

SECTION-VII

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SECTION-VII

1.0 BORED CAST- IN – SITU R.C.C. VERTICAL PILE FOUNDATION

1.1 General Scope

1.1.1 The work to be performed under this specification consists of boring, driving and installation of cast-in-situ vertical bored piles providing all labour, supervision, dewatering, materials, scaffolding, platform, cranes, staging, power, fuel, construction equipments, tools, tackles and plants, supplies, transportation on land and water, all incidental items not shown or specified but reasonably implied or necessary for successful completion of work including Contractor's supervision in strict accordance with IS Codes, approved drawings and specifications. The nature of work shall generally involve construction/installation of cast-in-situ vertical bored piles of specified size, pile caps, pedestals, tie beam (if required) etc as per Owner's construction drawing. The bidder shall furnish in their bid complete data regarding the method of installation of the pile foundations, complete list of equipments, tools and tackles, rigs, men, materials to be deployed for the work etc.

1.1.2 The Bidder's offer should be based on the mobilisation of at least one no. of piling rig for each tower location together with all associated working gangs, tool & tackles etc.(including at least 1 no. of rotary drilling rig capable of boring minimum 1200 mm diameter and upto 25 m depth below ground level with necessary tool/accessories for boring). However, if extra rigs are required to be deployed by the Contractor to match with the project construction schedule, in that case the same shall be deployed without any additional cost to the Owner.

1.1.3 The work shall include mobilization of all necessary equipments, providing necessary engineering supervision through qualified and technical personnel, skilled and unskilled labour, etc. as required to carry out the complete piling work. The minimum capacities of some key equipment are listed below. However, bidder has to furnish informations regarding the equipments they intend to deploy for the project as per Performa stipulated in the relevant schedules of the BPS.

<i>Sl.No</i>	<i>Description</i>	<i>Capacity</i>
1	Tripod height	6m. to 10m. (clear drop)
2	Rig (winch) capacity	3T to 5T
3	Weight of chisel	2T to 3T
4	Mud pump capacity	15 HP to 25 HP
5	Dia. of outlet pipe for bentonite	2.5 inch
6	Rotary drilling rig (Hydraulic) alongwith all accessories	Minimum torque 12T

Note: Bidder may have to provide higher capacity equipments than mentioned above, as per the actual requirement for the execution of the job, without any additional financial implication to TPTL.

- 1.1.4 The Contractor shall be responsible for the soundness of the above pile foundations attributable to the installation/construction of these foundations.
- 1.1.5 After completion of installation / construction of piles, pile integrity test shall be conducted for each pile by the contractor, in presence of Owner's representative, to establish its soundness. The procedure for conducting of pile integrity test is given briefly at clause 3.31 of this section. The tentative quantities of tests to be carried out are given in BPS. Bidder has to quote the price accordingly.
- 1.1.6 The setting of stub/fixing of foundation anchor bolts, as the case may be, shall be the responsibility of the Contractor.
- 1.1.7 In order to familiarize with the site condition and the work involved, the Bidders are advised to visit the site for on the spot study of the location before quoting their rates.
- 1.1.8 The Bidder has to quote based on the BOQ furnished in the schedule of Prices of B.P.S. No deviation in this respect will be acceptable and any bid quoted based on different Bill of Quantities shall be liable for rejection. However, the payment will be made as per actual quantity executed based on the unit rates quoted.

1.2 Qualifying requirement for Pile foundation

The bidder should have experience of its own or should engage the services of an agency(ies) meeting the following experience, for carrying out pile foundations covered under the scope of the work of the package. In case the bidder intend to engage services of an agency(ies) for pile foundations meeting the stipulated experience, an undertaking as per Format enclosed at Annexure-F shall be submitted from the agency(ies) along with the bid.

A) Technical Experience

The bidder/agency shall have successfully carried out as a prime contractor or as a sub-contractor or as a member in a Joint Venture and in which each one of them has been responsible for 100% execution of at least two works of a nature and complexity comparable to the work covered in the proposed contract(s) within the last ten years. The bidder's/ agency (ies) experience should include the following:

- (i) The bidder/agency should have installed cast-in-situ vertical bored pile foundation having **1000** mm minimum diameter and having minimum depth of 25 metres below ground level.
- (ii) a) The monthly rate of pile boring achieved by the bidder / agency should be **140** m for Package A1 & **1100** m for Package A2 and in any calendar month during last 5 years.

b) The monthly average rate of pile boring achieved by the bidder / agency should be **70** m for Package A1 & **550** m for Package A2 in any financial year during last 5 years.
- (iii) The monthly average rate of Concreting for pile cap, pedestal, tie beams etc. achieved by the bidder / agency should be **40** Cum for Package A1 & **220** Cum for Package A2 in any financial year during last 5 years.

B) Equipment capabilities

The bidder/ agency should own or have access to atleast 1 (one) no. Rotary drilling machine capable of boring 1000 mm diameter and up to 35 m depth below ground level with necessary tools/accessories for boring in all kinds of soil including bed rock.

In case bidder/agency is proposing above facilities from other agencies, they shall furnish the details of such agencies along with their consent letters.

1.3 Design and Drawing Requirements

The detailed soil investigation has already carried out by the Owner and any additional soil investigation wherever required and/or advised by Owner shall o be carried out by the Contractor. Owner will develop the pile foundation design based on the soil investigation report for the particular location. The construction drawing required for execution of pile foundation shall be given to the contractor after finalising the agency for execution of pile foundation.

1.4 Criteria For Terminating The Piles

- 1.4.1 The piles can be terminated at a depth based on design developed by the Owner, where loads bear by the piles can be transmitted to the soil in a proper manner or the depth where specified 'N' value is achieved,

whichever occurs later. However, in no case piles should be terminated at a higher level than that indicated in the drawing.

1.4.2 Standard penetration test (SPT) shall be carried out starting from 1.0 M above the specified pile termination depth and there after @ 1m. upto the pile termination depth.

1.4.3 The Standard Penetration Test (SPT) shall be carried out based on the following test procedures:

The test shall be conducted by driving a standard split spoon sampler in the bore hole by means of a 60 N hammer having a free fall of 0.75 M. The sampler shall be driven for 450 mm using the hammer and the number of blow shall be recorded for every 150mm penetration. The number of blows for the last 300 mm drive shall be reported as N value. The test shall be discontinued when the blow count is equal to 100 or the penetration is less than 25mm for 50 blows, whichever is earlier.

At the location where the test discontinued, the penetration and the number of blows shall be reported. Sufficient quantity of disturbed sample shall be collected from the split spoon sampler for identification/classification of soil. The sample shall be visually classified and recorded at the site.

The specification for the equipments and other accessories, procedure for conducting the test and collection of the disturbed soil sample shall conform to IS:2131 latest edition.

2.0 Construction of Bored Cast-in-Situ Pile Foundation

2.1 General Requirement

2.1.1 The specification along with specific requirements under Annexure-A covers the technical requirements for piling work, general description of work, quality and workmanship. In every case, work shall be carried out to the satisfaction of the Owner and conform to location, lines, grades and cross sections shown on the construction drawing or as directed by the Owner. The specifications are not, however, intended to cover minute details and the work shall be executed according to the relevant latest Indian Codes. In absence of the IS Codes, work shall be executed according to the best prevailing local Public Works Department practice or to the recommendations of the relevant American / British Standards or to the instructions of the Owner. This specification shall have precedence in case anything contrary to this is stated anywhere in this Bid Document. All the latest Editions of IS Codes are to be followed. In case of conflict between the Specification and Codes, the former shall prevail.

2.1.2 The work shall include mobilization of all necessary equipments (Annexure-

B), providing necessary engineering supervision through qualified and technical personnel, skilled and unskilled labour, etc. as required to carry out the complete piling work, and submission of records as per schedule. The bidder shall furnish complete data of their equipments required for installation of piles.

2.2 Layout and Levels

Layout and levels of structures etc. shall be made by the Contractor, at his own cost, from the general grid of the plot and the bench marks given by the Owner. The Contractor shall make his own arrangements, at his own cost, for locating the co-ordinates and position of piles as per approved drawings and for determining the Reduced Level (R.L.) of the locations with respect to the single bench mark indicated by the Owner. Two established reference lines in mutually perpendicular direction shall be indicated to the Contractor. The Contractor shall provide at site all the required survey instruments, materials and men to Owner for checking the detailed layout and correctness of the layout and levels to the satisfaction of the Owner so that the work can be carried out accurately according to specifications and drawings. The contractor shall be solely responsible for the correctness of layout and levels.

2.3 Properties, Storage & Handling of Construction Materials

This section specifies the properties, storage & handling of common building materials unless otherwise mentioned in the drawings or schedule of items.

2.3.1 Properties of Materials

All materials viz., cement, steel, aggregates, water etc. which are to be used for pile construction are detailed below. However, aggregates more than 20mm shall not be used.

2.3.1.1 Stone

All stones shall be from approved quarries, hard, tough, durable, compact grained, uniform in texture and colour and free from decay, flaws, veins, cracks and sand holes. The surface of a freshly broken stone shall be bright, clean and sharp and shall show uniformity of texture without loose grains and free from any dull, chalky or earthy appearance. Stone with round surface shall not be used. Stones showing mottled colours shall not be used for face work. A stone shall not absorb more than 5% of its weight of water after 24 hours immersion. The type of stone shall be as specified on

drawings and or instructed by the Owner. Samples shall be submitted by the Contractor and approved samples shall be retained by the Owner for comparison of bulk supply.

2.3.1.2 Cement

Cement used shall be ordinary Portland Cement, unless mentioned otherwise, conforming to the latest Indian Standard Code IS:269 or IS:8112 or IS:12269. Any variety of cement other than ordinary Portland Cement such as Portland Pozzolana Cement conforming to IS:1489 (latest edition) or Portland Slag Cement conforming to IS:455 (Latest edition) shall be used only after the written permission of the Owner. The Contractor shall submit the manufacturers certificate, for each consignment of cement procured, to the Owner. However Owner reserves the right to direct the Contractor to conduct tests for each batch/lot of cement used by the Contractor and Contractor will conduct those tests free of cost at the laboratory so directed by the Owner. The Contractor shall also have no claim towards suspension of work due to time taken in conducting tests in the laboratory. Changing of brand or type of cement within the same structure shall not be permitted without the prior approval of the Owner. Sulphate resistant cement shall be used if sulphate content is more than the limit specified in IS : 456, as per Geotechnical Investigation report.

2.3.1.3 Coarse aggregates

- a) Coarse aggregates shall be as per IS:383 (Latest Edition) consisting of hard, strong and durable pieces of crushed stone having angular shape & rectangular surface and shall be free from organic or clay coatings and other impurities like disintegrated stones, soft flaky particles, adherent coatings, clinkers, slag, mica and any other materials liable to affect the strength, durability or appearance of concrete.
- b) Aggregate other than crushed stone conforming to the provisions of specifications may be used if permitted by the Owner.
- c) Sieving and washing of aggregates by approved method shall be carried out, if desired by the Owner.
- d) Grading of coarse aggregate shall generally conform to IS:383 and shall be such as to produce a dense concrete of the specified proportions and strength and of consistency that will work readily into position without segregation.
- e) The maximum size of aggregate shall be as follows unless specified otherwise:
 - i) Reinforced concrete with very narrow space - 10mm.

- ii) Reinforced concrete & Plain Concrete - 20mm.
- iii) Lean Concrete 1:3:6 or 1:4:8-40mm.

