5 and 3.0 when tri-calcium aluminate percent by mass is 5 or less and greater than 5 respectively.	
	f)	Total loss on ignition shall not be more than 5 percent	f) Total loss on ignition shall not be more than 5 percent	f) Total loss on ignition shall not be more than 5 percent	



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S. No.	Name of the test	Remarks
2.	POZZOLANA PORTLAND CEMENT AS PER IS 1489	
a)	Physical tests	
	i) Fineness	Specific surface area shall not be less than 300 sq.m. per Kg. or 3000 Cm ² /gm
	ii) Compressive strength	a) 72 ± 1 hour : Not less than 16 Mpa (16 N/mm ²) b) 168 ± 2 hour : Not less than 22 Mpa (22 N/mm ²) c) 672 ± 4 hour : Not less than 33 Mpa (33 N/mm ²)
	iii) Initial & Final setting time	Initial setting time : Not less than 30 minutes Final setting time : Not more than 600 minutes
	iv) Soundness	Un-aerated cement shall not have an expansion of more than 10mm Le Chatelier test and 0.8% by Autoclave test as per IS 4031 (Part-3)
b)	Chemical composition tests	
	a) Magnesia percentage by mass Max. 6%	Review of MTCC only
	b) Insoluble material, percentage by mass $x + 4(100-x)/100$ where x is the declared % of pozzolana in the PPC	-do-
	c) Total sulphur content calculated as sulphuric anhydride (SO ₃), percentage by mass not more than 3.0	-do-
	Total loss on ignition shall not be more than 5 percent	



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ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR REINFORCEMENT STEEL AS PER IS 1786-1985 Edition-4.3 (2004-12)

S. No.	Name of the test	Fe 415	Fe 500
i)	Chemical analysis test		
	Carbon	0.30 Percent Maximum	0.30 Percent Maximum
	Sulphur	0.060 Percent Maximum	0.055 Percent Maximum
	Phosphorus	0.060 Percent Maximum	0.055 Percent Maximum
	Sulphur & Phosphorus	0.11 Percent Maximum	0.105 Percent Maximum
ii)	Physical tests		
	a) Tensile Strength Minimum	10% more than actual 0.2% proof stress but not less than 485 N/Sq.mm.	8 % more than actual 0.2% proof stress but not less than 545 N/Sq.mm
	b) 0.2% of proof stress/Yield stress Minimum, N/mm ²	415	500
	c) Elongation percent , Minimum	14.5	12
iii)	Bend & Rebend tests	Pass	Pass



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Annex-3

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR COARSE AGGREGATES AS PER IS 383

3. Coarse Aggregates													
i) Physical Tests													
a) Determination of particles size	a. IS Sieve Designation	%age passing for Single-Sized Aggregate of nominal size						Percentage Passing for grades Aggregate of nominal size					
	40 mm	20 mm	16 mm	12.5 mm	10 mm	40 mm	20 mm	16 mm	12.5 mm				
	63 mm	100	-	-	-	-	-	-	-				
	40 mm	85 to 100	100	-	-	95 to 100	100	-	-				
	20 mm	0 to 20	85 to 100	100	-	30 to 70	95 to 100	100	100				
	16 mm	-	-	85 to 100	100	-	-	90-100	-				
	12.5 mm	-	-	-	85 to 100	100	-	-	90 to 100				
	10 mm	0 to 5	0 to 20	0 to 30	0 to 45	85 to 100	10 to 35	25 to 55	30 to 70	40 to 85			
	4.75 mm	-	0 to 5	0 to 5	0 to 10	0 to 20	0 to 5	0 to 10	0 to 10	0 to 10			
	2.36 mm	-	-	-	-	0 to 5	-	-	-	-			
b. Flakiness index	Not to exceed 25%												
c. Crushing Value	Not to exceed 45%												
d. Presence of deleterious material	Total presence of deleterious materials not to exceed 5%												
e. Hardness	Abrasion value not more than 40%, Impact value not more than 30%												
f. Soundness test (for concrete work subject to frost action)	12% when tested with sodium sulphate and 18% when tested with magnesium sulphate												

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ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FINE AGGREGATES AS PER IS 383

