

## **SECTION - 3**

### **ENCLOSURES TO THE SPECIFICATION**

- (a) POWERGRID Technical Specification**
- (b) DRAWINGS (Chain link Fencing, Gate & Rain Water Harvesting)**
- (c) POWERGRID Field Quality Plan**

**POWERGRID Technical Specification for Civil Works**  
**(Page 1, 7 to 11, 14 to 21,49, 50 of 50)**

## 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 manufacturer guidelines. All materials shall be of best quality conforming to relevant Indian Standards and Codes. In case of any conflict between Standards/ Code 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 the Field Quality Plan (FQP) attached with this document.

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~~ (NOT APPLICABLE)

- 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.

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 formation of the area, past observations or 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 sizes of piles and pile groups.
  - iii) Allowable bearing pressure on the soil at various depths for different sizes 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 investigation 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

## DRAWINGS

Standard drawings have been developed for roads, road culverts, drains, cable trenches, cable trench crossing roads, sump, switchyard fence, fencing gates, rain water harvesting, fire fighting pump house (Super structure), control room building (Super structure) and fire water 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 POWERGRID 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 finalised after award.

### **3.1 Control room building and Switchyard Panel Room**

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

### **3.2 FIRE FIGHTING PUMP HOUSE BUILDING & 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**

Construction drawings for towers and equipments foundations, which are enclosed with the tender documents, have been standardised and are available on the POWERGRID website. However the Contractor shall confirm to use these drawings before execution as the type and dimensions depends on the soil parameters.

Drawings for any non-standard tower or equipment foundation, if required, shall be designed by the Employer and made available to the Contractor during detailed Engineering. Foundations for 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 Transit Camp**

The Architectural and Construction drawings of transit camp and covered parking are enclosed with the tender documents.

#### **3.4.1 Septic tank and soak pit**

The construction drawings of septic tank and soak pit for control room building and transit camp are enclosed with the tender document.

### **3.5 Roads, road culverts and rail cum 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.

### **3.6 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.

### **3.7 Chain link fencing and Switchyard gate**

The construction drawings are enclosed with the tender documents.

### **3.8 Rain water harvesting**

The construction drawings are enclosed with the tender documents.

### **3.9 External water supply from bore-well to fire water tank/Control building and Transit Camp**

(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 by the Employer at any one location within the sub-station. 80 mm dia GI pipe shall be provided by the Contractor from the bore-well to the fire water tank. From this a 25 mm dia tap off shall be connected by the Contractor to the roof water tank provided for

the control room building & transit camp.

(ii) The Contractor shall carry out all the external plumbing/erection works required for supply of water to the control room building, firewater tank and transit camp beyond the single point as at (i).

(iv) 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.

(v) Bore well is not in the scope of Contractor.

### **3.10 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.

### **3.11 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 levelled 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 foundations 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 levelled 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.

~~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 (1cement: 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 RAINWATER HARVESTING:**

- 6.1 In addition to drainage of rainwater, the Contractor shall make arrangement for rainwater harvesting also.
- 6.2 Rainwater harvesting shall be done by providing recharge structures with bore wells. The recharge structures shall be suitably located within the sub-station. Branch drains from the main drain carrying rainwater from entire switchyard shall be connected to the recharge structures.

A drawing showing details of recharge structure for rainwater harvesting is enclosed with tender document and is also available on POWERGRID website.

## **7.0 ROADS AND CULVERTS**

- 7.1 All the roads in the scope of contract shall be of concrete road.
- 7.2 There would be two types of Roads. The wider road shall be 5.5m wide and the other road shall be 3.75m wide.

The road outside the switchyard fenced area and road leading to control room building shall be provided with kerb stone and interlocking tiles on shoulder. Width of shoulder shall be 1.75m in case of 5.5m wide road and 1.3m in case of 3.75m wide road.

In case of switchyard road the shoulder would be 600mm wide on the sides of both types of road. Well compacted 75mm thick PCC 1:4:8 (1Cement: 4 coarse sand: 8 graded stone aggregate 40mm nominal size) shall be provided in shoulder area. The top surface of PCC shall be finished smooth.

RCC Hume pipe (NP-3) of 100mm diameter shall be provided across the road at every 100M interval along the road.

- 7.3 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.

- 7.4 All roads shall be rigid pavement type RCC road. Thickness of RCC, PCC and WBM shall be as per section details provided in the drawing. The concrete shall be laid and finished with screed board, vibration, vacuum dewatering process etc.
- 7.5 The details of roads and culverts are furnished in the drawing enclosed with tender document.
- 7.6 The shoulder of the road in case of substation extension shall match with the shoulder of the existing road.
- 7.7 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.

## **8.0 FOUNDATION / RCC CONSTRUCTION**

### **8.1 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 or volumetric mix 1:1.5:3 (1 cement: 1.5 coarse sand: 3 well graded stone aggregate 20mm nominal size) conforming to CPWD specification as per BPS. Volumetric mix 1:1.5:3 shall be considered equivalent to M-20. 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 confirm 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 600mm 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 400Kg/ cu.m as per IS-2911 (Latest revision)

## **8.2 DESIGN**

The following clauses shall be applicable only for the foundation / 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. Grade of concrete can be volumetric mix 1:1.5:3 (1cement: 1.5 coarse sand: 3stone aggregate 20mm nominal size) equivalent to M-20 or 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 with IS: 3370 (Part I to IV) by working stress 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 foundations.
- 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 be 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 foundations 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 foundations of Transformer & Reactor shall be of block type foundation. Minimum reinforcement shall be governed by IS: 2974 and IS: 456. In 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 system.

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 in the Autotransformer/Reactor. In case of transformers of 132kV and below, where hydrant system for fire fighting is not provided, volume of pit may be reduced to 130% of total oil volume.

The minimum height of the retaining walls of pit shall be 20 cm 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 and will be covered with 100mm thick layer of stone aggregate having 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- 1991. 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 2.0meter 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 will be made of reinforced cement concrete and shall be finished with water proofing cement paint of grey colour.

### **8.3 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.

### **9.0 Chain link Fencing and Switchyard Gate:**

Fencing and Gate shall be provided at the locations shown in approved general arrangement drawing. Separate gate shall be provided for men and equipment. Fence shall also be provided for the various equipments (if) mounted on ground or a height lower than 2.5m. Necessary gates shall be provided for each area so surrounded. Fencing and Gate shall be constructed as per drawing attached with tender documents and are also available on POWERGRID website.

Chain link galvanised fence fabric with 3.15mm dia wire and 75mm mesh size conforming to IS: 2721 shall be used. MS tube used shall be of grade YST22 and conform to IS: 1161. All other structural steel shall conform to IS: 2062. In case the substation is located within 30km from sea coast, the zinc coating shall be 900gm/ sq.m.

The whole assembly of tubular post and frame of panels shall be hot dip galvanized. The zinc coating shall be minimum 610 gram per sq. meter. The purity of zinc shall be 99.95% as per IS: 209.

The gate shall be made of medium duty M.S. pipe with welded joints. The main frame (outer frame) of the gate shall be made of 40mm dia pipe and vertical pipes of 15mm dia @ 125mm spacing (maximum) shall be welded with the main frame. Gate shall be painted with one coat of approved steel primer and two or more coats of synthetic enamel paint to give an even shade.

The height of the fencing shall be 1500mm on a toe wall of 300mm. Other details shall be as shown in the drawing.

## **10.0 TECHNICAL DETAILS OF THE BUILDINGS** (DESIGN AND DRAWING TO BE DEVELOPED BY CONTRACTOR)

### **10.1 BUILDINGS - GENERAL REQUIREMENTS**

The scope include the design, engineering and construction including anti-termite treatment, Plinth protection, DPC, Peripheral drain, Sanitary, Water supply, Electrification etc. of control room building and GIS building.

The Contractor shall appoint a reputed architect (To be approved by POWERGRID) for RCC framed control room building.

Control room building shall be so designed that most of the area of switchyard is visible from control room. Control room building shall be a double story building.

### **10.2 BUILDING DESIGN**

- a) The buildings shall be designed:
  - i) To the requirements of the National Building Code of India, and the standards quoted therein.
  - ii) For the specified climatic & loading conditions.
  - iii) To adequately suit the requirements of the equipment and apparatus contained in the buildings and in all respects to be compatible with the intended use and occupancy.
  - iv) With a functional and economical space arrangement.
  - v) To be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design.
  - vi) To allow for easy access to equipment and maintenance of the equipment.
  - vii) With, wherever required, fire retarding materials for walls,

## **13.0 MISCELLANEOUS GENERAL REQUIREMENTS**

- 13.1** 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.
- 13.2** 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.
- 13.3** 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.
- 13.4** FPS Bricks of clay having minimum 75 kg/cm<sup>2</sup> compressive strength can only be used for masonry work. Contractor shall ascertain himself at site regarding the availability of bricks of minimum 75 kg/cm<sup>2</sup> 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/cm<sup>2</sup>. for which no extra payment shall be made.
- 13.5** Angles 50x50x6 mm (minimum) with lugs shall be provided for edge protection all round cut outs/openings in floor slab.
- 13.6** 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.
- 13.7** 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.
- 13.8** 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.

**13.9** 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.

**14.0 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.

**15.0 STATUTORY RULES**

**15.1** 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.

**15.2** Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.

**15.3** 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.

**15.4** All building/construction materials shall conform to the best quality specified in CPWD specifications if not otherwise mentioned in this specification.