2.3.1.4 Sand

Sand shall be hard, durable, clean and free from any adherent coatings or organic matter and shall not contain clay balls or pellets. The sand shall be free from impurities such as iron pyrites, alkalies, salts, coal, mica, shale or other laminated materials, in such forms or quantities as to affect adversely the hardening, strength, durability or appearance of mortar, plaster or concrete or to cause corrosions to any metal in contact with such mortar, plaster or concrete. In no case the cumulative percentage of impurities in sand shall be more than 5% by weight. All sand shall be properly graded. Unless otherwise directed by the Owner all sand shall pass through IS Sieve no. 240 and 15% to 35% of sand for masonry mortar and 5% of sand for plaster shall pass through Sieve No. 30. Sand for concrete shall conform to IS:383 .

2.3.1.5 Water

Water shall be clean, fresh and free from organic matters, acids or soluble salts and other deleterious substances which may cause corrosion, discolouration, efflorescence etc. Potable water is generally considered fit for use. Water to be used shall comply with the requirements of IS:456 .

Average 28 days compressive strength of at least three 15 cm. cubes of concrete prepared with proposed water shall not be less than 90% of average strength of three similar cubes prepared with distilled water. PH of water shall generally be not less than 6.

2.3.1.6 Reinforcement

Reinforcement steel shall be clean and free from loose mill scales, dust, loose rust, oil and grease or other coatings which may impair proper bond. Reinforcement shall conform to IS:1786 (Latest edition) for deformed and cold twisted bars (Fe 500). If mentioned in the BPS, epoxy coated reinforcement shall conform to IS 13620. Thermo mechanically Treated (TMT) bars (equivalent grade) in place of Cold twisted deformed steel bars are also acceptable. Hard drawn steel wire shall conform to IS:432 (Latest Edition). All steel bars including and above 6mm diameter shall be of tested for quality. All wire netting shall be galvanised. Substitution of reinforcement shall not be permitted without the prior approval of the Owner.

2.3.2 Storage & Handling of Materials

All materials shall be stored by the Contractor in a manner affording convenient access for identification and inspection at all times. The storage arrangements shall be subject to the approval of the Owner. Storage of materials shall be as described in IS:4032.

All materials shall be so stored as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material which has deteriorated or has been damaged or is otherwise considered defective by the Owner shall not be used for concrete, and shall be removed from site immediately, failing which, the Owner will get the materials removed and the cost thereof shall be recovered from contract price. The Contractor shall maintain upto date accounts of receipt, issue and balance (stock wise) of all materials.

2.3.2.1 Stones

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

2.3.2.2 Cement

The cement shall be stored in dry enclosed shed, well away from the walls and insulated from the floor to avoid contact with moisture. The cement shall be stacked in easily countable stacks to facilitate removal of first in first out basis. The cement bags shall be gently kept on the floor to avoid leakage of cement from the bags. Sub-standard or partially set cement shall be immediately removed from the site as soon as it is detected. Cement stored for period beyond 90 days shall be tested before use.

2.3.2.3 Coarse and Fine Aggregate

Aggregates shall be stored on bricks soling or an equivalent platform so that they do not come in contact with dirt, clay, grass or any other injurious substance at any stage. Aggregate of different sizes shall be kept in separate and easily measurable stacks. If so desired by the Owner, aggregates from different sources shall be stacked separately with proper care to prevent intermixing.

2.3.2.4 Reinforcement

Reinforcement steel shall be stored consignment wise and size wise, off the ground and under cover, if desired by the Owner. It shall be protected from rusting, oil grease and distortions. If directed by the Owner, the reinforcement steel may have to be coated with cement wash before stacking, to prevent scale and rust at no extra cost to the Owner. The stacks shall be easily measurable. Only steel needed for immediate use shall be removed from storage. Fabricated reinforcement shall be carefully stored to prevent damage, distortion, corrosion & deterioration.

2.4 Owner's Authority to Reject Materials

Any material considered to be Sub-standard or not up to the specifications declared/certified by the Owner shall not be used by the Contractor and shall be removed from the site immediately at no extra cost to the Owner.

2.5 Site Preparation

This section of the specification covers site preparation of the areas as indicated in the drawings.

2.5.1 Reference Points and Bench Marks

2.5.1.1 Permanent reference pillars have been established and under no circumstances shall the Contractor remove or disturb any permanent mark without the approval of the Owner. The Contractor shall carefully maintain and protect all bench marks and reference points and shall layout all his work by accurate reference thereto. The Contractor shall remove all vegetation, excluding trees, from the site areas as directed by the Owner.

2.5.1.2 The area shall be stripped to remove roots of grass, rubbish and slush, shrubs or other organic materials. Spoiled materials shall be burnt or removed to be approved disposal areas on or near the job site as directed by the Owner.

2.6 Excavation (applicable for construction of pile cap)

2.6.1 The Contractor shall furnish all labour, equipment and materials required for complete execution of the work in accordance with the drawings and as described herein.

2.6.2 The Contractor shall control the grading in the vicinity of all excavation so that the surface of the ground will be properly slopped or diked to prevent

surface water from running into the excavated areas during construction.

- 2.6.3 Excavation shall include the removal of all materials required to execute the work properly and shall be made with sufficient clearance to permit the placing, inspection and setting of forms and completion of all works for which the excavation was done.
- 2.6.4 Side and bottoms of excavation shall be cut sharp and true, undercutting shall not be permitted. Each sides of excavation shall be used in lieu of formwork for placement of concrete unless authorised, in special cases, by the Owner, where limitation of space for larger excavation necessitate such decision.
- 2.6.5 When machines are used for excavation, the last 300mm before reaching the required level shall be excavated by hand or by such equipment that will leave the soil at the required final level, in its natural conditions.
- 2.6.6 Suitability for bearing of the bottoms of excavations shall be determined by the Owner.
- 2.6.7 The bottom of excavation shall be trimmed to the required level and when carried below such levels, by error, shall be brought to level by filling with lean concrete 1:4:8 mix, with aggregate of 40mm maximum nominal size at the Contractor's cost.
- 2.6.8 The Contractor shall be responsible for assumptions and conclusions regarding the nature of materials to be excavated and the difficulty of making and maintaining the required excavations and performing the work required as shown on the drawing and in accordance with these specifications. Cofferdams, sheet piling, sheeting, shoring, bracing, draining, dewatering etc, shall be furnished and installed as required and the cost there of shall be included in the unit rate quoted for the item of excavation. The Contractor shall be responsible for any damage to any part of the work and property caused by collapse of sides of excavations. Materials may be salvaged if it can be done with safety for the work and structure, as approved by the Owner.
- However, no extra claim shall be entertained for materials not salvaged or any other damage to Contractor's property as a result of the collapse. He shall not be entitled to any claim for redoing the excavation as a result of the same.
- 2.6.9 Excavations for foundations specified shall be carried at least 100mm or as

specified in relevant drawings below the bottom of structural concrete and then be brought to the required level by placing lean concrete of 1:4:8 mix or as specified in drawings with aggregate of 40mm maximum nominal size.

2.6.10 When excavation requires sheet piling, bracing, sheeting or shoring etc. the Contractor shall submit to Owner, drawings showing arrangement and details of proposed installation and shall not be proceed until he has received approval from the Owner.

2.6.11 The Contractor shall have to constantly pump out the water collected in pits due to rain water, springs etc. and maintain dry working conditions at no extra cost to the Owner.

2.6.12 Classifications

For the purpose of excavation in earthwork, all types of soil including kankar, morum, shingle and boulders upto 150mm size without binding matrix are included and no separate payment shall be made for different type of soils.

2.6.13 Measurement of Excavation

Measurement for payment will be based on volume calculations determined by the existing grade, the bottom elevation of structural/lean concrete with lateral dimension (vertical sides) 0.3m outside concrete outline of lowest footing for depths upto 1.0m below existing grade, and 1.0m outside concrete outline of lowest footing for depths more than 1m below existing grade (Concrete dimensions determined from drawings). The unit of measurement shall be cu.m.

Nothing extra would be payable for slope, shoring, shuttering, sheeting, sheet piling etc. irrespective of whatever is provided. If directed by Owner the excavation shall be done on slopes for slope stability point of view at no extra cost to the Owner. The Contractor shall arrange to transport the excavated soil to a distance as directed by Owner and the rates quoted for excavation in Price schedule shall include all lead, lift, carriage etc.

2.7 Cement Concrete

2.7.1 This section of the specification deals with cement concrete, plain or reinforced, and covers the requirement for concrete mix design, strength and quality, pouring at all levels, forming, protection, curing finishing, admixtures, inserts and other miscellaneous works.

2.7.2 The provisions of the latest revision of IS:456 shall be complied with unless permitted otherwise. Any other Indian Standard Code (Latest Revision) shall form the part of the specification to the extent it has been referred to or applicable within this specification.

2.7.3 The Contractor shall furnish all labour, material and equipment to form, place and finish all structural concrete, concrete works and miscellaneous items complete, as described herein.

2.7.4 Admixtures

The admixtures in concrete for promoting workability, improving strength, entraining air or for any other purpose shall be used only after the written permission from the Owner is obtained. Addition of admixtures should not reduce the specified strength of concrete in any case. The admixtures shall conform to IS: 9103 (Latest Edition). In case plasticisers are used in the concrete for any structure, fresh mix design be done considering the admixture with the specific approval from Owner. Nothing extra shall be payable to the Contractor on this account.

2.7.5 Grades of Concrete

The minimum grade of concrete to be used for piling shall be M-25 and minimum cement content shall be 400 kg/m³ in all condition. Concrete shall conform to the controlled design mix as specified in IS: 456 (latest edition). In addition, nominal mixes of 1:3:6 and 1:4:8 (with aggregates of nominal size 40mm maximum or as indicated on drawings), by volume or any other mix shall be used as per field quality plan or where specified. The concrete in aggressive surroundings due to presence of sulphate, etc., shall conform to IS: 456 (latest edition). The slump of concrete shall be maintained between 150 to 200 mm.

2.7.6 Workmanship

2.7.6.1 General

All workmanship shall be according to the latest and best possible standards.

Before starting a pour the Contractor shall obtain the approval of the Owner in a "Pour Card" maintained for this purpose. He shall obtain complete instructions about the material and proportions to be used. Slump,

workability, Quantity of water per unit weight of cement, number of test cubes to be taken type of finishing to be done, any admixture to be added, any limitation on size of pour and stopping of concrete in case of premature stopping of pours.

2.7.7 Mixing of Concrete

All control/design mix concrete shall be mixed at a single central batching plant situated within the area allocated for the Contractor's particular use as shown on the drawings. The plant shall have mechanically operated mixer of an approved size and type capable of ensuring a uniform distribution on the materials through the mass.

The proportions of fine and coarse aggregate, cement and water shall be as determined by the mix design or according to fixed proportions in case of nominal mix concrete and shall always be approved by the Owner. The quantities of the cement, final and coarse aggregates shall be determined by weight. The water shall be measured accurately after giving proper allowance for surface water present in the aggregate for which regular check shall be made by the Contractor.

The water shall not be added to the mix until all the cement and aggregates consisting the batch are already in the drum and dry mixed for atleast one minute. Mixing of each batch shall be continued until there is a uniformity in colour and consistency but in no case shall mixing be done for less than two (2) minutes and at least forty (40) revolutions after all the materials and water are in the drum. When absorbent aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Owner. Mixers shall not be loaded above their rated capacity as it prevents through mixing. If there is segregation after unloading from the mixer the concrete should be remixed.

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

When hand mixing is permitted by the Owner for concrete to be used in unimportant locations it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the mass is

uniform in colour and consistency. In case of hand mixing, an extra 10% of cement shall be added to each batch at no extra cost to Owner.