4. Fine aggregates					
i) Physical Tests		Percentage passing for graded aggregate of nominal size			
a) Determination of particle size		IS Sieve Designation	F.A. Zone I	F.A. Zone II	F.A. Zone III
		10 mm	100	100	100
		4.75 mm	90-100	90-100	90-100
		2.36 mm	60-95	75-100	85-100
		1.18 mm	30-70	55-90	75-100
		600 microns	15-34	35-59	60-79
		300 microns	5 to 20	8 to 30	12 to 40
		150 microns	0-10	0-10	0-10
b) Silt content			Not to exceed 8%	Not to exceed 8%	Not to exceed 8%
c) Presence of deleterious material		Total presence of deleterious materials shall not exceed 5%			
d) Soundness Applicable to concrete work subject to frost action		12% when tested with sodium sulphate and 15% when tested with magnesium sulphate			



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ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR CONCRETE WORK

1)	Concrete	a) Workability	Slump shall be recorded by slump cone method and it shall be between 25-75 mm. depending upon workability requirement as per IS 456.
		b) Compressive strength	<p>For Design mix as per IS:456 for Grade M20 or above</p> <p>For nominal (volumetric) concrete mixes compressive strength for 1:1.5:3 (Cement : Fine aggregates : Coarse aggregates) concrete 28 days strength shall be min 265Kg/cm² and for 1:2:4(Cement: Fine Aggregate: Coarse aggregate) nominal mix concrete 28 days strength shall be min 210Kg/cm².</p>

Notes :

- 1) All Design Mix concrete shall be as per IS: 456.
- 2) ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTHS FOR DESIGN MIX CONCRETE: AS PER Table-11 of IS:456 as given below:

Specified Grade	Mean of the Group of 4 Non-Overlapping consecutive test results in N/sq mm	Individual Test Results in N/sq mm
M 20 or above	<p>Shall greater than or equal to $f_{ck} + 0.825 \times \text{established standard deviation (rounded off to nearest 0.5 N/sq mm)}^*$</p> <p>Or</p> <p>$F_{ck} + 3 \text{ N/sq mm, whichever is greater}$</p>	$\geq f_{ck} - 3 \text{ N/sq mm}$

* Established value of standard deviation shall be determined based on Note of Table-11 of IS:456

3) ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTHS FOR NOMINAL MIX CONCRETE:

- a) On the basis of mandatory lab test result, in case of actual average compressive strength being less than specified strength but up to 70% of specified strength, concrete may be accepted and the rate payable shall be in the same proportion as the actual average compressive strength bears to specified compressive strength..

b) If the actual average strength of accepted sample is less than 70% of specified strength, the Site-in-charge shall reject the defective portion of work represent by sample and nothing shall be paid for the rejected work. Remedial measures necessary to retain the structure shall be taken at the risk and cost of contractor. If, however, the Engineer-in-charge / Project In-charge so desires, he may order additional tests to be carried out to ascertain if the structure can be retained/rectified. All the charges in connection with these additional tests shall be borne by the Contractor.

- c) 53 Grade cement shall be used after obtaining specific approval of the Engineer in charge.

- d) Portland slaa cement conforming to IS: 455 may be used as per Technical Specification.



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SAMPLING PLAN FOR BRICK-WORK

Scale of sampling and permissible number of defectives for visual and dimensional characteristics.

No of Bricks in the lot	For characteristics specified for individual bricks		For Dimensional characteristics for group of 20 bricks- No of bricks to be selected
	No of bricks to be selected	Permissible no of defective in the sample.	
(1)	(2)	(3)	(4)
2001-10000	20	1	40
10001-35000	32	2	60
35001-50000	50	3	80

Note : In case the lot contains 2000 or less bricks the sampling shall be as per decision of the Engineer – in- charge.

Scale of sampling for physical characteristics

Lot size	Sampling size for compressive strength water absorption and efflorescence	Permissible No of defectives for efflorescence
(1)	(2)	(3)
2001-10000	5	0
10001-35000	10	0
35001-50000	15	1



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ACCEPTABLE CRITERIA FOR BRICK WORK

1) Dimensional Tolerances: The dimensions of modular/ Non modular bricks when tested shall be within the following limits per 20 bricks.