**15.5** All tests as required in the standard field quality plans have to be carried out.

# **PGCIL Field Quality Plan**

(Pages 1 to 20)

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

## STANDARD FIELD QUALITY PLAN FOR SWITCHYARD CIVIL WORKS

### Section : FOUNDATION MATERIALS

| Sl. No. | Component/Operation & Description of Test                            | Sampling Plan with basis                                                                                                                                  | Ref. Document & acceptance norm                                          | Testing Agency                                                                                                                  | Remarks                                                                                    | Check |
|---------|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|-------|
| 1.      | CHECKING OF FOUNDATION MATERIALS                                     |                                                                                                                                                           |                                                                          |                                                                                                                                 |                                                                                            |       |
| A)      | CEMENT                                                               |                                                                                                                                                           |                                                                          |                                                                                                                                 |                                                                                            |       |
| i)      | Fineness                                                             | One sample per lot of 100 MT or part thereof from each source for MTCs and one sample per lot of 200 MT or part thereof from each source for site testing | IS:456, IS:269                                                           | Manufacturer/ POWERGRID approved lab                                                                                            | Review of manufacturers test certificates (MTCs) and laboratory test results by POWERGRID  | B     |
| ii)     | Compressive Strength                                                 |                                                                                                                                                           | IS:8112, IS:12269                                                        |                                                                                                                                 |                                                                                            |       |
| iii)    | Initial & final setting time                                         |                                                                                                                                                           | IS:1489 & POWERGRID specification                                        |                                                                                                                                 |                                                                                            |       |
| iv)     | Soundness                                                            |                                                                                                                                                           |                                                                          |                                                                                                                                 |                                                                                            |       |
| v)      | Heat of Hydration for low heat cement (Not applicable for OPC & PPC) |                                                                                                                                                           |                                                                          |                                                                                                                                 |                                                                                            |       |
| vi)     | Chemical Composition of Cement                                       | One sample per lot of 100 MT or part thereof from each source for MTCs                                                                                    | IS:456, IS:269<br>IS:8112, IS:12269<br>IS:1489 & POWERGRID specification | Manufacturer                                                                                                                    | Review of manufacturers test certificates by POWERGRID                                     | B     |
| B)      | COARSE AGGREGATES                                                    |                                                                                                                                                           |                                                                          |                                                                                                                                 |                                                                                            |       |
| i)      | Determination of Partical size (Sieve Analysis)                      | One sample per lot of 100 cubic meter or part thereof from each source for each size                                                                      | IS:383, IS:2386 and POWERGRID specification                              | POWERGRID approved lab. However, Moisture content test for design mix concrete shall be done on all days of concreting at site. | Each source to be approved by POWERGRID Review and acceptance of test result by POWERGRID. | B     |
| ii)     | Flakiness Index                                                      |                                                                                                                                                           |                                                                          |                                                                                                                                 |                                                                                            |       |
| iii)    | Crushing Value                                                       |                                                                                                                                                           |                                                                          |                                                                                                                                 |                                                                                            |       |
| iv)     | Specific Gravity*                                                    |                                                                                                                                                           |                                                                          |                                                                                                                                 |                                                                                            |       |
| v)      | Bulk Density*                                                        |                                                                                                                                                           |                                                                          |                                                                                                                                 |                                                                                            |       |
| vi)     | Absorption Value*                                                    |                                                                                                                                                           |                                                                          |                                                                                                                                 |                                                                                            |       |
| vii)    | Moisture Content*                                                    |                                                                                                                                                           |                                                                          |                                                                                                                                 |                                                                                            |       |
| viii)   | Soundness of Aggregate**                                             |                                                                                                                                                           |                                                                          |                                                                                                                                 |                                                                                            |       |
| ix)     | Presence of deleterious materials                                    |                                                                                                                                                           |                                                                          |                                                                                                                                 |                                                                                            |       |
|         | * Applicable Design concretes only                                   | ** Applicable to concrete work subject to frost action                                                                                                    |                                                                          |                                                                                                                                 |                                                                                            |       |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

|      |                                                                                                  |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |
|------|--------------------------------------------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|---|
| C)   | FINE AGGREGATE                                                                                   |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |
| i)   | Gradation/Determination of Particle size (Sieve Analysis)                                        | One sample per lot of 100 cubic meter or part thereof from each source | IS:383,IS:2386,IS:456 and POWERGRID specification                                                                                                                                              | POWERGRID approved lab. However Moisture content test for design mix concrete shall be done on all days of concreting at site. | Each source to be approved by POWERGRID Review and acceptance of test result by POWERGRID. | B |
| ii)  | Specific Gravity and density                                                                     |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |
| iii) | Moisture content                                                                                 |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |
| iv)  | Absorption Value                                                                                 |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |
| v)   | Bulking                                                                                          |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |
| vi)  | Silt Content Test                                                                                |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |
| vii) | Presence of deleterious materials                                                                |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |
| D)   | BRICKS                                                                                           |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |
| i)   | Dimensional tolerance                                                                            | As per enclosed Annexure-II                                            | CPWD & POWERGRID specification                                                                                                                                                                 | POWERGRID approved Lab.                                                                                                        | Approved by POWERGRID                                                                      | B |
| ii)  | Compressible Strength                                                                            |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |
| iii) | Water Absorption                                                                                 |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |
| iv)  | Efflorescence                                                                                    |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |
| E)   | WATER                                                                                            |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |
| i)   | Cleanliness (Visual Check)                                                                       | Random                                                                 | IS:456, IS:3025 and POWERGRID specification. The water used for mixing concrete shall be fresh, clean and free from oil, acids and alkalies, organic materials, or other deleterious materials | Contractor                                                                                                                     | Each source to be approved by POWERGRID                                                    | B |
| ii)  | Chemical and physical properties of water for checking its suitability for construction purposes | One sample per source                                                  | IS:456, IS:3025 and POWERGRID specification                                                                                                                                                    | Contractor/ POWERGRID Approved Lab                                                                                             | Approved by POWERGRID                                                                      | B |
|      | *Applicable to design mix concretes only                                                         |                                                                        |                                                                                                                                                                                                |                                                                                                                                |                                                                                            |   |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

| Sl. No.           | Component/Operation & Description of Test                          | Sampling Plan with basis                                                                                                                                                                                                                                                                                                                                   | Ref. Document & acceptance norm                     | Testing Agency                        | Remarks                                                                            | Check |
|-------------------|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------------|------------------------------------------------------------------------------------|-------|
| 1.                | REINFORCEMENT STEEL                                                |                                                                                                                                                                                                                                                                                                                                                            |                                                     |                                       |                                                                                    |       |
| i)                | Identification & size                                              | Random                                                                                                                                                                                                                                                                                                                                                     | IS:432, IS:1139, IS:1786 & POWER GRID specification | Contractor                            | Approved by POWERGRID                                                              | B     |
| ii)               | Chemical Analysis Test                                             | One sample per heat                                                                                                                                                                                                                                                                                                                                        | IS:432, IS:1139, IS:1786 POWERGRID specification    | Manufacturer                          | Review of manufacturers test certificates by POWERGRID                             | B     |
| iii)<br>iv)<br>v) | Tensile Test<br>Yield stress/proof stress<br>Percentage Elongation | One sample per lot of 40 MT or part thereof for each size of steel conforming to IS: 1139 and 5 MT or part thereof for HDS wire for each size of steel as per IS: 432. For steel as per IS:1786 under 10mm 1 sample for each 25 MT or part thereof. 20 mm-16 mm 1 sample for each 35 MT or part thereof. Over 16mm 1 sample for each 45 MT or part thereof | IS:432, IS:1139, IS:1786 POWER GRID specification   | Manufacturers/ POWERGRID approved lab | Review of manufacturers test certificates as well as lab test results by POWERGRID | B     |
| vi)               | Bend/Rebend Test                                                   | One sample per lot of 20 MT or part thereof for each size of steel as per IS:432, IS:1139. For steel as per IS:1786 under 10mm-16mm 1 sample for each 25MT or part thereof 10 mm-16mm 1 sample for each 45 MT or part thereof.                                                                                                                             | IS:432, IS:1139, IS:1786 POWER GRID specification   | Manufacturers/ POWERGRID              | Review of manufacturers test certificates as well as lab test results by POWERGRID | B     |
| vii)              | Reverse Bend Test for HDS wire                                     | One sample per lot of 5 MT or part thereof for each size                                                                                                                                                                                                                                                                                                   | IS:432 POWER GRID specification                     | Manufacturer/ POWERGRID approved lab  | Review of manufacturers test certificates as well as lab test result by POWERGRID  | B     |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