2.7.8 Conveying Concrete

Concrete shall be handled and conveyed from the place of mixing to the place of final laying as rapidly as practicable, by approved means, before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation of Concrete which may occur during transportation of concrete. In case of any such segregation during transport, the concrete shall be re-mixed. During very hot or cold weather, if directed by the Owner, concrete shall be transported in deep containers, mortar leak proof, which will reduce the rate or water loss by evaporation and loss of heat. Conveying equipments for concrete shall be well maintained and thoroughly cleaned before commencement of concrete mixing. Such equipment shall be kept free from set concrete.

2.7.9 Placing of Concrete

- a) Formwork and reinforcement shall be approved in writing by the Owner before concrete is placed. The forms shall be well wetted and all shavings, dirt and water that may have collected at the bottom shall be removed before concrete is placed. Concrete shall be deposited in its final position without segregation, re-handling or flowing. The interval between adding the water to the dry materials in the mixer and the completion of the final placing inclusive of compaction of the concrete shall be well within the initial setting time for the particular cement in use or as directed by the Owner. As far as possible, concrete shall be placed in the formwork by means approved by the Owner and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 180cm shall have to be approved by the Owner. Once the concrete is deposited in its final position, it shall not be disturbed. Care should be taken to avoid displacement of reinforcement or movement of formwork.
- b) The placing of concrete shall be a continuous operation with no interruption in excess of 30 minutes between the placing of continuous portions of concrete.
- c) After the concrete has been placed it shall be spreaded and thoroughly compacted by approved mechanical vibration to a maximum subsidence without segregation and thoroughly worked

around reinforcement or other embedded fixtures into the correct form and shape. Vibrators shall not be used for pushing and shoveling concrete into adjoining areas. Vibrators must be operated by experienced men and over-vibration shall not be permitted. Head tamping in some case may be allowed subject to the approval of the Owner. Care must be taken to ensure that the inserts, fixtures, reinforcement and form work are not displaced or disturbed during placing of concrete. No concrete shall be placed in open while it rains. If there has been any sign of washing of cement and sand, the concrete shall be entirely removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete. Slabs, beams, pile caps, footings and the similar members shall be poured in one operation normally, in special circumstances with the approval of the Owner these can be poured in horizontal layers not exceeding fifty (50) cm in depth. When poured in layers, it must be ensured that the under layer, is not already hardened. Blending of under layer if any, shall be effectively removed.

- d) Wherever vibration has to be applied externally the design of formwork and the disposition of vibrators shall receive special consideration to ensure efficient compaction and to avoid surface blemishes.

2.7.10 Construction Joints (for pedestal, pile cap, tie beam etc.)

- a) When the work is to be interrupted, the concrete shall be rebated at the joint to such shape and size as may be required by the Owner or as shown on the drawings. All vertical construction joints shall be made with stone boards, which are rigidly fixed and slotted to allow for the passage of the reinforcing steel. If desired by the Owner, keys and/or dowel bars shall be provided at the construction joints. Construction joints shall be provided in positions as shown or described on the drawing. Where it is not described, the joints shall be in accordance with the following :
 - i) In a column, the joint shall be formed about 75mm below the lowest soft of the beams framing into it.
 - ii) Concrete in a beam shall be placed throughout without a joint, but if the provision or a joint is unavoidable, the joint shall be vertical and at the middle of the span.

- iii) In forming a joint, concrete shall not be allowed to slope away to thin edge. The locations of construction joints shall be planned by the Contractor well in advance of pouring and have to be approved by the Owner.

- b) Before the fresh concrete is placed, the cement skin of the partially hardened concrete shall be thoroughly removed and surface made rough by hacking, sand blasting, water jetting, air jetting or any other method as directed by the Owner. The rough surface shall be thoroughly wetted for about two hours and shall be dried and coated with 1:1 freshly mixed cement sand slurry immediately before placing the new concrete. The new concrete shall be worked against the prepared surface before the slurry sets. Special care shall be taken to see that the first layer of concrete placed after a construction joint is thoroughly rammed against the existing layer. Old joints during pour shall be treated with 1:1 freshly made cement sand slurry only after removing all loose materials.

- c) The unit rate of concrete work shall include the cost of preparation of construction joints as mentioned above and no extra payment shall be admissible on this account.

2.7.11 Inserts

All anchors, anchor bolts, inserts, stubs, etc. and any other items those are required to be embedded in the concrete shall be placed in correct position before pouring. Extra care shall be taken during pouring operation to maintain their locating Blockouts and openings shall be kept as indicated in the drawings. These inserts shall be welded to the nearest reinforcement to keep them in position and all such welding shall be deemed to be included in the unit rate quoted and nothing extra shall be payable on this account.

2.7.12 Blockouts

Blockouts in concrete as indicated in the drawing and as directed by the Owner shall be provided wherever required. Nothing extra shall be payable to the Contractor on this account.

2.7.13 Repairs and Finishes of Concrete

All concrete surfaces either cast-in-situ or pre-cast shall have even, clean finish, free from honey combs, air bubbles, fins or other blemishes. The form-

work joints marks for concrete work exposed to view shall be rubbed with carborandum stone and defects patched up with a paste of 1 part sand and 1 part cement and cured. The finish shall be made to the satisfaction of the Owner.

Concrete surfaces to be subsequently plastered or where brickwork shall be built against it shall be adequately hacked as soon as the form is stripped off so that proper bond can develop. The unit rate of concrete work shall be inclusive of the cost of cleaning and finishing exposed surface as mentioned above.

2.7.14 Curing and Protection of Concrete (for pile cap, pedestal & tie beam)

Newly placed concrete shall be protected by approved means from rain, sun & wind. Concrete placed below ground level shall be protected from failing earth during the after placing. Concrete placed in ground containing deleterious substances shall be kept free from contact with such ground or with water leaking from such ground during placing of concrete and for a period of atleast three days or as otherwise instructed by the Owner. The ground water around newly poured concrete shall be kept to an approved level by pumping or other approved means of drainage. Adequate steps shall be taken to prevent floatation or flooding. Steps, as approved by the Owner, shall also be taken to protect immature concrete from damage by debris, excessive loading, vibration etc. which may impair the strength or durability of the concrete.

All fresh concrete shall be covered with a layer of hessain or similar absorbant material and kept constantly wet for a period of seven days or more from the date of placing of concrete as per directions of the Owner. Curing can also be made by ponding. Concrete shall be cured by flooding with water of minimum 25mm depth for the period mentioned above. Step shall also be taken to protect immature concrete from damage debris by excessive loading, vibrations, abrasions, deleterious ground water, mixing with earth or foreign materials, floatations etc. that may impair the strength and durability of the concrete. Approved curing compound may be used in view of moist curing with the permission of the Owner. Such compound shall be applied to all exposed surfaces of the concrete as soon as possible after the concrete has set.

2.7.15 Testing and Acceptance Criteria

The Contractor shall carry all sampling and testing in accordance with Standard Field Quality Plan at his own cost in a laboratory approved by

the Owner and submit to the Owner the test results in triplicate within 3 (Three) days after completion of the test.

2.7.16 Acceptance Criteria for Concrete

- a) The acceptance criteria of concrete shall be in accordance with Standard Field Quality Plan (SFQP). However, in exceptional circumstances, the Owner may at his discretion accept a concrete of lower strength than specified and which is otherwise unacceptable according to SFQP.
- b) Payment for concrete which is normally unacceptable as per the SFQP, but has been accepted by the Owner shall be made at a reduced rate proportionate to the strength obtained.
- c) Concrete work found unsuitable for acceptances shall have to be dismantled and replacement is to be done as per specification by the Contractor. No payment for the dismantled concrete, the relevant form work and reinforcement, embedded fixtures, etc. wasted in the dismantling shall be made to the Contractor. If any damage is done to the embedded items of adjacent structures, the same shall be made good free of charge by the Contractor, to the satisfaction of Owner.
- d) The dimensions of concrete as cast, when compared with the drawing, shall be within the tolerances given below. Steps in surface alignment shall not exceed 2mm. No reduction will be permitted in the cover to reinforcement because of a specified negative tolerance in a concrete section.

<i>Structural Element Detail</i>	<i>Permissible Deviation in mm.</i>	
Faces of concrete in foundations and structural members against which backfill is placed	+25	-5
Exposed concrete foundations	+10	-5
Top surfaces of slabs and for concrete to received grouted plant or structural steel work	+5	-5
Alignment of beams, columns walls slabs and similar items	+5	0
Cross sectional dimensions of beams, columns, walls, slabs and similar items	+5	-5
Level and alignment of holding down bolts	+5	-5

Level of holding down bolt assemblies	+10	-5
Alignment of holding down bolts assemblies	+5	-5
Centres of pockets or holes with greatest lateral dimensions not exceeding 150mm	+5	-5
Centres of pockets or holes with greatest lateral dimension exceeding 150mm	+10	-5

2.7.17 Method of Measurement

2.7.17.1 Actual volume of work as executed or as per drawing issued, whichever is less, shall be measured in cubic metre correct upto second place of decimal. Deductions for openings, conduits, pipes, ducts, pockets, chases etc. shall be made provided they are larger than 0.1 sq.m. in area (for each opening upto and less than 0.1 sq.m. in area the form work shall not be paid for separately).

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

2.7.17.3 Separate items are measured for the various grades of concrete.

2.8 Reinforcement Steel

2.8.1 This section of the specification shall cover furnishing of working drawings with bar-bending schedule and the furnishing, cleaning, bending, binding, placing with arrangements for chairs, supports and suitable covers for all reinforced concrete works, below and above ground level as per drawings and specifications.

2.8.2 General Requirements

2.8.2.1 The Contractor shall prepare and furnish to the Owner bar-bending schedule with working drawings for all RCC works for review and approval by the Owner. Reinforcement steel of same type & grade shall be used for structural reinforcement. No work shall be commenced without the approval of the bar-bending schedule by the Owner.

2.8.2.2 Contractor shall supply, fabricate and place reinforcement to shapes and dimensions as indicated or required to carry out the intent of drawings and specifications. The reinforcement shall be either plain or deformed steel bars or welded wire fabric conforming to relevant IS specifications.

2.8.2.3 Any adjustment in reinforcement to suit field conditions and construction joints other than shown on drawings shall be subjected to the approval of

Owner.

2.8.3 Bending

2.8.3.1 Unless otherwise specified, reinforcing steel shall be bent in accordance with procedure specified in IS:2502 and or as approved by the Owner. Bends and shapes shall comply strictly with the dimensions in the approved Bar Bending Schedule. Contractor shall be entirely responsible for its correctness. Bars correctly bend shall only be used.

2.8.3.2 No reinforcement shall be bent when in position in the work without approval of the Owner, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Re-bending can be done only if approved by the Owner. Reinforcement bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved.

2.8.4 Placing in position

2.8.4.1 All reinforcement shall be accurately fixed and maintained in position as shown on the drawings by such approved means as mild steel chairs, and/or concrete spacer blocks. Bars intended to be in contact, at crossing points, shall be securely bond together at all such points by two number No.20G annealed soft-iron wire.

Binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be so spaced that the main bars do not sag perceptibly between adjacent spacers.

2.8.4.2 The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be checked by the Owner for accuracy of placement and cleanliness and necessary correction as directed by him shall be carried out. The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Owner. Care should be taken to ensure that projecting ends of ties and other embedded metal do not encroach into the concrete cover. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar 1:2 (one part cement: two parts sand) by volume and cured for atleast (7) days. The sizes and locations of the concrete blocks shall be approved by the Owner.

2.8.4.3 Longitudinal reinforcement in pile shall be high yield strength deformed

steel bars conforming to IS:1786 unless specified otherwise. Thermo mechanically Treated (TMT) bars (equivalent grade) in place of Cold twisted deformed steel bars are also acceptable. Lateral reinforcement in pile shall be of for steel or mild steel conforming to IS: 432 Part-I.