S.No	DESCRIPTION	MODULAR BRICKS	NON-MODULAR BRICKS
1	LENGTH	372 to 388 cm (380 \pm 8 cm)	432 to 468 cm (450 \pm 18)
2	WIDTH	176 to 184 cm (180 \pm cm)	213 to 231cm (222 \pm 9)
3	HEIGHT	176 to 184 cm (180 \pm 4 cm)	134 to 146 cm (140 \pm 6)

- 2) Compressive strength: the bricks shall have a minimum average compressive strength as specified in POWERGRID specification. The compressive strength of any individual brick tested shall not fall below the min. average compressive strength specified for the corresponding class of brick by more than 20% . in case compressive strength of any individual brick tested exceeds the upper limit specified for the corresponding class of bricks, the same shall be limited to upper limit of the class as specified for the purpose of calculating the average compressive strength.
- 3) Water absorption : The average water absorption of bricks shall not be more than 20% by weight.
- 4) Efflorescence : The rating of efflorescence of bricks shall not be more than moderate.



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PHYSICAL, REQUIREMENT OF COARSE AGGREGATE

S.No.	Type of Constn.	Type of W.B.M	Test Method	Requirements
1.	Sub-base	Los Angeles Abrasion Value or Aggregate Impact value	IS:2386(Pt.IV) IS:2386 (Pt.IV) IS:5640***	60% max. * 50% max
2.	Base	a) Los Angeles Abrasion Value or Aggregate Impact value b) Flakiness Index	IS:2386(Pt.IV) IS:2386 (Pt.IV) IS:5640*** IS:2386 (Pt.I)	50% max. * 40% max ** 15% max
3.	Surface Course	a) Los Angeles Abrasion Value or Aggregate Impact value b) Flakiness Index	IS:2386(Pt.IV) IS:2386 (Pt.IV) IS:2386 (Pt.I)	40% max. 30% max 15% max
4	Binding Material	Plasticity index	IS :2720 (Pt V)	Less than 6

* Aggregates may satisfy requirements of either of the two tests

** The requirements of flakiness index shall be enforced only in case of crushed/broken stone and crushed slag.

*** Aggregates like brick metal, kankar and laterite which get softened in presence of water, shall be tested for impact value under wet conditions in accordance with IS:5640.



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GRADING REQUIREMENTS OF COARSE AGGREGATE FOR W.B.M

Grading No.	Size Range	Sieve designation	% by weight passing the sieve
1	90mm to 45mm (Suitable for sub base courses of compacted layer of not less than 90mm thickness).	125mm 90mm 63mm 45mm 22.4mm	100 90-100 25-60 0-15 0-5
2.	63mm to 45mm	90mm 63mm 53mm 45mm 22.4mm	100 90-100 25-75 0-15 0-5
3.	53mm to 22.4mm	63mm 53mm 45mm 22.4mm 11.2mm	100 95-100 65-90 0-10 0-5
4	Screening		
	A) 13.2 mm	13.2 mm 11.2 mm 5.6 mm 180 micron	100 95-100 15-35 0-10
	B) 11.2 mm	11.2 mm 5.6 mm 180 micron	100 90-100 15-35



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Date of Issue	29.01.2016
Validity	Till next revision

SFQP No.	DOC No.C/QA&I/SFQP/SCW
REV.	04

Requirement of grading of broken Burnt Brick Coarse aggregate

IS Sieve Designation	Percent Passing
75 mm	100
37.5 mm	95-100
19.0 mm	45-75
4.75 mm	0-5

General Notes:

- 1) This standard Field Quality Plan is not to limit the supervisory checks which are otherwise required to be carried out during execution of work as per drawings/Technical specifications etc.
- 2) All materials under supply contract should have Cat-A CIP before they are erected.
- 3) Contractor shall be responsible for implementing/documenting the SFQP. Documents shall be handed over by the contractor to POWERGRID after the completion of the work.
- 4) Project incharge means over all incharge of work. Site Incharge means incharge of the section.
Site Engineer's responsibility may be allocated to Site JE, with the approval of Regional Head, only in such cases where, Site Engineer is not in position.
- 5) In case of deviation the approving authority will be one step above the officer designated for acceptance in this quality plan subject to minimum level of Site incharge.
- 6) Acceptance criteria and permissible limits for tests are indicated in the Annexures. However for further details/tests POWERGRID specification and relevant Indian standards shall be referred.
- 7) Tests as mentioned in this FQP shall generally be followed. However E.I.C. reserves the right to order additional tests wherever required necessary at the cost of the agency.
- 8) All counter checks/tests by POWERGRID shall be carried out by POWERGRID's officials' at least at the level of Site. Engr.
- 9) The authorized dealer means the dealer whose names are listed in the main producer's web site or certified by the main producers.
- 10) Accepting Authority for testing Laboratory shall be Regional Head.



STANDARDISED FIELD QUALITY PLAN

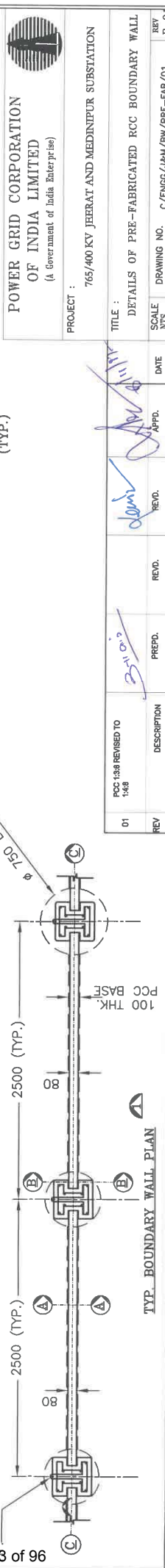
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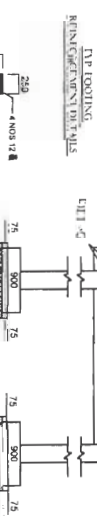
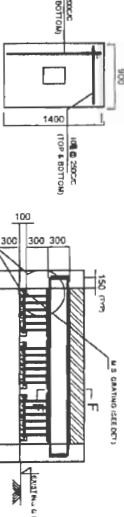
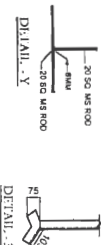
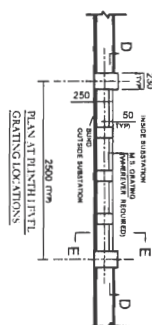
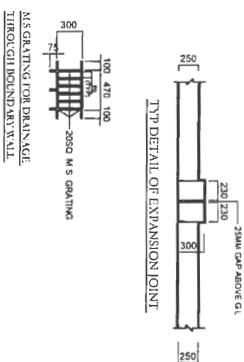
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- 11) Mobile testing Labs owned by the contractor may also be acceptable if their facilities meet the testing requirements and the testing equipments are properly calibrated at Third Party Labs where testing/calibration is to be carried out should be accredited by NABL or an agency operating in line with ISO/IEC 17011 and having full membership & MRA of ILAC/APLAC, subject to approval of project Incharge.
- 12) **READYMIX CONCRETE (RMC) IS ACCEPTABLE FOR USE. HOWEVER, SITE INCHARGE SHALL APPROVE THE SOURCE OF MATERIALS TO BE USED FOR RMC. The documentation to be maintained shall be as per IS 4926:2003 i.e i) Information to be supplied by the purchaser (clause 7)**
 - ii) **Information to be supplied by the producer (clause 8)**
 - iii) **Sampling for concrete strength should be one set of 3 nos of cubes for every 50 cu.m or part thereof for each day of concreting and 28 days compressive strength shall be tested in line with IS:456.**
- 13) Epoxy coating on reinforcement steel wherever required shall be done as per IS 13620.
- 14) Cement is to be used in the order it is delivered (ie. First in First Out). Cement bought to works shall not be more than 6 weeks old from the date of manufacture. In case the cement remains in storage for more than 3 months, the cement shall be retested before use and shall be rejected, if it fails to conform to any of the requirements given in the relevant Indian Standard. Cement shall be packed in bags and stored in accordance with the provisions in IS -4082.
- 15) Three samples of each size of steel (all sizes of 10mm & above) out of 100MT steel Lot need to be physically weighted to ascertain their acceptance as per technical specification. The weighted samples at site may be kept under custody for three months.
- 16) If e-mail facility is not available in POWERGRID approved Lab, report may be collected directly by POWERGRID /Speed Post / Register Post / UPC.
- 17) In case any Laboratory refuses to allow POWERGRID representative for witnessing the test, same shall be taken in writing and approved by Regional Head.