## Section : FOUNDATION

| Sl. No. | Component/Operation & Description of Test                                                 | Sampling Plan with basis                                                                                                               | Ref. Document & acceptance norm                      | Testing Agency                              | Remarks                                                                    | Check |
|---------|-------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|---------------------------------------------|----------------------------------------------------------------------------|-------|
| C.      | STRUCTURAL STEEL USED IN CABLE TRENCHES & FOUNDATIONS                                     |                                                                                                                                        |                                                      |                                             |                                                                            |       |
| i)      | Dimensional Check                                                                         | Random                                                                                                                                 | POWERGRID Specification & approved drawing           | Contractor                                  | Checklist to be prepared and signed jointly                                | B     |
| ii)     | Visual Check for damages, rusting, Pitting etc.                                           | 100%                                                                                                                                   | POWERGRID Specification & approved drawing           | Contractor                                  | Checklist to be prepared and signed jointly                                | C     |
| iii)    | Visual Check for welding, defects, primer, coating and painting/galvanizing as applicable | Random                                                                                                                                 | POWERGRID specification & approved drawings          | Contractor                                  | Checklist to be prepared and signed jointly                                | C     |
| iv)     | Physical properties of structural steel                                                   | 1 sample per lot of 40 MT or part thereof for tensile tests and 1 sample per lot of 20 MT or part thereof for bend test for each size. | IS:2062, POWERGRID specification & approved drawings | Manufacturer/<br>POWER GRID<br>Approved lab | Review of Mfgs. Test certificates as well as lab test results by POWERGRID | B     |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

| Sl. No. | Component/Operation & Description of Test                        | Sampling Plan with basis | Ref. Document & acceptance norm                              | Testing Agency                                | Remarks                                     | Check |
|---------|------------------------------------------------------------------|--------------------------|--------------------------------------------------------------|-----------------------------------------------|---------------------------------------------|-------|
| 2.      | GANTRY/EQUIPMENT FOUNDATION/ CABLE TRENCH                        |                          |                                                              |                                               |                                             |       |
| A.      | BEFORE EXCAVATION                                                |                          |                                                              |                                               |                                             |       |
| i)      | Checking of pegs condition as per line and alignment             | 100% on each location    | IS:4091, IS:3764 & POWERGRID approved drawings/specification | Contractor                                    | Approval by POWERGRID                       | C     |
| ii)     | Checking of pit making as per drawing & RL                       | 100% on each location    | IS:4091, IS:3764 & POWERGRID approved drawings/specification | Contractor                                    | Approval by POWERGRID                       | C     |
| B.      | EXCAVATION                                                       |                          |                                                              |                                               |                                             |       |
| i)      | Dimensional conformity                                           | Each location            | IS:4091, IS:3764 & POWERGRID approved drawings/specification | Contractor                                    | Approval by POWERGRID (JMC/MB)              | B     |
| ii)     | Verticality/slopes & Squareness of each pit                      | Each location            | IS:4091, IS:3764 & POWERGRID approved drawings/specification | Contractor                                    | Checklist to be prepared and signed jointly | B     |
| iii)    | Verification of classification of foundation wherever applicable | Each location            | IS:4091, IS:3764 & POWERGRID approved drawings/specification | Joint inspection by POWER GRID and contractor | Approval by POWERGRID                       | B     |
| C.      | FOUNDATION BOLTS/METALLIC INSERTS                                |                          |                                                              |                                               |                                             |       |
| i)      | Check for proper                                                 | 100%                     | POWERGRID                                                    | Contractor                                    | Checklist to be                             | C     |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

|      |                                                                                                            |                        |                                                                                  |                                                           |                                                   |   |
|------|------------------------------------------------------------------------------------------------------------|------------------------|----------------------------------------------------------------------------------|-----------------------------------------------------------|---------------------------------------------------|---|
|      | identification<br>foundation bolts w.r.t<br>type of foundation                                             |                        | specification &<br>approved drgs.                                                |                                                           | prepared and<br>signed jointly                    |   |
| ii)  | Visual check for<br>mechanical damage<br>and galvanising/<br>painting if applicable<br>for metallic insert | 100%                   | POWERGRID<br>specification &<br>approved drgs.                                   | Contractor                                                | Checklist to be<br>prepared and<br>signed jointly | C |
| iii) | Alignment & Level                                                                                          | 100%                   | POWERGRID<br>specification &<br>approved drgs.                                   | Contractor                                                | Checklist to be<br>prepared and<br>signed jointly | B |
| iv)  | Grouting/Underpinning<br>of foundation base<br>plate                                                       | 100%                   | POWERGRID<br>specification &<br>approved drgs.                                   | Contractor                                                | Checklist to be<br>prepared and<br>signed jointly | C |
| D.   | P.C.C. Padding                                                                                             | For all<br>locations   | IS:456 and<br>POWERGRID<br>approved<br>foundation<br>drawings &<br>specification | Joint<br>inspection by<br>POWER<br>GRID and<br>contractor | Approval by<br>POWERGRID                          | B |
| E.   | SHUTTERING(Form<br>work)                                                                                   |                        |                                                                                  |                                                           |                                                   |   |
| i)   | Check for materials,<br>breakage or damage                                                                 | 100%                   | IS:456,<br>POWERGRID<br>specification/<br>approved<br>drawings                   | Joint<br>inspection by<br>POWER<br>GRID and<br>contractor | Approval by<br>POWERGRID                          | C |
| ii)  | Check for plumb,<br>alignment parallelism,<br>squareness and<br>equidistance from<br>stub                  | 100%<br>casting        | IS:456,<br>POWERGRID<br>specification/<br>approved<br>drawings                   | Joint<br>inspection by<br>POWER<br>GRID and<br>contractor | Approval by<br>POWERGRID                          | B |
| iii) | Dimensional check                                                                                          | 100% before<br>casting | IS:456,<br>POWERGRID<br>specification/<br>approved<br>drawings                   | Joint<br>inspection by<br>POWER<br>GRID and<br>contractor | Approval by<br>POWERGRID                          | B |
| iv)  | Check for level &<br>height                                                                                | 100% before<br>casting | POWERGRID<br>specification/<br>approved<br>drawings                              | Joint<br>inspection by<br>POWER<br>GRID and<br>contractor | Approval by<br>POWERGRID                          | B |
| v)   | Check for rigidity of                                                                                      | 100%                   | POWERGRID                                                                        | Joint                                                     | Approval by                                       | B |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

|       |                                                                                                                                                                            |                      |                                                                              |                                                           |                                         |   |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|------------------------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------|---|
|       | frame/tightness                                                                                                                                                            |                      | specification/<br>approved<br>drawings                                       | inspection by<br>POWER<br>GRID and<br>contractor          | POWERGRID                               |   |
| vi)   | Cleaning and oiling                                                                                                                                                        | 100%                 | POWERGRID<br>specification/<br>approved<br>drawings                          | Joint<br>inspection by<br>POWER<br>GRID and<br>contractor | Approval by<br>POWERGRID                | B |
| vii)  | Diagonal bracing if<br>required as per<br>drawings/site<br>conditions                                                                                                      | 100%                 | POWERGRID<br>specification/<br>approved<br>drawings                          | Joint<br>inspection by<br>POWER<br>GRID and<br>contractor | Approval by<br>POWERGRID                | C |
| viii) | Checking of joints to<br>avoid undue loss of<br>cement slurry                                                                                                              | 100%                 | POWERGRID<br>specification/<br>approved<br>drawings                          | Joint<br>inspection by<br>POWER<br>GRID and<br>contractor | Approval by<br>POWERGRID                | C |
| E.    | PLACEMENT OF<br>REINFORCEMENT<br>STEEL                                                                                                                                     |                      |                                                                              |                                                           |                                         |   |
| i)    | Check the steel bars<br>for rust, cracks,<br>surface flaws,<br>laminates etc. (Visual<br>check)                                                                            | 100%                 | IS:456 and<br>POWERGRID<br>specification/<br>approved<br>drawings            | Joint<br>inspection by<br>POWER<br>GRID and<br>contractor | Approval by<br>POWERGRID                | C |
| ii)   | Check as per the bar<br>bending schedule<br>before placement of<br>concrete                                                                                                | For all<br>locations | IS:456,IS:2502<br>and<br>POWERGRID<br>specification/<br>approved<br>drawings | Joint<br>inspection by<br>POWER<br>GRID and<br>contractor | Approval by<br>POWERGRID<br>(Pour Card) | B |
| iii)  | Check cutting<br>tolerance for bars as<br>per check<br>list/drawings. Check<br>whether all the bent<br>bars and lap lengths<br>are as per approved<br>bar bending schedule | For all<br>locations | IS:456,IS:2502<br>and<br>POWERGRID<br>specification/<br>approved<br>drawings | Joint<br>inspection by<br>POWER<br>GRID and<br>contractor | Approval by<br>POWERGRID<br>(Pour Card) | B |
| iv)   | Check whether all<br>joints & crossing of<br>bars are tied properly                                                                                                        | 100%                 | IS:456 and<br>POWERGRID<br>specification/                                    | Joint<br>inspection by<br>POWER                           | Approval by<br>POWERGRID                | C |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