- 2.8.4.4 The longitudinal reinforcement in pile shall be provided considering the combination of vertical (compression and tension) and horizontal loads. However, the minimum longitudinal reinforcement shall be 0.4 percent of the sectional area calculated on the basis of outside area of casing or the pile shaft where casing is not used, whichever is more. The minimum number of longitudinal reinforcement shall be six and its minimum diameter shall be 12mm. The stipulated minimum reinforcement shall be provided for the full length of pile.
- 2.8.4.5 The longitudinal reinforcement shall project 52 times its diameter above cut-off level unless otherwise indicated.
- 2.8.4.6 The minimum diameter of the links or spirals bar shall be 6mm and the spacing of the links or spiral shall not be less than 150mm and in no case more than 250mm. The laterals shall be tied to the longitudinal reinforcement to maintain its shape and spacing.
- 2.8.4.7 Reinforcement cage shall be sufficiently rigid to withstand handling and installation without any deformation and damage. As far as possible number of joints (laps) in longitudinal reinforcement shall be minimum. In case the reinforcement cage is made up of more than one segment, these shall preferably be assembled before lowering into casing tube/pile bore by providing necessary laps as per IS:456.
- 2.8.4.8 The minimum clear distance between the two adjacent main reinforcement bars shall normally be 100mm for the full depth of cage, unless otherwise specified.
- 2.8.4.9 The laps in the reinforcement shall be such that the full strength of the bar is effective across the joint and the reinforcement cage is of sound construction. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS:456, unless otherwise specified. If the bars in a lap are not of the same diameter, the smaller will guide the lap length.
- 2.8.4.10 Laps shall be staggered as far as practicable and as directed by the Owner. Not more than 50% bars shall be lapped at a particular section. Lap joints shall be staggered by at least 1.3 times the lapped length (Centre to Centre).
- 2.8.4.11 Proper cover and central placement of the reinforcement cage in the pile bore shall be ensured by use of suitable concrete spacers or rollers, cast specifically for the purpose without any additional cost to the Owner.

2.8.4.12 Minimum clear cover to the reinforcement shall be 75mm unless otherwise mentioned.

2.8.4.13 Unless otherwise specified by the Owner reinforcement shall be placed within the following tolerance as specified in Clause 11.3 of IS:456.

a) For effective depth 200mm or less +10mm.

b) For effective depth more than 200mm +15mm.

The cover shall in no case be reduced by more than one-third of specified cover or 5mm whichever is less.

2.8.4.14 Welding of reinforcement bars shall be avoided. However, welding may be done in specific case subject to prior permission from the Owner.

2.8.5 Acceptance Criteria

Reinforcement shall be checked for cleanliness, proper bending, binding, placing and securing in position with provision for proper cover.

2.8.6 Method of Measurement

2.8.6.1 Bar or any other type of reinforcement used like hard drawn steel wire fabric etc. for reinforced concrete shall be measured by weight in Tonnes. The weight shall be arrived at by multiplying the actual or theoretical length measured along standard hooks, cranks, bends, authorised laps, etc. whichever is less by the sectional weights. Claims for payment for this items shall be submitted with supporting documents giving the schedule of Bars with sketches. The sectional weight to be adopted shall be IS Sectional weight.

2.8.6.2 Standard hooks, cranks, bends, authorised laps, etc. shall be measured.

2.8.6.3 Separator pieces between two or more layers of steel shall not be measured.

2.8.6.4 No payment shall be made for supports, spacers, chairs, hangers, etc. of height/length 300mm and less, required for keeping the steel in position unless otherwise specified in the contract. For supporting horizontal reinforcement at heights larger than 300mm support drawings shall be prepared by the Contractor and payment shall be made for the supports as provided by the Owner, or as actually placed, whichever is less, at the same rate as for reinforcement.

2.8.6.5 No extra will be paid for modification of already embedded reinforcement, if required due to faulty fabrication of placement.

2.8.6.6 Dowels neither shown in the drawings nor instructed by the Owner, but required for construction facilities and/or sequences, shall not be measured.

2.9 Form work (applicable for pile cap, pedestal & tie beam)

2.9.1 General

2.9.1.1 If it is so desired by the Owner, the Contractor shall prepare, before commencement of the actual work, design and drawings for form work and centering and get them approved by the Owner. The form work shall conform to the shape, lines and dimensions as shown on the drawings.

Form work shall be composed of steel and/or best quality shuttering wood of non- absorbant type. Timber shall be free from significant knots and shall be of medium grain as far as possible and hard woods shall be used as caps and wedges under or over posts. Plywood or equivalent shall be used where specified to obtain smooth surfaces for exposed concrete work. Sturts shall generally be mild steel tubes, and strong sal ballis of 150mm in diameter or above. Bamboos, small diameter ballis, etc. shall not be used unless approved by the Owner in specified cases.

Supports or props should not be supported on an unproped lower suspended floor or beam unless calculations are submitted to the Owner to confirm the strength of the lower floor or beam and no propping shall be taken out until the Owner approval has been given.

2.9.1.2 The concreting shall be true and rigid and thoroughly braced both horizontally and diagonally. The forms shall be sufficiently strong to carry without undue deformation, the dead weight of the concrete as liquid as well as working load. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration, without appreciable deflection, building, distortion or loosening off its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of mortar. The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of Owner immediately and rectified free of charge as directed by him. To achieve the desired rigidity, the bolts, space blocks, the wires and clamps as approved by the Owner shall be used but they must in no way impair the

strength of concrete or leave stains or marks on the finished surface, where there are chances of these fixtures being embedded, only mild steel or concrete of adequate strength shall be used. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork should not be used.

2.9.1.3 For exposed interior and exterior concrete surfaces of beams, columns and walls, plywood or other approved forms; thoroughly cleaned and tied together with approved corrosion-resistant devices shall be used. Rigid care shall be exercised in ensuring that all columns are in plumb and true and throughout cross braced to keep them so. All floors and beams centering shall be crowned not less than 8mm in all directions for every 5 meter span. Unless described on the drawing or elsewhere beveled strips 25mm shall be provided without any extra charge to form angles and in corners of columns and beam boxes for chamfering of corners. Temporary openings for cleaning inspection and for pouring concrete shall be provided at the base of vertical forms and as may be directed by the Owner. The temporary openings shall be so formed that they can be conveniently closed when required and must not leave any mark on the concrete.

2.9.2 Cleaning and Treatment of Forms

2.9.2.1 All forms shall be thoroughly cleaned of old concrete wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish loose concrete, chippings, shavings saw dust etc. shall be scrupulously removed from the interior of the forms before the concrete is poured. Alongwith wire brushes, brooms, etc. compressed air jet and/or water jet shall be kept handy for cleaning, if directed by the Owner.

2.9.2.2 Before shuttering is placed in position the form surface in contact with concrete shall be treated with approved non-standing oil or composition. Care shall be taken that the oil or composition does not come in contact with reinforcing steel or existing concrete surface. They shall not be allowed to accumulate at the bottom of the shuttering.

2.9.2.3 Formwork shall be so designed and so erected that the forms for slabs and the sides of beams, columns and walls may be removed first, leaving the shuttering to the soffits of beams and their supports in position. Re-propping of beams shall not be done except with the approval of Owner and props can be reinstated in anticipation of abnormal conditions. If formwork for column is erected for the full height of the section, as placing of concrete proceeds, wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment of the formwork and to allow it to be

removed gradually without jarring the concrete.

2.9.3 Removal of Forms

2.9.3.1 The Contractor shall begin the removal of formwork only after approval of Owner. He shall place on record the date on which the concrete is placed in different parts of the work and the date of the removal of formwork there from. This record shall be checked and countersigned by the Owner. The Contractor shall be responsible for the safe removal of formwork but the Owner may delay the time of removal if he considers it necessary. Any work showing signs of damage through premature removal of form-work or loading shall be entirely reconstructed without any extra cost to Owner.

2.9.3.2 Forms for various types of structural components shall not be removed before the minimum periods specified below which shall also be subject to the approval of the Owner.

2.9.3.3 No supporting forms shall be removed suddenly in such manner as to create shock loading. Forms for sides shall not be removed before 2 days. Bottom forms shall not be removed before 28 days unless this period is reduced with specified concurrence of the Owner.

However, in any case, formwork shall not be struck until the concrete has reached a strength at least twice the stress to which the concrete may be subjected to, at the time of removal of forms.

2.9.4 Re-use of Forms

Before re-use, all forms shall be thoroughly scrapped cleaned, joints, etc.; examined and when necessary repaired and inside surface treated as specified herein before. Formwork shall not be used/re-used, if declared unfit or unserviceable by the Owner.

2.9.5 Acceptance of Formwork and Finished Concrete

2.9.5.1 Finished concrete shall be true to shape, lines, levels plumb and dimensions as shown on drawings.

2.9.5.2 All embedded fixtures shall be of correct type and in correct position as shown in drawings.

- 2.9.5.3 Finished concrete surface shall be free from blemishes like honey-combs, air bubbles, fins, etc.
- 2.9.5.4 Exposed concrete surface shall be free from rust stains, grease and mould oil stains etc. and shall have uniform pleasing appearance to the satisfaction of the Owner.
- 2.9.5.5 The finished concrete shall be of a standard quality and equal to the accepted sample.

3.0 Pile Installation

Installation of piles shall be carried out as per pile layout drawings, installation criteria and the directions of the Owner.

3.1 Equipment and Accessories

- 3.1.1 The equipment and accessories for installation of bored cast-in-situ piles shall be selected giving due consideration to the sub soil conditions, ground water conditions and the method of casting, etc. These shall be of standard type and shall have the approval of the Owner.
- 3.1.2 List and details of equipment and accessories proposed to be used for the job shall be submitted alongwith the bid.
- 3.1.3 The capacity of the rig shall be adequate so as to reach the specified founding level.
- 3.1.4 Provision shall be kept for chiseling within the pile bore, as specified elsewhere in this specification. Chiseling shall be carried out only with the approval of Owner.

3.2 Installation Criteria

- 3.2.1 The Contractor while boring the pile bores, shall constantly collect the bore spoils and these shall be compared with the layer wise soil classifications reported in the bore-log details of the location, reported in the soil investigation report. Should there be any variation between the two soil classifications, these shall be immediately reported to the Owner.
- 3.2.2 Whenever the rock strata is encountered in the pile bore, the Contractor shall immediately report the matter to the Owner and shall take up the work of rock chiseling only after the certification/approval of the Owner. Since the piles are required to be terminated in the firm/hard strata the Contractor shall demonstrate such founding strata and seek approval of the Owner before terminating the piles.
- 3.2.3 In order to verify the terminating depth, where rock strata is met with, the

rock samples obtained from the bore spoils obtained from the chiseling of pile bores shall be tested for point load strength index and these shall then be compared/correlated to the values of uniaxial compression strength test shown in the soil investigation report. Accordingly, the termination of piles in the socketing horizon shall be done with prior approval of the Owner.

3.2.4 Approval of foundation level by the Owner shall in no way absolve the Contractor of his responsibility to guarantee the sound installation of piles true to the requirement of the specifications.

3.3 Control of position and alignment

3.3.1 Piles shall be installed as accurately vertical as possible, the permissible limits for deviation with respect to position and inclination/alignment shall conform to IS-2911 Part I/Sec.2, which is reproduced below for ready reference.

- a) The maximum deviation of vertical piles shall not exceed 1.5 per cent in alignment.
- b) Piles should not deviate more than 75mm or D/10 whichever is less from their designed position at cut off level.