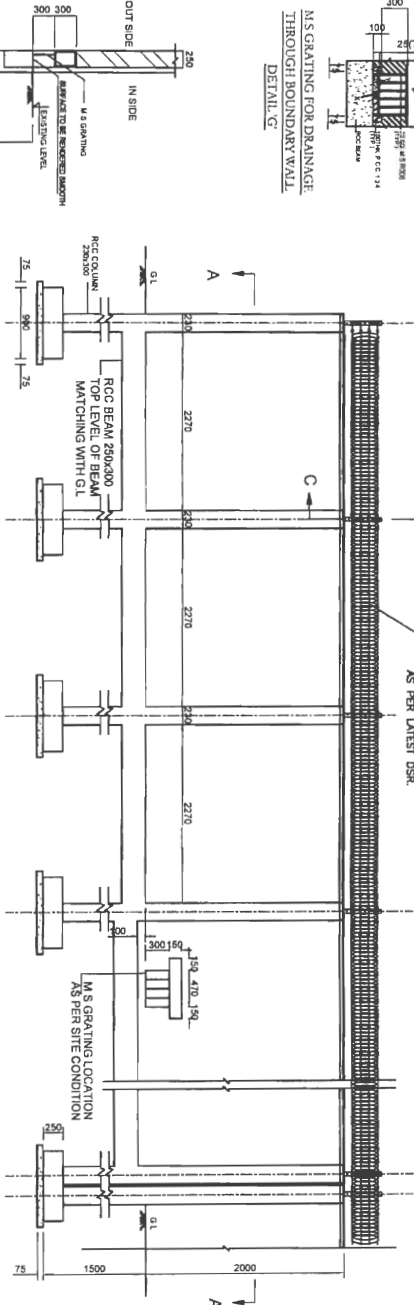




TYPICAL DETAIL OF EXPANSION JOINT

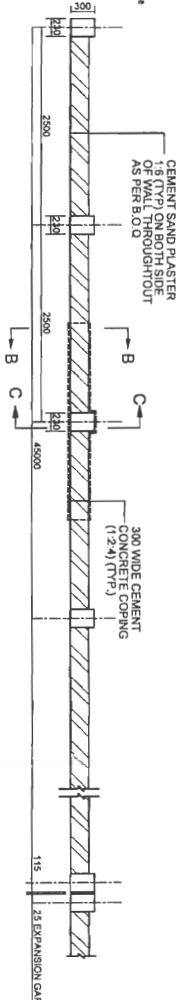


M.S. GRATING FOR DRAINAGE THROUGH BOUNDARY WALL
DETAIL - G



TYPICAL WALL ELEVATION

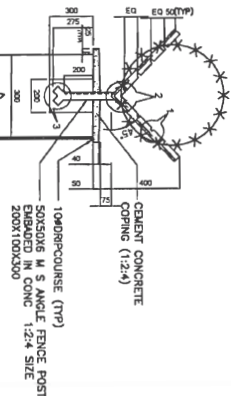
SECTION A-A



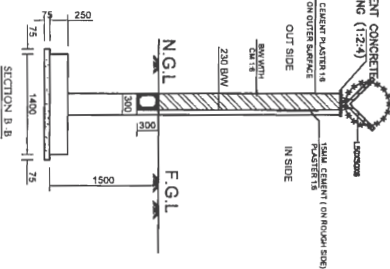
DETAIL - 2



SECTION C-C



SECTION B-B



DETAIL - 1



THIS DRAWING IS ONLY APPLICABLE FOR PORTION I.E. UPTO 50 METRES OF EACH SIDE OF MAIN GATE.