|      |                                                                                                                                  |                 |                                                                     |                                               |                                                                |   |
|------|----------------------------------------------------------------------------------------------------------------------------------|-----------------|---------------------------------------------------------------------|-----------------------------------------------|----------------------------------------------------------------|---|
|      | with right guage & annealed wire as per specification                                                                            |                 | approved drawings                                                   | GRID and contractor                           |                                                                |   |
| v)   | Check for proper cover distance spacing of bars, spacers, & chairs after the reinforcement cage has been put inside the formwork | 100%            | IS:456 and POWERGRID specification/ approved drawings               | Joint inspection by POWER GRID and contractor | Approval by POWERGRID                                          | C |
| vi)  | Check whether lapping of bars are tied properly with right gauge and annealed wire as per specification                          | 100%            | IS:456 and POWERGRID specification/ approved drawings               | Joint inspection by POWER GRID and contractor | Approval by POWERGRID                                          | B |
| G.   | PILE FOUNDATION (Additional Tests)                                                                                               |                 |                                                                     |                                               |                                                                |   |
| i)   | Check of centre line of pile group                                                                                               | Each pile group | IS:2911 & POWERGRID approved pile foundation drawings/specification | Joint inspection by POWER GRID and contractor | Checklist to be prepared and signed jointly                    | B |
| ii)  | Check pile location                                                                                                              | Each pile       | IS:2911 & POWERGRID approved pile foundation drawings/specification | Joint inspection by POWER GRID and contractor | Checklist to be prepared and signed jointly                    | B |
| iii) | Temporary casing tube & permanent liner also check thickness of liner material (if applicable)                                   | Each pile       | IS:2911 & POWERGRID approved pile foundation drawings/specification | Joint inspection by POWER GRID and contractor | Verticality of the tube to be checked                          | B |
| iv)  | Bentonite slurry (if applicable)                                                                                                 | Each pile       | IS:2911 & POWERGRID approved pile foundation drawings/specification | Joint inspection by POWER GRID and contractor | Records to be kept by POWERGRID for specific gravity of slurry | B |
| v)   | Pile depth, level, size                                                                                                          | Each pile       | IS:2911 &                                                           | Joint                                         | Approved by                                                    | B |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

|       |                                           |                                            |                                                                     |                                               |                                                                        |   |
|-------|-------------------------------------------|--------------------------------------------|---------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------|---|
|       | and alignment                             |                                            | POWERGRID approved pile foundation drawings/specification           | inspection by POWER GRID and contractor       | POWERGRID                                                              |   |
| vi)   | Chipping of pile head                     | Each pile                                  | IS:2911 & POWERGRID approved pile foundation drawings/specification | Joint inspection by POWER GRID and contractor | Before concreting pile cap, pile head to be chipped off for concreting | B |
| vii)  | Standard Penetrator Test                  | As per Powergrid BOQ/Specification         | IS:2911 & POWERGRID approved pile foundation drawings/specification | Joint inspection by POWER GRID and contractor | Records to be kept by POWERGRID                                        | B |
| viii) | Pile load testing                         | As per Powergrid BOQ/Specification IS:2911 | IS:2911 & POWERGRID approved pile foundation drawings/specification | Joint inspection by POWER GRID and contractor | Records to be kept by POWERGRID Approval by POWERGRID                  | B |
| ix)   | Anchor bolts if applicable                |                                            |                                                                     |                                               |                                                                        |   |
| a)    | Level, centre to centre distance of bolts | 100% on each location                      | POWERGRID approved pile foundation drawings/specification           | Joint inspection by POWER GRID and contractor | Checklist to be prepared and signed jointly                            | B |
| b)    | Visual check for galvanising              | 100% on each location                      | POWERGRID approved pile foundation drawings/specification           | Joint inspection by POWER GRID and contractor | Checklist to be prepared and signed jointly                            | B |
| 3.    | CONCRETING                                |                                            |                                                                     |                                               |                                                                        |   |
| A)    | APPROVAL OF MIX DESIGN                    | Each Mix.                                  | IS:456 & POWERGRID approved drawings and specifications             | POWER GRID Approved by lab                    | Approval by POWERGRID                                                  | A |
| B)    | BATCHING,MIX-                             | 100%                                       | IS:456 &                                                            | Joint                                         | Approval by                                                            | B |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

|     |                                                                                                     |                           |                                                         |                                               |                                                                                             |   |
|-----|-----------------------------------------------------------------------------------------------------|---------------------------|---------------------------------------------------------|-----------------------------------------------|---------------------------------------------------------------------------------------------|---|
|     | ING & PLACING OF CONCRETE AND COMPACTING                                                            |                           | POWERGRID approved drawings and specifications          | inspection by POWER GRID and contractor       | POWERGRID                                                                                   |   |
| C)  | FIXING OF CHIMNEY COLUMN<br>Check for Width/length squareness, parallelism & equidistance from stub | 100%                      | IS:456 & POWERGRID approved drawings and specifications | Joint inspection by POWER GRID and contractor | Approval by POWERGRID                                                                       | C |
| D)  | PLACING CONCRETE, AND COMPACTING                                                                    | 100%                      | IS:456 & POWERGRID approved drawings and specifications | Joint inspection by POWER GRID and contractor | Min. gap between boxes and reinforcement bars should be maintained<br>Approval by POWERGRID | B |
| E)  | CONCRETE TESTING                                                                                    |                           |                                                         |                                               |                                                                                             |   |
| i)  | Slump test                                                                                          | One sample per foundation | IS:456,IS:516, IS:1199 and POWERGRID Specification      | Contractor                                    | Approval by POWERGRID                                                                       | B |
| ii) | Check for quantities for cement, fine aggregate, coarse aggregate and water while batching          | 100% on all locations     | IS:456,IS:516, IS:1199 and POWERGRID Specification      | Contractor                                    | Checklist to be prepared and signed jointly                                                 | B |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

| Sl. No. | Component/Operation & Description of Test                                          | Sampling Plan with basis                                                                                                                            | Ref. Document & acceptance norm                    | Testing Agency         | Remarks                                                                                                                   | Check |
|---------|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|------------------------|---------------------------------------------------------------------------------------------------------------------------|-------|
| F)      | CONCRETE CUBE TESTING                                                              |                                                                                                                                                     |                                                    |                        |                                                                                                                           |       |
| i)      | Compressive Strength                                                               | One sample for every 20 Cum of concreting or part thereof for each days concreting (one sample consists of min. 3 test cubes for 28 days strength). | IS:1199,IS:456, IS:516 and POWERGRID Specification | POWERGRID Approved lab | Approval by POWERGRID Cubes must be tested within a week after 28 days curing period and test results should be approved. | A     |
| G)      | CHECK FINISHING, DIMENSIONAL CONFORMITY AND WORKMANSHIP BEFORE & AFTER BOX REMOVAL | 100%                                                                                                                                                | IS:456,IS:516, IS:1199 and POWERGRID Specification | Contractor             | Approval by POWERGRID                                                                                                     | B     |
| 4.      | BACKFILLING                                                                        |                                                                                                                                                     |                                                    |                        |                                                                                                                           |       |
| i)      | Check for thickness of Layer & watering                                            | 100%                                                                                                                                                | POWERGRID Specification and approved drawings      | Contractor             | Approval by POWERGRID                                                                                                     | C     |
| ii)     | Visual check for correction/ramming                                                | 100%                                                                                                                                                | POWERGRID Specification and approved drawings      | Contractor             | Approval by POWERGRID                                                                                                     | C     |
| iii)    | Compaction test (Percentage of max. dry density)                                   | Gantry Foundation-2 samples for each pit. Equipment                                                                                                 | POWERGRID specification                            | POWERGRID approved lab | Review of lab test results by POWERGRID Elevation for testing to be                                                       | B     |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

|      |                                                    |                                    |                                                       |            |                                             |   |
|------|----------------------------------------------------|------------------------------------|-------------------------------------------------------|------------|---------------------------------------------|---|
|      |                                                    | and other foundation-20% at random |                                                       |            | decided by POWERGRID                        |   |
| 5.   | BRICK-WORK                                         |                                    |                                                       |            |                                             |   |
| i)   | Mortar mix/proportion                              | Random                             | IS:2250, POWERGRID Specification & CPWD Specification | Contractor | Approval by POWERGRID                       | B |
| ii)  | Plumb & Alignment                                  | Random                             | POWERGRID Specification & CPWD Specification          | Contractor | Approval by POWERGRID                       | B |
| iii) | Joints                                             | Random                             | POWERGRID Specification & CPWD Specification          | Contractor | Approval by POWERGRID                       | B |
| 6.   | PLASTERING                                         |                                    |                                                       |            |                                             |   |
| i)   | Plastering thickness and evenness                  | Random                             | POWERGRID Specification & CPWD Specification          | Contractor | Approval by POWERGRID                       | B |
| ii)  | Mortar mix proportion                              | Random                             | POWERGRID Specification & CPWD Specification          | Contractor | Approval by POWERGRID                       | B |
| 7.   | CURING FOR CONCRETE, MASONRY, PLASTERING ETC.      | 100% on all location               | IS:5613 & POWERGRID Specification                     | Contractor | Approval by POWERGRID                       | C |
| 8.   | SWITCH YARD EARTHING                               |                                    |                                                       |            |                                             |   |
| i)   | Check for dimension of earth mat rod               | Random                             | POWERGRID Specification & drawings                    | Contractor | Approval by POWERGRID                       | B |
| ii)  | Depth of excavation                                | Random                             | POWERGRID Specification & drawings                    | Contractor | Approval by POWERGRID                       | C |
| iii) | Check for weld joints and anti corrosive treatment | Random                             | POWERGRID Specification & drawings                    | Contractor | Approval by POWERGRID                       | B |
| iv)  | Backfilling                                        | 100%                               | POWERGRID Specification & drawings                    | Contractor | Approval by POWERGRID                       | C |
| 9.   | SITE SURFACING                                     |                                    |                                                       |            |                                             |   |
| i)   | Levelling                                          | 100%                               | POWERGRID Specification and approved drawings         | Contractor | Checklist to be prepared and signed jointly | C |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

|           |                                                                  |                                                                                                      |                                                                                                                           |                                          |                                                                                                              |   |
|-----------|------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|------------------------------------------|--------------------------------------------------------------------------------------------------------------|---|
| ii)<br>a) | Soil Sterilisation<br>Spraying of<br>chemicals                   | 100%                                                                                                 | POWERGRID<br>Specification and<br>Manufacturers<br>recommendations                                                        | Con tractor                              | Checklist to be<br>prepared and<br>signed jointly                                                            | B |
| iii)      | Grading of 20/40mm<br>Stone                                      | 1 sample per<br>lot of 500<br>Cubic Metre<br>or part<br>thereof from<br>each source<br>for each size | IS: 383, IS: 2386<br>and<br>POWERGRID<br>Specification.<br>The grading shall<br>be as per single<br>sized nominal<br>size | Contractor/<br>POWERGRID<br>Approved lab | Each source to<br>be approved by<br>POWERGRID<br>Review and<br>acceptance of<br>test results by<br>POWERGRID | B |
| iv)       | Compacted thickness<br>of 20/40 mm stone<br>layers as applicable | Random                                                                                               | POWERGRID<br>Specification and<br>specification<br>drawings                                                               | Contractor                               | Checklist to be<br>prepared and<br>signed jointly                                                            | B |