3.4 Boring

3.4.1 Boring operations shall be done by rotary or percussion type drilling rigs using direct or reverse mud circulation (DMC or RMC) methods or grab method. In soft clays and loose sands bailer method, if used, shall be used with caution to avoid the effect of suction. In cohesive soils, use of water for boring shall be restricted to a minimum, while boring in cohesionless deposits water level in the bore hole shall be maintained at or slightly above the standing water table.

Boring operations by any of the above methods shall be done using drilling mud. The bidder shall be required to furnish along with their bid, complete details regarding the installation of piles and the method by which they wish to install the piles.

3.4.2 The Contractor shall satisfy himself about the suitability of the method to be adopted for site. If DMC or RMC is used, bentonite slurry shall be pumped through drill rods by means of high pressure pumps. The cutting tools shall have suitable pores for the bentonite slurry to flow out at high pressure. If the Contractor fails to make proper bore for any reason, the Contractor has to modify the boring technique and switchover to other boring methods as approved by the Owner at no extra cost to the Owner.

3.4.3 Working level shall be above the pile cut off level. After the initial boring of about 1.0 to 2.0m temporary guide casing shall be lowered in the pile bore.

The diameter of guide casing shall be of such diameter to give the necessary finished diameter of the concrete pile. The centre line of guide casing shall be checked before continuing further boring. Guide casing shall be minimum 2.0m length. Additional length of casing may be used depending on the conditions of the strata, ground water level etc.

3.4.4 Use of drilling mud (bentonite slurry) for stabilising the sides of the pile bore is necessary wherever subsoil is likely to collapse in the pile bore. Drilling mud to be used shall meet the requirement as given in Annexure-C.

3.4.5 The bentonite slurry and the cuttings, which are carried to the surface by the rising flow of the slurry shall pass through settling tanks of adequate size to remove the sand and spoils from the slurry before the slurry is recirculated back to the boring. The bentonite slurry mixing and recirculation plant shall be suitably designed and installed.

3.4.6 The bentonite slurry shall be maintained at 1.5m above the ground water level during boring operations and till the pile is concreted. When DMC or RMC method is used the bentonite slurry shall be under constant circulation till start of concreting.

3.4.7 The size of cutting tools shall not be less than the diameter of the pile by more than 75mm. However, the pile bore shall be of the specified size.

3.5 Chiseling

3.5.1 Chiseling, if required, may be resorted to with the permission of the Owner below the socketing horizon. The chiseling tool or bit shall be of adequate size and weight so as to reach the desired depth.

3.6 Cleaning of Pile bore

3.6.1 After completion the pile bore upto the required depth, the bottom of the pile bore shall be thoroughly cleaned. Cleaning shall ensure that the pile bore is completely free from sludge/bored material, debris of rock/boulder etc. Necessary checks shall be made as given in this Section to confirm the thorough cleaning of the pile bore.

3.6.2 Pile bore shall be cleaned by fresh drilling mud through tremie pipe before start of concreting and after placing reinforcement.

3.6.3 Pile bore spoil along with used drilling mud shall be disposed off from site up to 2 Km. or as directed by the Owner.

3.7 Adjacent Structures

3.7.1 When working near existing structures care shall be taken to avoid any damage to such structures.

3.8 Concreting

- 3.8.1 The Contractor shall carry out concrete mix design in accordance with IS:10262 and submit mix design calculations and get them approved from the Owner well in advance of installation of piles. The Contractor shall carry out adequate number of tests in accordance with IS:456 to ensure concrete of the minimum specified strength at requisite workability (slump).
- 3.8.2 Concreting shall not be done until the Owner is satisfied that the bearing strata (soil/rock) met with the termination level of pile, satisfied the installation criteria/approved founding depth.
- 3.8.3 The time between the completion of boring and placing of concrete shall not exceed 6 hrs. In case the time interval exceed 6 hrs the pile bore shall be abandoned. However, the Owner may allow concreting, provided the Contractor extends the pile bore by 0.5 m beyond the proposed depth, and clean the pile bore properly. The entire cost of all operation and materials for this extra length shall be borne by the Contractor.
- 3.8.4 Pile bore bottom shall be thoroughly cleaned to make it free from sludge or any foreign matter before and after placing the reinforcement cage.
- 3.8.5 Proper placement of the reinforcement cage to its full length shall be ensured before concerting.
- 3.8.6 Entire concreting shall be done by tremie method. The operation of tremie concreting shall be governed by IS:2911 Part I/Sec.2. Drilling mud shall be maintained sufficiently above the ground water level.
- 3.8.7 Concreting operations shall not proceed if the contaminated drilling mud at the bottom of the pile bore posses density more than 1.25 T/Cu.m. or sand content more than 7%. The drilling mud sample shall be collected from the bottom of pile bore. This shall be checked at regular intervals, as decided by the Owner thereafter.
- 3.8.8 Consistency of the drilling mud suspension shall be controlled throughout concreting operations in order to keep the bore stablised as well as to prevent concrete getting mixed up with the thicker suspension of the mud.
- 3.8.9 It shall be ensured that volume of concrete poured is at least equal to the theoretically computed volume of pile shaft being cast.
- 3.8.10 The temporary guide casing shall be entirely withdrawn cautiously, after concreting is done up to the required level. While withdrawing the casing

concrete shall not be disturbed.

3.8.11 Tests on concrete cubes shall be carried out as specified in this section of the Specifications.

3.9 Cut-off-level (COL)

3.9.1 Cut-off-level of piles shall be as indicated in approved construction drawings or as directed by the Engineer-in-Charge.

3.9.2 The top of concrete in pile shall be brought above the COL to remove all laitance and weak concrete and to ensure good concrete at COL for proper embedments into pile cap.

3.9.3 When the pile cut off level is less than 1.0 metre below the working level, concrete shall be cast up to the piling platform level to permit overflow of concrete for visual inspection. In case COL of pile is more than 1.0 metre below working level then concrete shall be cast to minimum of one metre above COL.

3.9.4 In the circumstances where COL is below ground water level, the need to maintain a pressure on the unset concrete equal to or greater than water pressure shall be observed and accordingly length of extra concrete above COL shall be determined by the Contractor with prior approval of Owner.

3.10 Sequence of Piling

3.10.1 Each pile shall be identified with a reference number and date wise proper record of construction shall be maintained by the Contractor.

3.10.2 The convenience of installation may be taken into account while scheduling the sequence of piling in a group. This scheduling shall avoid piles being bored close to other recently constructed piles.

3.11 Building up of Piles

3.11.1 If any pile, already cast as per construction drawing, requires any extra casting due to any change in cut off level or the cast pile top level is less than the specified level or for any other reason, then the pile shall be built up by using M-25 grade concrete, ensuring proper continuity with the existing concrete and to the satisfaction of the Owner. Necessary reinforcement as per design requirement and suitable shuttering shall be provided before

casting the concrete. Surrounding soil shall also be built up to the required level by proper compaction to ensure lateral capacity of the pile.

3.12 Breaking off of Piles

3.12.1 If any pile already cast requires breaking due to lowering in cut off level or for any other reason, then the same shall be carried out, (not before seven days of casting of concrete in the piles) without affecting the quality of existing pile such as loosening, cracking etc. to the satisfaction of the Owner.

3.13 Preparation of Pile head

3.13.1 The soil surrounding the piles shall be excavated upto the bottom of the ear concrete below the pile cap with provision for working space sufficient enough to place shuttering reinforcement concreting and any other related operations.

3.13.2 The exposed part of concrete above the COL, shall be removed/chipped off and made square at COL not before seven days of casting of pile.

3.13.3 The projected reinforcement above COL shall be properly cleaned and bent to the required shape and level to be anchored into the pile cap.

3.13.4 The pile top shall be embedded into the pile cap by minimum 50mm or clear cover to reinforcement, whichever is higher.

3.13.5 All loose material on the top of pile head after chipping to the desired level shall be removed and disposed off upto a lead of 2km or as directed by the Owner.

3.14 Rejection and Replacement of Defective Piles

3.14.1 The Owner reserve the right to reject any pile which in his opinion is defective on account of load capacity, structural integrity, position, alignment, concrete quality etc. Piles that are judged defective shall be pulled out or left in place as decided by the Owner without affecting the performance of adjacent piles. The Contractor shall install additional piles to substitute the defective piles as per the directions of the Owner at no extra cost to the Owner.

3.15 Recording of Piling Data

3.15.1 The Contractor shall record all the information during installation of piles.

Typical data sheet for recording pile data as shown in Appendix D of IS:2911 Part I/Sec.2 shall be maintained by the contractor. The pile data shall also include all the details as in Annexure-D. On completion of each pile installation, pile record in triplicate shall be submitted to Owner within two days of completion of concreting of the pile.

3.16 Sampling, Testing and Quality Assurance

3.16.1 Facilities required for sampling and testing materials, concrete, etc. in field and in laboratory shall be provided by the Contractor. The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and this Specification. Where no specific testing procedure is mentioned the tests shall be carried out as per the prevalent accepted engineering practice to the directions of the Owner. Tests shall be done in the presence of the Owner or his authorised representative. In case the Owner requires additional test, the Contractor shall arrange to get these tests done and submit to the Owner the test results in triplicate within three days after completion of any test.

3.16.2 The Contractor shall maintain records of all inspection and testing, which shall be made available to the Owner. The Owner at his discretion, may waive some of the stipulations for small and unimportant concreting operations and other works.

3.16.3 Materials found unsuitable for acceptance shall be removed and replaced by the Contractor. The work shall be redone as per specification requirements and to the satisfaction of the Owner at no extra cost to the Owner.

3.17 Quality Assurance Programme

a) The standard field quality plan (SFQP) enclosed in this specification is to be adhered to by the contractor while executing the pile foundation work in conjunction with the various testing procedures described in the specification. Wherever the procedures for testing and quality described in this specification is in variance to the standard field quality plan, the testing and quality assurance procedures described herein will prevail. The testing apparatus/equipment installed in the filed laboratory shall be calibrated / corrected by the qualified person as frequently as possible to give accurate testing results.

b) Frequency of sampling and testing, etc. and Acceptance Criteria are given in SFQP. The testing shall be done at field laboratory or any

other laboratory approved by the Owner. However, the testing frequencies set forth are the desirable minimum and the Owner shall have the full authority to call for tests as frequently as he may deem necessary to satisfy himself that the materials and works comply with the Specifications. The materials shall be tested to meet all the specified requirements before acceptance at manufacturers premises or at independent government approved laboratory. Tests indicated in the table are for cross checking at site the conformity of the materials to the Specifications.

3.18 Testing Concrete

- 3.18.1 Concrete and other materials shall be tested for quality and strength and other properties. Details of testing shall be specified elsewhere in the technical specification for concrete and allied works.
- 3.18.2 One sample consisting of six test cubes shall be made from the concrete used in each test pile, three to be tested after 7 days and three after 28 days.
- 3.18.3 For working piles, minimum one sample consisting of six test cubes shall be made from the concrete for each pile, three to be tested after 7 days and three after 28 days.
- 3.18.4 In preparation of test cubes/specimens vibrators shall not be used.
- 3.18.5 Concrete shall be tested for slump at every 1 hour interval.
- 3.18.6 Other properties of concrete and materials shall be tested for frequency of sampling and testing pertaining to concrete and allied works.

3.19 Testing for position and alignment

- 3.19.1 Each pile shall be checked for its position with respect to specified location. Each pile bore shall be checked for its alignment.
- 3.19.2 Permissible limits for deviation shall be as specified under clause of this Section of the Specification.