IMPORTANT NOTE:- SITE TO ENSURE THAT EARTH FILLING ON EITHER SIDE SHALL NOT TOUCH THE BOUNDARY WALL AS THE BOUNDARY WALL HAS NOT BEEN DESIGNED FOR LOADING OF EARTH FILLING.

REV	DESCRIPTION	FILED	REV'D	REV'D	APP'D	DATE
00	REVISIONS					

PROJECT : 765/400 KV SUBSTATION
TITLE : BOUNDARY WALL DETAILS (Rec + Brick)
DRAWING NO : C/ENGG/TB/CB/BW/01

RELEASED FOR CONSTRUCTION

POWER GRID CORPORATION OF INDIA LIMITED
(A Government of India Enterprise)



- NOTES:
1. ALL DIMENSIONS ARE IN MILLIMETERS.
 2. LOCATION OF BOUNDARY WALL SHALL BE DECIDED BY THE SITE AS PER THE SITE CONDITION.
 3. COARSE SAND SHALL BE USED FOR FILLING OF THE JOINT.
 4. 1:2 CEMENT GROUTING FOR ANGLE JOINT AT TOP OF BOUNDARY WALL SHALL BE IN CONCRETE.
 5. CONCERNING COIL FENCING OF 600 MM DIA. SHALL BE AS PER LATEST DSR.
 6. BRICK WORK TO BE DONE WITH BRICKS OF CLASS DESIGNATION 7.5.
 7. PLASTERING WORK SHALL BE IN CEMENT MORTAR 1:6 (CEMENT & FINE SAND).
 8. P.C.C. OF 1:4:8 GRADE SHALL BE WITH 40MM NOMINAL SIZE AGGREGATE.
 9. EXPANSION JOINTS ARE TO BE PROVIDED IN THE BOUNDARY WALL AT A MAXIMUM OF 45.0 M.
 10. ALL EXPOSED PLASTER SURFACES TO BE OIL STAINED WITH OIL BOUND COAT WITH CEMENT PRIMER.
 11. STRUCTURAL STEEL FOR ANGLE JOINTS SHALL CONFORM TO IS 2062 ANGLE POST SHALL BE PAINTED WITH TWO OR MORE COATS OF SYNTHETIC EMULSION PAINTS OF APPROVED BRAND AND MANUFACTURE OVER A PRIMER COAT OF APPROVED STEEL PRIMER.
 12. THE DIFFERENCE IN GROUND LEVEL IS MORE THAN 500MM.
 13. NO FOUNDATION SHALL REST ON THE FILLED UP SOIL, IF ANY, THE FOUNDATION SHALL BE MINIMUM 200MM BELOW VIRGIN SOIL.
 14. NO OF M.S. GRATING AND THEIR LOCATION TO BE INSTALLED IN BOUNDARY WALL KEEPING IN VIEW THE MAX. POSSIBLE ONCHMENT AREA FOR EACH GRATING.
 15. COATS OF BLACK ANTI-CORROSIVE BUTYLASTIC PAINT OF APPROVED BRAND AND MANUFACTURE OVER A PRIMER COAT OF APPROVED STEEL PRIMER.
 16. CONCRETE FOR R.C.C. WORK SHALL BE OF GRADE AS PER IS 456.
 17. REINFORCEMENT BARS SHALL BE H.Y.S.D. BARS OR TMT BARS CONFORMING TO IS 1786 LATEST REVISION AND GRADE AS PER IS 456.
 18. STRUCTURE STEEL USED FOR GRATING SHALL CONFORM TO IS 2062 LATEST EDITION.
 19. LAP JOINTS SHALL BE 50 X DIA OF BAR.
 20. LAP JOINTS SHALL BE 50 X DIA OF BAR.
 21. LAP JOINTS SHALL BE 50 X DIA OF BAR.
 22. LAP JOINTS SHALL BE 50 X DIA OF BAR.
 23. LAP JOINTS SHALL BE 50 X DIA OF BAR.

विभागीय प्रमुख के निदेशानुसार
प्रमाणित किया जाता है कि
यह योजना पूर्णतः सही है।
प्रमाणित करने वाले का नाम
[Signature]
[Date]