## Section: GENERAL GUIDELINES FOR IMPLEMENTATION

1. Details of categories of check codes A,B & C including accepting and deviation dispositioning authorities are indicated at Annexure-I.
2. POWERGRID specification shall mean POWERGRID technical specification, approved drawings data sheets and LOA provisions applicable for the specific contract.
3. Acceptance criteria and permissible limits for certain tests are indicated at Annexure-II. For balance tests, site to verify the same with respect to POWERGRID specification, relevant Indian Standards and/or prevalent code of practice.
4. It is clarified that the tests indicated at column 2 of this FQP i.e. against column “Component operation & Description of Test”, are only generally required to be conducted. However, POWERGRID reserves the right to carry-out any additional tests at any stage if the situation so warrants.
5. POWERGRID site representative shall witness all the tests conducted by the contractor as mentioned in the FQP. However, in case of tests conducted in the POWERGRID approved lab, it is preferred to witness the tests in the lab itself, if possible.
6. Head of GHQ shall approve testing laboratory before accepting the test results from the lab.
7. Head of GHQ shall approve the sources for cement , coarse aggregate, fine aggregate & water before actual utilization.
8. All the testing & measuring equipments used by the contractor for testing are required to be calibrated. A copy of valid calibration report shall be retained by POWERGRID as records.
9. Classification of foundations shall be approved by POWERGRID based on the Joint Inspection Report & soil investigation reports.
10. Curing of concrete work should be continued for minimum period of 10 days.

# **POWERGRID CORPORATION OF INDIA LIMITED**

**(Quality Assurance & Inspection Deptt.)**

## **11. ZONE-IV FINE AGGREGATE**

11.1 Zone-IV fine aggregate shall be used for nominal mix. Reinforced cement concreting work.

11.2 Zone-IV fine aggregate shall be avoided for design mix reinforced cement concreting work unless tests have been done to ascertain the suitability of proposed with the prior approval POWERGRID site.

12. Bricks should be free from cracks, flaws and modules of free lime. They should have smooth rectangular faces with sharp corners and should be uniform in colour.

## **13. CEMENT**

13.1 In case of cement is in the scope of the contractor, the same shall be procured from sources approved by POWERGRID site and got tested on sample basis for specified acceptance tests as specified in the FQP at a reputed Third Party Lab approved by POWERGRID site.

13.2 The samples of cement for site testing shall be taken within three weeks of the delivery and all the tests shall be commenced within one week of sampling. If the cement remains in store for a period of more than six months. All the site tests are required to be repeated before usage.

## **14. REINFORCEMENT STEEL & STRUCTURAL STEEL USED IN CABLE TRENCHES & FOUNDATIONS**

14.1 In case supply of steel is in the scope of the contractor, the same shall be procured from the main producers i.e. SAIL, TISCO, IISCO or Rashtriya Ispat Nigam or the rerollers approved by main producers. The steel shall be got tested at site on sample basis for specified acceptance tests as specified in this FQP at a reputed Third Party Lab approved by POWERGRID site.

14.2 The results of the testing of cement and reinforcement steel referred in 13.1 and 14.1 above shall be got approved from POWERGRID site before cement and reinforcement steel are put to use. However, in exceptional cases due to exigencies of work. POWERGRID site may authorize the contractor to use Cement and Reinforcement Steel even before the test results are received. However, in all such cases, if the test results subsequently received are found to be not complying with the specified acceptance criteria, the contractor shall have to dismantle and recast all such foundations cast with such non-conforming materials at his own cost. Confirmation to this effect shall be obtained from the contractor by the Project authorities beforehand in all such cases.

15. The contractor shall submit welding procedure specification (WPS) including the type of electrode used for approval of POWERGRID site before starting the welding work.

16. Approval/acceptance of individual test results by POWERGRID in the course of execution of contract will not relieve the contractor of his contractual obligations and responsibilities, nor does it limit the Owner's right under the contract.

17. In case, requirement of special items like Super Sulphated Cement, Corrosive Resistant Reinforcement Steel (CRRS) etc. arise due to site conditions, the specific approval of POWERGRID may be obtained before using the same and all the tests as per relevant standards shall be carried out.

18. All the materials shall be stored by the contractor in a manner affording convenient access for identifications and inspection at all times. Storage of material shall be in accordance with IS: 4032 (Latest Edition).

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

ANNEXURE-I

PAGE 1 OF 1

## ACCEPTING AND DEVIATION DISPOSITIONG AUTHORITIES FOR DIFFERENT CATEGORIES OF CHECKS AS ENVISAGED IN FIELD QUALITY PLANT

| CATE<br>GORY | TYPE<br>OF<br>CHECK | 100%<br>CHECKING/WITNESSING<br>BY                  | COUNTER<br>CHECK/SURVEI<br>LLANCE<br>CHECK BY    | ACCEPTING<br>AUTHORITY, IF<br>TEST RESULTS<br>ARE WITHIN<br>PERMISSIBLE<br>LIMITS | DEVIATION<br>DISPOSITIONING<br>AUTHORITY                       |
|--------------|---------------------|----------------------------------------------------|--------------------------------------------------|-----------------------------------------------------------------------------------|----------------------------------------------------------------|
| 'A'          | CRITI-<br>CAL       | EXECUTING DEPTT. PLUS<br>FQA REPRESENTATIVE<br>GHQ | FQA REPRESENTATIVE AND<br>RHQ/DHQ REPRESENTATIVE | HEAD OF DHQ                                                                       | HEAD OF RHQ IN<br>CONSULTATION<br>WITH<br>CQA, IF<br>REQUIRED. |
| 'B'          | MAJOR               | EXECUTING DEPTT.                                   | DHQ-<br>REPRESENTATIVE                           | HEAD OF GHQ                                                                       | HEAD OF DHQ                                                    |
| 'C'          | MINOR               | CONTRACTORS<br>REPRESENTATIVE                      | EXECUTING<br>DEPTT.                              | MINIMUM E4<br>LEVEL<br>EXECUTING OF<br>SUB-<br>STATION/TL                         | HEAD OF GHQ                                                    |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

ANNEXURE-2

Page 1 of 5

## ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FOUNDATION MATERIALS AND CONCRETE

### A) CEMENT

| S. No. | Description of the tests                                                      | 33 Grade OPC as per IS:269                              | 43 Grade cement as per IS:8112 | PPC as per IS:1489         | Low Heat cement                                                               |
|--------|-------------------------------------------------------------------------------|---------------------------------------------------------|--------------------------------|----------------------------|-------------------------------------------------------------------------------|
| 1.     | Fineness (min.)                                                               | 225 m <sup>2</sup> /kg                                  | 225 m <sup>2</sup> /kg         | 300 m <sup>2</sup> /kg     | 225 m <sup>2</sup> /kg                                                        |
| 2.     | Compressive strength (min.)<br>72 ± 1 hours<br>168 ± 2 hours<br>672 ± 4 hours | 160 kgf/cm <sup>2</sup><br>220 kgf/cm <sup>2</sup><br>- | 23 MPa<br>33 MPa<br>43 MPa     | 16 MPa<br>22 MPa<br>33 MPa | 100 Kgf/cm <sup>2</sup><br>160 Kgf/cm <sup>2</sup><br>350 Kgf/cm <sup>2</sup> |
| 3.     | Initial setting time (min.)                                                   | 30 minutes                                              | 30 minutes.                    | 30 minutes                 | 30 minutes                                                                    |
| 4.     | Final setting time (max.)                                                     | 600 minutes                                             | 600 minutes                    | 600 minutes.               | 600 minutes.                                                                  |
| 5.     | Soundness (Le Chatelier Method)                                               | Maximum 10 mm expansion                                 | Maximum 10 mm expansion        | Maximum 10 mm expansion    | Maximum 10 mm expansion                                                       |
| 6.     | Heat of Hydration (max.)                                                      | -                                                       | -                              | -                          | Max. 65 cal/gm for 7 days & max. 75 cal./gm for 28 days                       |
| 7.     | Chemical composition                                                          | As per IS                                               | As per IS                      | As per IS                  | As per IS                                                                     |