3.20 Properties of drilling mud

- 3.20.1 Properties of drilling mud shall be checked as per requirements indicated in Annexure 'C'. Prior to the commencement of piling work and thereafter

minimum once in a week or as found necessary by the Owner, one sample consisting of 3 specimens shall be tested.

3.20.2 Density and sand content of the drilling mud shall be checked in each pile.

3.21 Check for Pile bore

3.21.1 On completion of boring and cleaning the bottom of each pile bore shall be checked by the methods as approved by the Owner, to ensure that it is free from pile bore spoil/debris and any other loose material, before concreting. Concreting shall be done only after the approval of the Owner.

3.21.2 For sampling of drilling mud from the pile bore the following method or any other suitable method shall be adopted.

A solid cone shall be lowered by a string to the bottom of pile bore. A sampler tube closed at top with a central hole (hollow cylinder) is lowered over the cone, then a top cover shall be lowered over the cylinder. Care shall be taken for proper fittings of assembly to minimise the leakage while lifting the cone assembly to the ground surface. The slurry collected in the sampler tube shall be tested for density and sand content.

3.22 Rates and Measurements

3.22.1 Rates

3.22.1.1 The items of work in the schedule of items, describe the work in brief. The various items in schedule of items shall be read in conjunction with the corresponding sections in the Technical Specifications, including amendments, and additions, if any. For each item in schedule of items, the unit rate shall include for the activities covered in the description of the item as well as for all necessary operations described in the specification and specific requirements.

3.22.1.2 The unit rates shall include for minor details which are obviously and fairly intended, and which may not have been included in the description in these documents, but are essential for the satisfactory completion of the work. Unit rates shall also include for all safety measures as required by codal provisions, local regulations, acts, bye-laws, etc. and for execution of work to the satisfaction of the Owner.

3.22.1.3 Unit rate for each item shall be inclusive of mobilisation all plant, equipment, scaffolding, labour, materials, skilled and unskilled labour, and demobilisation after completion of work, supervision, establishing level and coordinates at each work.

3.22.1.4 Unit rate per metre length basis for a particular diameter and capacity of pile shall remain valid for the actual lengths provided/to be provided

irrespective of the minimum length specified elsewhere in this specification.

- 3.22.1.5 The unit rate for pile boring through soil including weathered rock/laterite shall be inclusive of boring with RMC method only and providing all plant equipment, labour, materials, skilled and unskilled labour, making observations, establishing the ground level and coordinates at each location of pile by carrying levels from one established bench mark and distances from one set of grid lines furnished by the Owner.
- 3.22.1.6 Unit rate for pile boring through soil, including weathered rocks shall be inclusive of bailing out all the pile bore spoils from the pile bore, keeping the bore hole free from bored material/debris etc. and disposing the bored/chiseled material along with the drilling mud upto a distance of 2 Kms., flushing the pile bore by fresh bentonite before concreting, collection of samples from bottom of pile bore, transporting to laboratory, testing and reporting of results.
- 3.22.1.7 Unit rate quoted for pile boring through soil including weathered rocks and chiseling through rock shall include shifting of plant and equipment from one pile location to another providing temporary casing pile and removal of the same after completing, concreting, supply of necessary materials, equipment and manpower, cost of boring by approved method as specified, etc. The quoted unit rate for boring/installation of pile shall also be inclusive of the empty boring and extra concreting required above the pile cut off level.
- 3.22.1.8 Unit rate for pile boring through soil including weathered rock / laterite shall also include chiseling, if any required, the chieseling through rock in the pile below socketing horizon upto the specified level shall be inclusive of bailing out the pile bore debris/spoils from the pile bore and disposing off the chieseled materials/debris alongwith the sludge/mud upto 2 kms., flushing the pile bore by fresh bentonite before concreting, collection of samples from bottom of the pile bore, transporting to laboratory, testing and reporting of results.
- 3.22.1.9 Unit rate of concreting shall include concreting in piles by tremie method, cost of preparation of pile head and disposal of debris etc., resulting from breaking off of pile upto COL, upto a distance of 2 km.
- 3.22.1.10 Unit rate of reinforcement shall include cleaning, straightening, cutting, bending, binding with annealed wire, welding, tack welding, providing concrete cover blocks, spacers, chairs, placing of reinforcement cage in pile shaft and all other cost for tools and plants, materials, labour, transportation of steel to the piling site by all means as required.
- 3.22.1.11 Unit rate shall include for all quality assurance requirements, but not limited

to providing for technical inspection, transportation of samples to laboratory, testing samples, maintaining and submitting all test records, etc.

- 3.22.1.12 The rate quoted for boring and installation shall be inclusive of performing point load test on the rock samples obtained from bore spoils during the chiselling operations, and shall be inclusive of transportation to laboratory, testing and reporting of the results.

3.22.2 Measurement

- 3.22.2.1 Measurement for the item of boring through soil including weathered rock shall be done by linear measurement for the length bored from the pile cut off level through soil/weathered rock up to approved termination/founding level of the pile in metres, upto second place of decimal, separately for a pile of given diameter and capacity.

3.23 Pile Caps, Pedestals, Tie Beams etc.

- 3.23.1 The Concrete work in pile caps, pedestals/chimneys, tie Beams etc. including reinforcement and formwork shall have to be done by the Contractor as shown in the construction drawings and as per Specification for concrete, formwork and reinforcement given in this Specification.

- 3.23.2 The payment for the various items for pile caps, pedestals/chimneys, tie-beams etc. shall be governed by the rates quoted against the relevant items of the schedule of items. The volume of piles below and within the pile cap shall be deducted while calculating the quantity of P.C.C. below pile cap and R.C.C. of pile cap.

- 3.23.3 The use of admixtures in concrete for promoting workability, improving strength, eliminating formation of entraining air or for any other purposes may be used only with the written approval of the Owner. Addition of admixture should not reduce the specified strength of concrete in any case. The admixtures shall conform to IS:6103 (Latest Edition). In case, plasticisers are used in the concrete for any structure, fresh mix design shall be done considering the admixture and mix design shall be approved by the Owner. Nothing extra shall be payable to the Contractor on this account.

3.24 Back Filling

3.24.1 General Requirement

- 3.24.1.1 After completion of foundation footings, pile caps, pedestals, tie beams and other constructions below the elevation of the grades, and prior to back filling, all forms of temporary shoring, timber etc. shall be removed and the excavation cleaned of all trash, debris and perishable materials, back filling shall begin only with the approval of the Owner.
- 3.24.1.2 The soil to be used for back filling purpose shall be inorganic material and

shall be free from any foreign substance which can harm or impair the strength of footing in any manner. In any case the soil to be used for back filling purpose shall have the prior approval of the Owner.

3.24.1.3 The soil to be used for back filling purpose shall be either from the excavated earth or from the borrow pits, as directed by the Owner. The soil may have to be brought from a distance upto 2 km. By the shortest haulage route as approved by the Owner. If directed by the Owner, the excavated earth from the adjoining areas (which is to be disposed off upto a distance of 500 metres by manual labour) shall be used as for back filling purpose. In such case the Contractor shall be paid only for the operations involving back filling. The lead for this purpose shall not be paid as this shall be paid under the excavation item.

3.24.1.4 Back filling shall not be dropped directly upon or against any structure where there is danger of displacement or damage.

3.24.1.5 Back filling shall be placed in horizontal layers not to exceed 200mm in thickness. Each layer shall be compacted with proper moisture content and with such equipment as may be required to obtain a density equal to or greater than 95% of maximum dry density as determined by the relevant Indian Standard. The method of compaction shall be subject to the approval of the Owner. Pushing of earth for back filling shall not be adopted under any circumstances.

3.24.1.6 On completion of structures, the earth surrounding them shall be accurately finished to line and grade as shown on the drawings or as per the instruction of the Owner. Finished surface shall be free of irregularities and depressions and shall be within 50mm of the specified level.

3.24.1.7 Any additional quantity of back filling, if required, beyond the excavation payment line shall be done by the contractor at his own expense.

3.24.2 Measurements

Measurements shall be based on the volume between the structure near line and the payment line. Measurement shall be in cubic metre rounded off upto 2nd place of decimal and the rate shall include all the necessary operations required to complete the work as per drawing, Specifications and satisfaction of the Owner.

3.25 Erection of Steel Embedded Parts

3.25.1 This covers the technical requirements for the supply and fabrication

and/or erection of all embedded steel parts by the Contractor. The extent and type of embedded steel parts to be erected shall be as per detailed drawings.

- 3.25.2 The supply of embedded steel parts is in the scope of the Contractor.
- 3.25.3 Embedded steel parts shall include items such as foundation grillages anchor bolts, slabs anchor bolt, pipe sleeves, hoist structures, ladders, steel pieces set in concrete inserts, expansion bolts, auxiliary framing for equipment supports, dowel bars for concrete work, miscellaneous frames, etc. shown on the drawing or as material shall include setting in forms for connecting in place and grouting as required. The grouting operations shall be performed as per the direction of Owner.
- 3.25.4 The Contractor shall erect all embedded steel parts in accordance with the drawings and these specification including setting materials in concrete or grouting pieces in place, furnishing all labour, materials, scaffolding, tools and services necessary for and incidental to the work to its transporting, unloading, storing, handling and erection. Contractor shall furnish welding rods and arrange for field welding as required in accordance with IS Code 816 (Latest Edition).
- 3.25.5 Exposed surface of embedded material are to be painted with one coat of approved anticorrosive and/or bituminous paint without any extra cost to the Owner. The threads of holding down bolts shall be greased and protected with water proof tape.
- 3.25.6 Installation**
- 3.25.6.1 During erection, the Contractor shall provide necessary temporary bracing or supports to ensure proper installation of the materials. All materials shall be erected in the true locations as shown in the drawings, plumb and level. Extreme care shall be taken to ensure that the threads of holding down bolts and comparable items are protected from damage.
- 3.25.6.2 The Contractor shall set holding down bolts, anchor and tubes using the templates. He shall fabricate templates from the drawings supplied. Where no drawings are supplied he shall produce his own fabricated drawings for approval by the Owner and shall fabricate the templates accordingly.
- 3.25.6.3 Groups of holding down bolts shall be set to a tolerance such that the whole group is not more than 3mm from its true position in plan at the top of the bolt tubes and not more than 3mm from the required level. The top ends of

all bolt shanks shall be in one plane to the tolerance stated above.

Holding down bolt assemblies shall be set vertically to a tolerance of not less than 1:500.

3.25.7 Protection Against Damage in Transit

3.25.7.1 All steel work shall be efficiently and sufficiently protected against damage in transit to site from any cause whatsoever. All protecting plates or bars and all ends of members at joints shall be stiffened, all straight bars and plates shall be bundled, all screwed ends and machined surface shall be suitably packed and all bolts, nuts, washers and small loose parts shall be packed separately in cases so as to prevent damage or distortion during transit. Should there be any distortion of fabricated members, the Contractor shall immediately report the matter to the Owner. Distorted steel received from stores or distorted during transport from stores to the fabrication yard shall not be used in fabrication unless the distortions are minor which in the opinion of the Owner can be removed by acceptable methods. The cost of all such straightening shall be borne by the Contractor within his unit rates.

These distortions shall be rectified by the Contractor by cold bending. If heating is necessary to rectify the defects, the details of the procedure shall be intimated to the Owner whose approval shall be taken before such rectification. The temperature of heat treatment shall not exceed the limits beyond which the original properties of steel are likely to be impaired.