### B) COARSE AGGREGATE :

#### (i) Sieve Analysis

| IS SIEVE DESIGNATION | PERCENTAGE PASSING FOR GRADED AGGREGATE OF NOMINAL SIZE |           | PERCENTAGE PASSING FOR SINGLE SIZED AGGREGATE OF NOMINAL SIZE |          |
|----------------------|---------------------------------------------------------|-----------|---------------------------------------------------------------|----------|
|                      | 40 mm                                                   | 20 mm     | 40 mm                                                         | 20 mm    |
| 63 mm                | -                                                       | -         | 100                                                           | -        |
| 40 mm                | 95 to 100                                               | 100       | 85 – 100                                                      | 100      |
| 20 mm                | 30 to 70                                                | 95 to 100 | 0 – 20                                                        | 85 - 100 |
| 10 mm                | 10 to 35                                                | 25 to 55  | 0 – 5                                                         | 0 - 20   |
| 4.75 mm              | 0 to 5                                                  | 0 to 10   | -                                                             | 0 - 5    |

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

ANNEXURE-2

Page 2 of 5

- (ii) Flakiness Index Not to exceed 25%
- (iii) Crushing value Not to exceed 45%
- (iv) Soundness of aggregate applicable for concrete works subject to frost action Loss of weight after 5 cycle not to exceed 12% when tested with Sodium sulphate and 18% when tested with magnesium sulphate
- (v) Deleterious material Not to exceed 5% of the weight of aggregate when tested as per IS:2386 Part – II (1963)

## ( C ) FINE AGGREGATE

- (i) Sieve Analysis Shall confirm to Zone-I, Zone-II or Zone-III

| IS Sieve designation | Grading Zone-I | Percentage Grading Zone-II | Passing for Grading Zone-III | Grading Zone-IV |
|----------------------|----------------|----------------------------|------------------------------|-----------------|
| 10 mm                | 100            | 100                        | 100                          | 100             |
| 4.75 mm              | 90 - 100       | 90 - 100                   | 90 - 100                     | 90 - 100        |
| 2.36 mm              | 60 - 95        | 75 - 100                   | 85 - 100                     | 95 - 100        |
| 1.18 mm              | 30 - 70        | 55 - 90                    | 75 - 100                     | 90 - 100        |
| 600 Micron           | 15 - 34        | 35 - 59                    | 60 - 79                      | 80 - 100        |
| 300 Micron           | 15 - 20        | 8 - 30                     | 12 - 40                      | 15 - 50         |
| 150 Micron           | 0 - 10         | 0 - 10                     | 0 - 10                       | 0 - 15          |

- (ii) For guidance of adjusting sand in mix of concrete, the following table may be used.

| Moisture Content % | building % by volume |
|--------------------|----------------------|
| 2                  | 15                   |
| 3                  | 20                   |
| 4                  | 25                   |
| 5                  | 30                   |

- (iii) Silt Content Test: Shall not exceed 8% when tested as per test procedure specified in appendix-D of chapter 3 of 1991-92 CPWD Specification.
- (iv) Deleterious Materials: Total deleterious material shall not be more than 5% by weight.

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

ANNEXURE-2

Page 3 of 5

(D) REINFORCEMENT STEEL: As per relevant Indian Standards.

(E) CONCRETE CUBE TEST

For nominal (volumetric) concrete mixes, compressive strength for 1:1½:3 (cement : sand : coarse aggregate) concrete shall be 265 kg/cm<sup>2</sup> for 28 days and for 1:2:4 nominal mix, it shall be 210Kg/cm<sup>2</sup>.

(F) ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTH FOR NOMINAL MIX CONCRETE

- (a) The average of the strength of three specimen be accepted as the compressive strength of the concrete, provided the strength of any individual cube shall neither be less than 70% nor higher than 130% of the specified strength.
- (b) If the actual average strength of accepted sample exceeds specified strength by more than 30%, the Engineer-in-charge, if he so desires, may further investigate the matter. However, if the strength of any individual cube exceeds more than 30% of specified strength, it will be restricted to 30% only for computation of strength.
- (c) If the actual average strength of accepted sample is equal to or higher than specified strength upto 30%, then strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.
- (d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate at the discretion of Engineer-in-Charge.
- (e) If the actual average strength of accepted sample is less than 70% of specified strength, the Engineer-in-Charge shall reject the defective portion of work represented 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 contract. If, however, the Engineer-in-Charge so desires, he may order additional tests to be carried out to ascertain if the structure can be retained. All the charges in connection with these additional tests shall be borne by the contractor.

(G) ACCEPTANCE CRITERIA FOR DESIGN MIX CONCRETE SHALL BE AS PER IS:456.

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

ANNEXURE-2

Page 4 of 5

## (H) SAMPLING PLAN FOR BRICK WORK

- i) 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.

- ii) 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                                              |

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

# POWERGRID CORPORATION OF INDIA LIMITED

(Quality Assurance & Inspection Deptt.)

ANNEXURE-2

Page 5 of 5

## (I) ACCEPTANCE CRITERIA FOR BRICK-WORK

- (i) Dimensional tolerances: The dimensions of modular bricks when tested shall be within the following limits per 20 bricks.

Length 372 to 388 cm ( $380 \pm 8$ cm)

Width 176 to 184 cm ( $180 \pm$ cm)

Height 176 to 184 cm ( $180 \pm 4$ cm) for 90 mm high bricks

- (ii) In case of non-modular bricks, %age tolerance will be +/- 2% for group of 20 numbers of class 10 bricks and +/- 4% for other class of bricks.

- (iii) 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.

- (iv) Water absorption: The average water absorption of bricks shall not be more than 20% by weight.

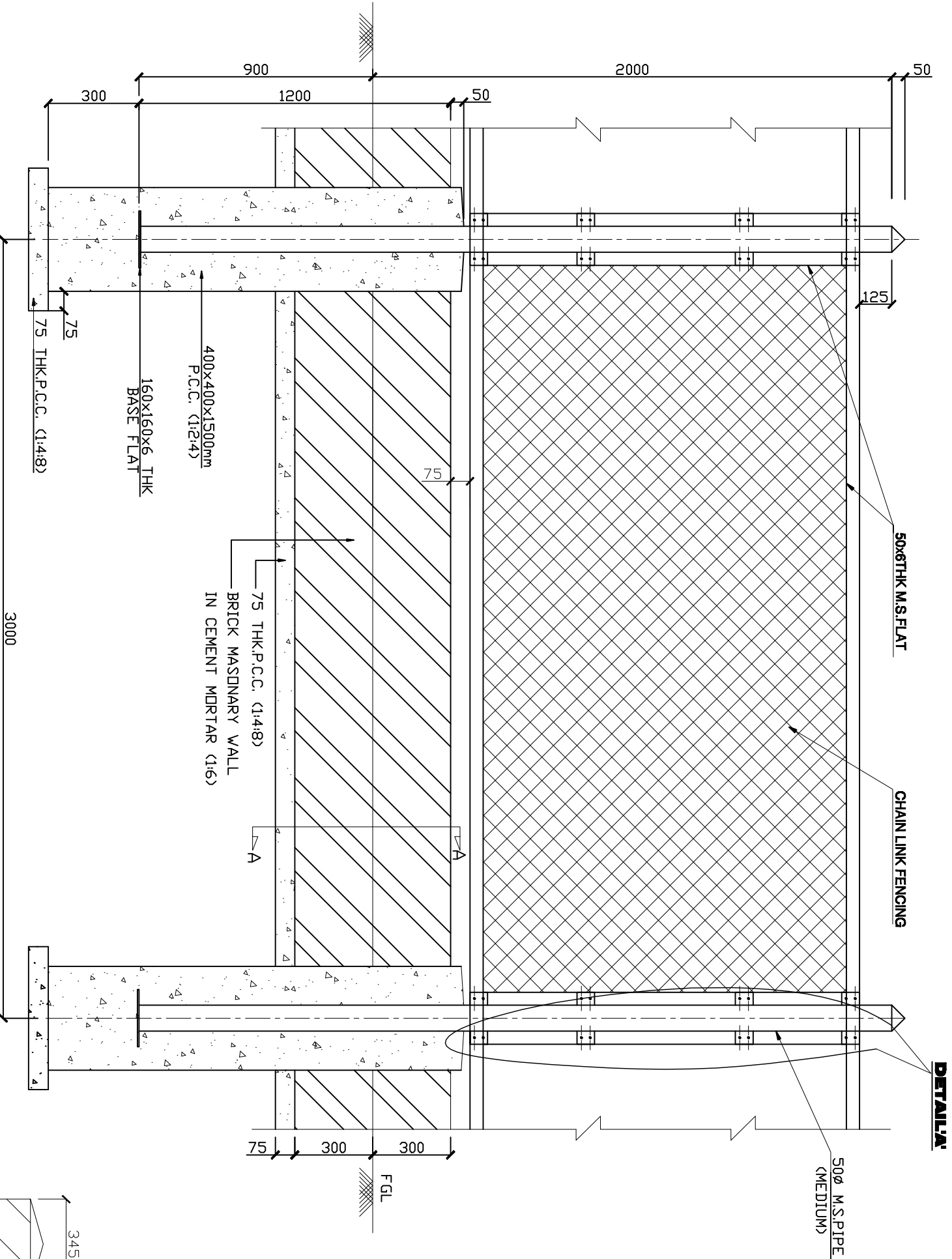
- (v) Efflorescence: The rating of efflorescence of bricks shall not be more than moderate.

## DRAWINGS

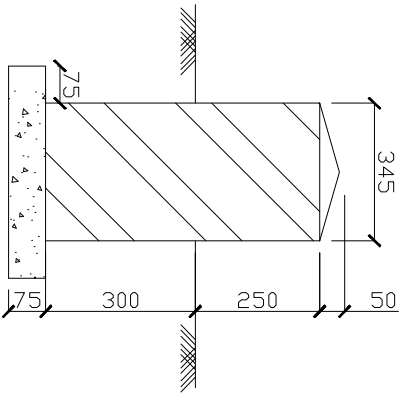
**(I) CHAINK LINK FENCING - DRG NO. C/ENGG/CVL/SYD/FENCE/101**

**(I) GATE - DRG NO. C/ENGG/CVL/SYD/GATE/002**

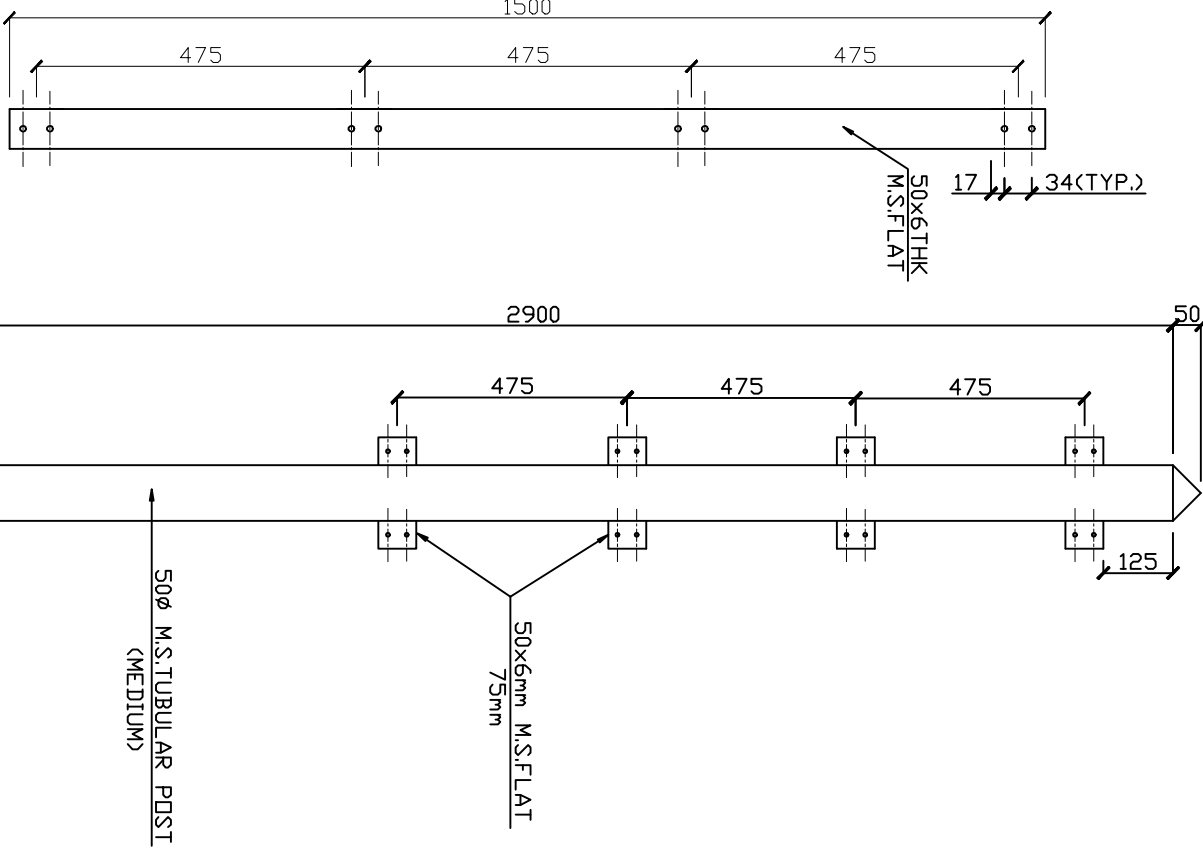
**(I) RAIN WATER HARVESTING - DRG NO. C/ENGG/STD/RWH-01**



TYPICAL ELEVATION OF SWITCHYARD FENCING



SECTION A-A



RELEASED FOR CONSTRUCTION.

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



PROJECT :

STANDARD SUB STATION DRAWING

TITLE :