3.26 Foundations Bolts

3.26.1 Foundation bolts for the structures and elsewhere may require to be supplied through this contract, these shall be embedded in first stage concrete while the foundation is cast. The Contractor shall ensure the proper alignment of these bolts to match the holes in the base plate. The final adjustment of these bolts and their grouting are included in the scope of this contract. Grouting of block outs and the gap between the base plate and top of concrete shall be done by the Contractor after finalisation of alignments. The unit rate of concreting quoted for pedestal shall include the cost of above adjustments, grouting, templates and skins etc. required for this purpose.

3.26.2 The Contractor shall be responsible for the correct alignment and levelling of all steel work on site to ensure that the towers are in plumb.

3.26.3 Before erection of columns/towers on their foundations the top surface of

base concrete shall be thoroughly cleaned with wire brushes and by chipping to remove all laitance and loose materials and shall be chipped with a chisel to ensure proper bond between the grout and the foundation concrete. The Contractor shall also be responsible for bringing down the top of concrete to the desired level by chipping. In case the foundation as cast is lower than the desired level, the Contractor shall make up the difference by providing additional pack plates without extra payment for any such work or material. No steel structures shall be erected on their foundations unless such foundations have been certified fit for erection steel by the Owner. Adequate number of air release holes and inspection holes shall be provided in the base plate.

3.26.4 Stability of Structure

3.26.4.1 The Contractor shall be responsible for the stability of the structure at all stages of its erection at site and shall take all necessary measures by the additions of temporary bracings and guying to ensure adequate resistance to wind and also to loads due to erection equipment and their operations. Guying and bracing shall be done due to erection equipment and their operations. Guying and bracing shall be done in such a way that it does not interface with the movement or working of other agencies working in the area. For the purpose of guying the Contractor shall not use other structures in the vicinity which are likely to be damaged by the guy.

3.26.4.2 Such temporary bracings shall neither be included in the measurement nor extra rate shall be payable. Such temporary bracings used shall be the property of the Contractor and may be removed by him at the end of the job from the site of work.

3.27 Grouting and under Pinning

3.27.1 Furnishing of all labour materials and equipment and performance of all operations necessary to complete the work of grouting of blockouts and foundation bolt holes and under pinning of base plates is in the scope of the Contractor. The cost of the above shall be included in the unit concreting rate for pedestal.

3.27.2 Materials

3.27.2.1 Cement shall conform to the stipulations contained in IS:383 (Latest Edition) and shall have a fineness modulus not exceeding 3 and less than 2.5.

3.27.2.2 Sand shall conform to the stipulations contained in IS:383 (Latest Edition) and shall have a fineness modules not exceeding 3 and less than 2.5.

3.27.2.3 Water shall be clean and fresh and shall be of potable quality.

3.27.2.4 Aluminium powder or anti-shrinkage admixture like 'Groutex' CRS-NS grout (by Cement Research Institute of India) or its equivalent shall be of standard brand from reputed manufacturer and shall be approved by the Owner prior to its use for work.

3.27.3 General Requirements

3.27.3.1 The blockout and bolt holes which have to be grouted shall be cleaned thoroughly by use of compressed air immediately before taking up the grouting operations.

3.27.4 Grouting

Grouting shall be adopted for filling the blockouts, pockets below foundation bolt holes. Cement and aluminium powder or anti-shrinkage admixture of approved quality shall be first blended thoroughly in the required proportions as per manufacturer's specification. The mix of grouting shall contain one part of cement and two parts of coarse sand. The quantity of aluminium powder shall usually be of the order of 0.005% by weight of cement. Any grout which has been mixed for a period longer than half an hour shall not be used on the work. Immediately after preparation the grout shall be poured into the blockouts, pockets and foundation bolt holes either from the sides or through the holes provided for this purpose in the base plate, by using special equipment for pressure grouting. It shall be ensured by rodding and by tapping of bolts that the blockout is completely filled without leaving any voids. The pouring shall cease as soon as each hole is filled and any excess grout found on the surface of the concrete foundation shall be completely removed and the surface dried.

3.27.5 Under Pinning

a) It shall be resorted to for filling the space between the underside of base plate and the top of foundation concrete. After grouting has been completed as specified above, space between the top surface of the foundation concrete and the underside of the base plate shall be filled with mortar or concrete depending upon thickness to be filled as follows :

Less than 40mm	Dry packed mortar
Over 40mm	Dry packed fine concrete

Mortar, fine concrete shall be blended with aluminium powder about 0.005% by weight of cement or with anti-shrinkage admixture in a suitable proportion to the cement mortar in accordance with the recommendations of the manufacturer and subject to the approval of the Owner. Mortar shall comprise cement, sand and water in proportion of approx. 1:3:0.4 by weight. Concrete shall comprise cement, sand, 10mm max. sized coarse aggregate and water in proportion of 1:1.25:2:0.4 weight. In all cases minimum 28 days cube strength should not be less than 25N/mm².

Shims provided for the alignment of plant bases shall be positioned at the edges of the base to permit subsequent removal which shall take place not less than 7 days after the underpinning has been executed. The resulting cavities shall be made good with the same grade of mortar or concrete as has been used for the underpinning of the rest of the base plate.

- b) Cement, sand and aluminium powder or approved anti-shrinkage admixture, shall first be blended thoroughly in the required proportion. The mortar shall then be prepared by mixing with quantity of water which will produce a sufficiently workable mix to enable complete and proper compaction of the mortar.
- c) The mortar shall then be placed below the base plate and rammed in a horizontal direction for each edge until the mortar oozes out through the grout holes provided in the base plate.
- d) When it is clear that the centre of base has been properly filled, the mortar outside the base plate shall be briefly rammed to ensure compaction below the edges.
- e) Any mortar which has been mixed for a period longer than half an hour, shall not be used in the work.

3.276 Curing

The work shall be cured for a period of 7 days commencing 24 hours after the completion of the grouting and under pinning operations. The curing shall be done by covering the surfaces with wet gunny bags.

3.28 Water Proofing Cement Additive

3.28.1 This covers the technical requirements for furnishing, placing and mixing waterproofing cement additive in all kinds of cement concrete, plain or reinforced and cement mortar for all kinds of steel structures at all levels, including encasement of steel sections, as shown in drawing or otherwise specified.

3.28.2 The Contractor shall furnish all labour and equipment to place and mix waterproofing cement additive in concrete of any grade and cement mortar, thereafter carry out the work as specified earlier, for concrete and then complete the work as indicated on the drawing and described herein.

3.28.3 Material

3.28.3.1 The waterproofing cement additive shall conform to Indian Standard Specifications IS:2645 (Latest Edition).

3.28.3.2 Waterproofing additive shall as far as possible be free from aggressive chemicals like chloride, sulphides, etc. which can cause corrosion of steel reinforcement in R.C.C. and Pre-stressed concrete work.

3.28.3.3 The Contractor shall arrange the service of the manufacturer's supervision at no extra cost to the Owner to supervise the work, if desired by the Owner.

3.28.4 Mixing

Waterproofing additive shall be based at the rate specified by the manufacturer or as indicated in the drawing and shall be mixed as required by the Owner.

3.28.5 Test of Samples

Samples of concrete in which waterproofing cement is added shall be tested for waterproofness, compressive strength, water absorption, density etc. The results shall conform to relevant IS Specifications.

3.29 Water Proofing of Concrete Structures

3.29.1 Water proofing of concrete structures shall be done by either suitable extraneous treatments like applying Bituminous paints, applying waterproof plaster, etc. or internally by suitable design of the concrete mix, addition of suitable admixture in the concrete or mortar at the time of

mixing and/or installing water bars at the joints. Addition of admixtures shall not reduce the specified strength of concrete in any case.

3.29.2 Materials and Application

3.29.2.1 The materials shall conform to the respective I.S. Codes whenever applicable. The Owner's approval to the materials shall be obtained by the Contractor before procurement. Such an approval shall not relieve the Contractor of his responsibility with regards to the quality of the materials. If desired by the Owner, test certificates for the materials shall be submitted by the Contractor and samples for the testing by the Contractor shall be supplied free. The materials shall be of best quality available, fresh and thoroughly cleaned.

3.29.3 Water Proofing Admixtures in Concrete

i) In Concrete works

This shall be described under clause specified elsewhere in the specification for water proofing cement additive.

ii) In Plastering

The Concrete surface, to be plastered, shall be packed to Owner's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The admixture shall be of approved manufacturer and be of best quality available subject to approval of the Owner. The plasters shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume alongwith the approved water proofing admixture and laid in appropriate thickness in layers not exceeding 15mm layer or as per Manufacturer's specification. The additive shall be of quality and type approved by the Owner. If desired by the Owner, the Contractor shall have the work supervised by the Manufacturer's supervisor at no extra cost to the Owner. On completion, the plastered surface shall be cured continuously for a minimum period of 14 days.

3.29.4 Bituminus Painting

Surface to be waterproofed shall be absolutely dry clean and dust free. The surface shall be sand prepared completely coated with hot coal tar pitch as per IS:216 (not heated above 375 deg.F) using not less than 3 Kg. per sq.m. or with hot asphaltic bitumen according to IS:73 (not heated above 400 deg.F)

using not less than 1.25 Kg. in case of coal tar and 1 Kg. per sq.m. in case of asphalt. Immediately after application of the second coat and before it has dried up, sand shall be spread on the surface to cover it completely. Sufficient time shall be allowed after spreading of sand, before back filling is done, in order to allow the final coat to dry up completely. Coal tar or asphalt to be used shall be of approved manufacturer and of the best quality available subject to approval by the Owner.

3.30 Bar Grips

3.30.1 This covers the technical requirement for furnishing and installation of bar grips complete including all labour materials, equipments, staging, etc.

3.30.2 The Contractor shall furnish and install the bar grips for various dia of deformed bars as indicated in drawings and as required by these specifications.

The bar grip splicing system shall be of approved manufacturer and of the best quality available subject to approval of the Owner.

3.30.3 Splicing

3.30.3.1 a) The reinforcement bars are to be joined end to end without any gap and the sleeve placed in position.

b) Pressure is applied by means of a hydraulic press which swages the sleeve down on the bar ends in a series of bites which are applied at high pressure.

c) The job can also be done in two stages. The 1st stage is to press the half sleeve on the loose bar at the reinforcement yard. The 2nd stage work is to be done at the actual site after the loose bar is inserted through the unrepresented end of the sleeve and pressed insitu.

3.30.3.2 The joints shall be staggered as far as possible. Necessary staging arrangements are to be made by the Contractor.

3.30.3.3 It may be necessary to fix the sleeve to the reinforcement bars at one end in the open yard for the facility of working. All these working details are to be furnished earlier subject to the approval of the Owner.

3.30.3.4 The length of the sleeve should be adequate, that it is safe under the pull out loading conditions.

3.30.3.5 One percent representative samples of each dia, bars shall be sent for laboratory testing at the cost of the Contractor to check the efficiency of the joints under ideal condition. These samples of sleeves will be sent in the Laboratory for pull out tests.

3.30.4 Inspection

All bar grips installation shall be subject to inspection and approval by the Owner before concreting operation are performed. In case of any defect or joint being not upto mark, the same shall be replaced by the Contractor at no extra cost.

3.31 Pile Integrity Test

3.31.1 Pile Integrity test is used to assess the as-installed pile characteristics as well quality achieved during the construction of pile. The parameters to be evaluated through the Pile Integrity Test (also known as dynamic pile testing) should generally cover True static capacity of the pile at the time of testing, total skin friction and end bearing of the pile, skin friction variation along the length of the pile, compressive and tensile stress, displacement of pile, changes in cross-section if any etc.

3.31.2 The equipments consist of an electronic control unit, a hand-held instrumented hammer and an accelerometer and computer.