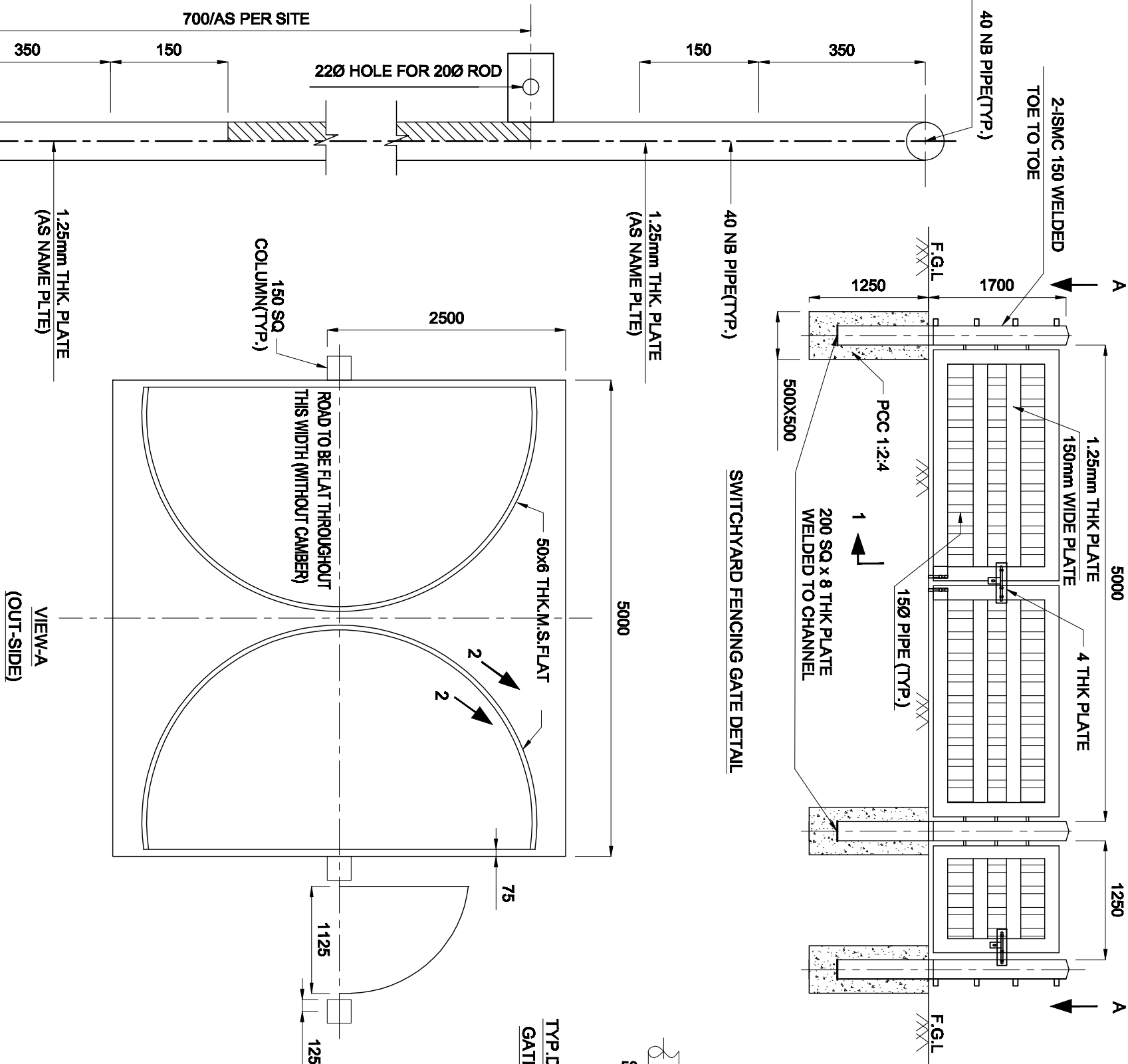
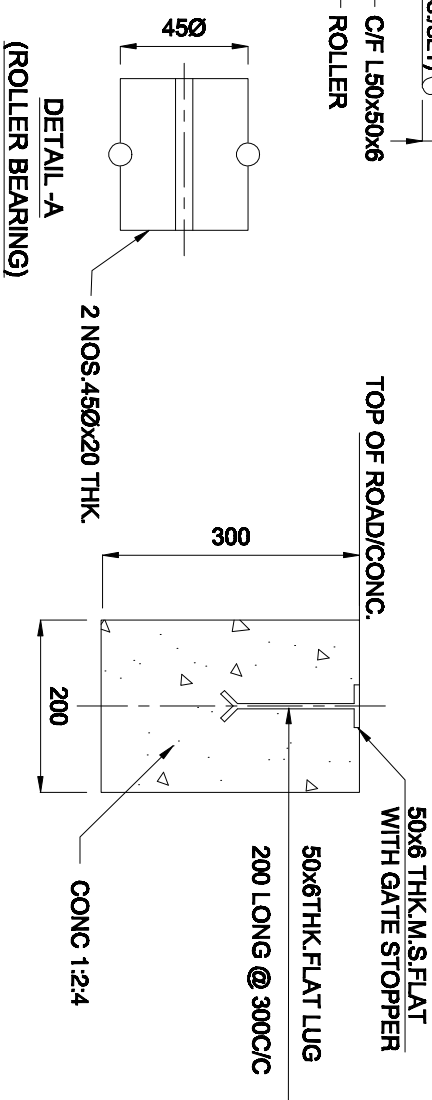
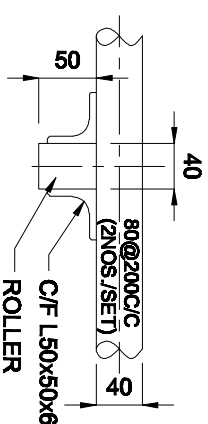
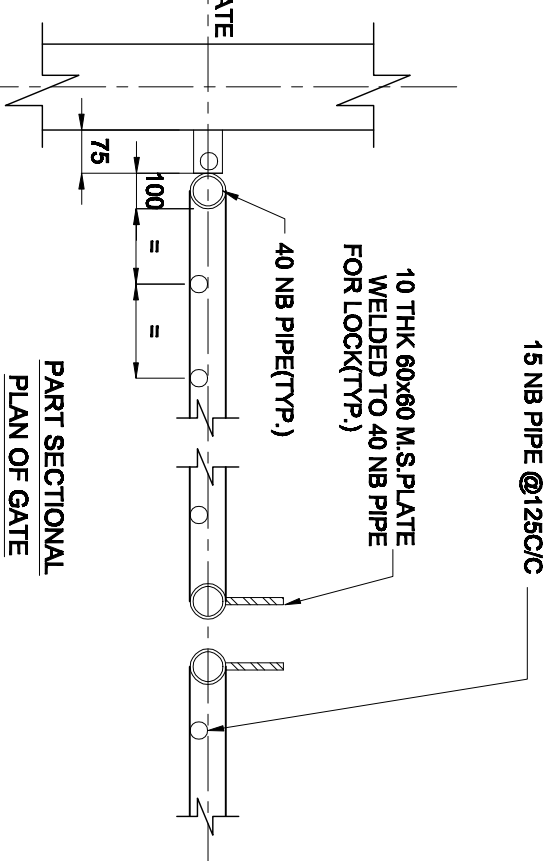
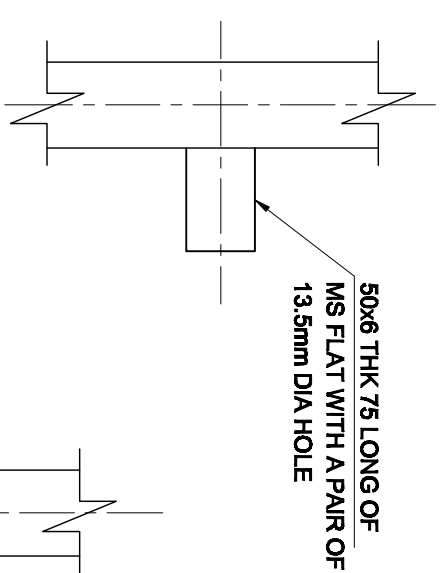
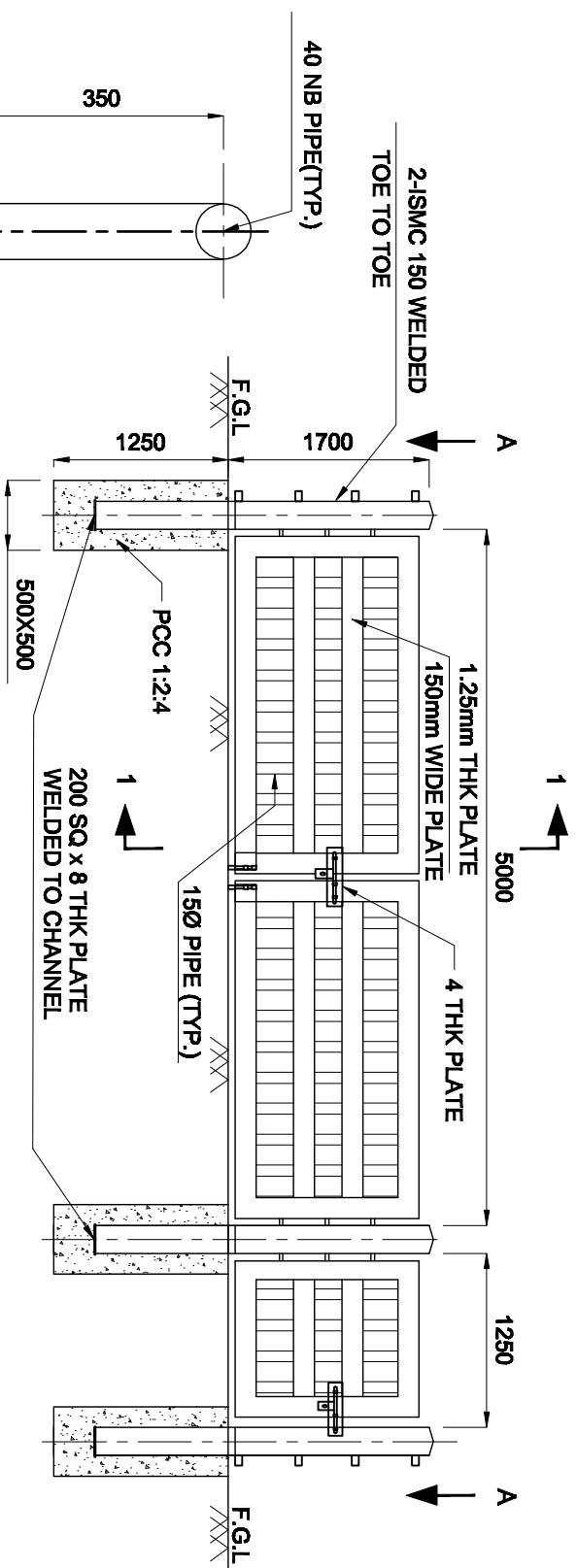
STANDARD DETAILS FOR SWITCH YARD  
CHAIN LINK FENCING

DITK SONDHYASTD-DRAWING

- NOTES:
- #000 SHALL DENOTE SWITCHYARD FINISHED GROUND LEVEL
  - CHAIN LINK FENCING SHALL HAVE 3.15 mm DIAMETER WIRE AS PER IS 2721 WITH 75x75 mm MESH SIZE AND GALVANIZED AS PER SPECIFICATION.
  - TUBULAR POST SHALL BE PLACED @ 3.0m CENTRE TO CENTRE.
  - CORNER TUBULAR POST SHALL BE PROVIDED CLEATS IN FOUR SIDES SUITING TO REQUIREMENT.
  - TUBES/PIPES OF POST SHALL BE GALVANIZED
  - CONCRETE FOR P.C.C. SHALL CONFORM TO CPWD SPECIFICATION.
  - CONCRETE PEDESTAL SHALL BE CAST IN VIRGIN SOIL/WELL COMPACTED EARTH.
  - EXPOSED SURFACE OF BRICK MASONARY/CONCRETE PEDESTAL SHALL BE PLASTERED WITH 12mm THICK CEMENT PLASTER 1:6 AND PAINTED WITH CEMENT PAINT OF REQUIRED SHADE.

|        |       |       |       |       |       |       |       |       |      |              |                                      |          |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|------|--------------|--------------------------------------|----------|
| PREP.. | REVD. | REVD. | REVD. | REVD. | REVD. | REVD. | REVD. | APPD. | DATE | SCALE<br>NTS | DRAWING NO. C/ENGG/CVL/SYD/FENCE/101 | REV<br>0 |
|--------|-------|-------|-------|-------|-------|-------|-------|-------|------|--------------|--------------------------------------|----------|

APPROVED BY GM (ENGG) S/S & TL ON 10.11.2009



## NOTES:

1. ALL DIMENSIONS ARE IN MM & ELEVATION ARE IN METER UNLESS NOTED OTHERWISE
2. ALL LEAN CONC. SHALL BE PCC (1:4:9) UNLESS NOTED OTHERWISE.
3. UNLESS NOTED OTHERWISE LAP/ANCHOR LENGTH SHALL BE 50 TIMES THE DIA OF BARS
4. ALL STRUCTURAL STEEL CONFORM TO IS:2062 & SHALL PAINTED WITH A COAT OF APPROVED STEEL PRIMER & TWO COATS OF SYNTHETIC ENAMEL. PAINT UNLESS NOTED OTHERWISE.
5. DROP BOLTS SHOULD BO PROVIDED ON THE FAR SIDE ONLY.
6. ALL WELDS ARE 6MM THK. FILLET WELDS UNLESS NOTED OTHERWISE.
7. GATE & M.S. HOOKS TO BE PAINTED WITH ONE COAT APPROVED STEEL PRIMER BEFORE ERECTION & TWO COAT OF SYNTHETIC PAINTS AFTER ERECTION.
8. STRUCTURAL PIPES SHALL BE MEDIUM TYPE CONFORMING TO IS 1161/806

RELEASED FOR CONSTRUCTION.

[illegible]