3.31.3 The pile top is prepared to make a plane surface (by placing a thin cement mortar in an area of 200mm x 200mm) after removal of weak lattaince. The accelerometer is fixed to the top of the pile and the instrumented hammer is struck firmly on the pile top. This generates a wave form that travels down the pile and gets reflected from the bottom as well as from any discontinuities in the pile.

3.31.4 The results to be stored in a compact control unit and transferred to computer and detail analysis to be carried out.

3.31.5 The contractor is to submit a detailed report for the data specified in cl. 7.1 above and as required by the Owner.

4.0 Structural Steel MS Liner for R.C.C. Vertical Piles and Painting of Liner

4.1 General Requirements

This specification covers general requirements for supply, fabrication, shop painting (if required), and delivery at site mild steel liners of specified diameters and lengths for piles.

4.2 M.S. liner shall be provided to piles at locations, as directed by the Owner. The extent upto which the MS liners for piles required to be provided shall be as shown in the approved drawings and as per direction and written approval of the Owner.

4.3 Drawings

4.3.1 Contractor shall submit calculations and fabrication details for connection/splice/joint for fabrication of liners and get these approved by the Owner before starting any fabrication works. The approval of fabrication drawings prepared by the Contractor shall not relieve the Contractor of the responsibility for the liners in place.

Fabrication drawing (drawn to large enough scale) to convey all information clearly shall include the following:

- i) Reference of the design drawings based on which fabrication had been prepared. The reference should include and indicate the latest revision of design drawing.
- ii) Layout, elevations and sections with erection marking of all members.
- iii) Quality of Structural Steel, Welding electrodes, and standards to which these conform to.
- iv) Detailing of structural joints and shop/field splices.
- v) Details of shop and field joints/connections.
- vi) Bill of material indicating size and weight of members/component.
- vii) Erection assemblies and sub-assemblies identifying all transportable parts.
- viii) Method of erection, special erection instructions, and special precautions to be taken during erection, as required.

4.3.2 Owner reserves the right to make changes in the fabrication drawings. Revisions to drawings may be made to reflect more updated requirements. Revisions to drawings and any new drawings made to include additional work by Contractor shall be considered as a part of this specification and the Owner shall entertain no extra claim on this account. All revisions in the

drawings should be highlighted in the drawing distinctly.

4.3.3 Unless otherwise specified, the drawings and specifications are intended to include everything obviously requisite and necessary for the proper and entire completion of the work and the job shall be carried out accordingly for the completeness as required.

4.3.4 In the case of variations in drawings and specifications, the decision of the Owner shall be final. In case Contractor in the execution of his work, find discrepancies in the information furnished by Owner, he shall refer such discrepancies to the Owner before proceeding with such work.

4.4 Fabrication

4.4.1 General

The fabrication work shall be carried out generally in accordance with IS:800 as well as the stipulation contained in these specifications. All materials shall be completely shop fabricated and finished with proper connection materials for ready assembly in the field. All the workmanship and finish shall be of the best quality and shall conform to the best approved method of fabrication. All materials shall be finished straight and shall be machined true and square where so specified. All edges shall be free of burrs, shearing and chipping shall be neatly and accurately done. Material at the shop shall be kept clean and protected from weather, Checklist format, inspection certificate for fabrication and protocol for handing over of structural steel shall be submitted by the Contractor in the form as agreed to by the Owner.

4.5 Straightening

All material shall be straight and free from bends or twists. If necessary, before being worked, the materials shall be straightened, unless otherwise required/specified. In case plates are distorted or twisted, straightening or flattening shall be done by methods that will not injure the plates. Long plates shall be straightened by passing through mangle of leveling rolls. Heating or forging shall not be resorted to without the prior approval of Owner in writing.

4.6 Welding

4.6.1 Welding shall be in accordance with IS:816, IS:819, IS:1024, IS:1261, IS:1323, IS:4353 and IS:9595, as appropriate.

- 4.6.2 For welding of any particular type of joint, Contractor shall give evidence acceptable to the Owner of having satisfactorily completed appropriate tests as described in any of the Indian Standards - IS:817,IS:1393,IS:7307 (Part J), as relevant and as per the checklists given in the Annexure to this section of the specification.
- 4.6.3 The works shall be done as per approved fabrication drawings which would clearly indicate various details of joints to be welded, type of weld, length and size of weld, whether shop or site weld. Symbols for welding on shop drawings shall be according to IS:813. Efforts shall be made to reduce site welding so as to avoid improper welding due to constructional difficulties.
- 4.6.4 Welding of Structural Steel shall be done by an electric arc process. The procedure to be followed, materials, plant and equipment to be applied shall be subject to the approval of the Owner and shall conform generally to relevant acceptable standards viz. IS:816, IS:9595, IS:814, and Indian Standard Hand Book for metal arc welding, and other standard codes of practice internationally accepted.
- 4.6.5 "Open-Arc-Welding" process employing coated electrodes shall be employed for fabrication of other welded connections and field welding.
- 4.6.6 Wherever welding is done for assembling the components of liner, the job shall be so positioned that downhand welding is possible. In cases where such positioning of job is not possible other manual welding positions could be resorted to.
- 4.6.7 Any structural joints shall be welded only by those welders who are qualified for all welding procedures and positions required in such joint that is welded. The entire weld of any liner joint shall be made by one welder.
- 4.6.8 All welds shall be free from defects like blow holes, slag inclusions, lack of penetration, undercutting, cracks and show uniform Sections, smoothness of Weld metal, feather edge without overlap and freedom from porosity.
- 4.6.9 Proper edge preparation shall be made for jointing of materials before welding. Suitable edge preparation shall be done for all processes of welding except for square butt welds. Type of edge preparation shall depend on the thickness of parent materials that are to be joined. The edge forms shall be chosen to suit the design, technology and production conditions and shall be subject to the approval of the Owner. The edge form of weldments shall be prepared either by machines or by automatic gas cutting with surface roughner of the welding area not exceeding 50sq.mm.

All edge cut by flame shall be ground before they are welded.

- 4.6.10 The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired e.g. normal penetration welds or deep penetration welds.
- 4.6.11 Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS:3613 (Latest). The electrodes shall be sorted properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated.
- 4.6.12 Specific approval of the Owner shall be taken by the Contractor for the various electrodes proposed to be used on the work before any welding is started.
- 4.6.13 Electrodes larger than 5mm diameter shall not be used for root-runs in butt-welds.
- 4.6.14 Welding plant and accessories shall have capacity adequate for the welding procedure laid down and shall satisfy appropriate standards and be of approved make and quality. All the electrical plant in connection with the welding operation shall be properly and adequately earthed and adequate means of measuring the current shall be provided.
- 4.6.15 Voltage and current (and polarity if direct current is used) shall be set according to the recommendations of the manufacturer of the electrode being used and suitability to thickness of material, joint form etc.
- 4.6.16 Pre-qualified welding procedures recommended by appropriate welding standards and known to provide satisfactory welds shall be followed. For non-standard procedures, qualification tests as prescribed in IS:9595 (latest) shall be made to verify the adequacy of the procedures. A welding procedure shall be prepared by Contractor and submitted to the Owner for approval before start of welding. This shall include all details of welding procedures with references to provisions of IS:9595 (Latest) and IS:4353. Approval of the welding procedure by Owner shall not relieve Contractor of his responsibility for correct and sound welding without undue distortion in the finished structure.
- 4.6.17 No welding shall be done, when the surface of the members is wet, during

periods of high wind, unless the welding operator and the work are properly protected.

4.6.18 In joints connected by fillet welds, the minimum sizes of single run fillet welds for first run and minimum full sizes of fillet welds shall conform to requirements of IS:816.

4.7 Pre-Heating Inter-run Temperature and Post Weld Heat Treatment.

- i) Welding of mild steel shall not be undertaken when the plate temperature is 0oC or below.
- ii) Mild steel plates conforming to IS:226 and thicker than 20 mm and plates conforming to IS:2062 and thicker than 25 mm may require preheating of the parent plate prior to welding. In welding materials of unequal thickness the thicker part shall be taken for this purpose.

Minimum Preheat and Interpass Temperature

Thickness of Thicker part at point of welding	Other than low hydrogen welding electrodes		Low hydrogen welding electrodes	
	IS:226 steel or IS:2062 steel	IS:8500	IS:226 steel	IS:8500 or steel IS:2062
Upto 20mm incl.	None	Welding by this electrode	None	10 deg.C
Over 20mm to 40mm incl.	65 deg.C	not allowed	10 deg.C	65 deg.C
Over 40mm to 63mm incl.	110 deg.C		65 deg.C	110 deg.C
Over 63mm	150 deg.C		110 deg.C	150 deg.C

- iii) Base metal shall be preheated, as required to the temperature given in table above prior to welding or tack welding. When base metal not otherwise required to be preheated is at a temperature below 0 deg. C, it shall be preheated, prior to tack welding or welding. Preheating shall bring the surface of the base metal to the specified preheat temperature and this temperature shall be maintained as minimum interpass temperature while welding is in progress.
- iv) Pre-heating may be applied by external flame heating equipment, by electric resistance or electric induction process such that uniform heating of the surface extending upto a distance or four times the thickness of the plate on either side of the welding joint is obtained.
- v) Thermo-Chalk or other approved methods shall be used for measuring the plate temperature.

4.8 Sequence of Welding

- i) The sequence of welding shall be carefully chosen to ensure that the components assembled by welding are free from distortion and large residual stresses are not developed. The distortion should be effectively controlled either by a counter effect of by counter distortion. The direction of welding should be away form the point of restraint and towards the point of maximum freedom.
- ii) Each case shall be carefully studied before finally following a particular sequence of welding.

4.8.1 Approval of welding sequence and procedure shall not relieve the Contractor of the responsibility for the correct welding and for minimising the distortion in the finished structure which in no case shall exceed that laid down in Indian Standards.

4.8.2 All welds shall be finished full and made with correct number of runs, the welds being kept free from slag and other inclusions, all adhering slag being removed from exposed faces immediately after such run.

4.8.3 Current shall be appropriate for the type of electrode used. To ensure complete fusion, the weaving procedure should go proper and rate of arc advancement should not be so rapid so as to leave the edges unmelted.

4.8.4 Pudding shall be sufficient to enable the gases to escape from the molten

metal before it solidifies.

- 4.8.5 Non-uniform heating and cooling should be avoided to ensure the excessive stresses are not locked up resulting ultimately in cracks.
- 4.8.6 The fusion faces shall be carefully aligned. Angle shrinkage shall be controlled by presenting. Correct gap and alignment shall be maintained during the welding operation.
- 4.8.7 All main butt welds shall have complete penetration and except where it is impracticable they shall be welded from both sides, back surface of the weld being gouged out clean before first run of the weld is given from the back.
- 4.8.8 Intermittent welds shall not be permitted without the approval of the Owner. These shall be permitted only when specifically approved in the fabrication drawings.
- 4.9.9 Inspection of Welds: All Welds shall be inspected for flaws by any of the methods described under Clause "Inspection". The choice of the method adopted shall be determined by Owner.
- 4.8.10 The Contractor shall carry out tests which establish soundness of welds. In case the tests uncover defective work, the Contractor shall correct such defects at his own cost and prove the soundness of rectified work at his own cost.
- 4.8.11 The correction of defective welds shall be carried out as directed by Owner without damaging the parent metal. When a crack in the weld is removed, magnetic particles inspection or any other equally positive means as prescribed by Owner shall be used to ensure that the whole of the crack and material upto 25 mm beyond each end of the crack has been removed. Cost of all such test and operations incidental to correction shall be to Contractor's account.

4.9 Inspection and Rectification

4.9.1 Visual Inspection

100 percent of the welds shall be inspected visually for external defects. Dimensions of welds shall be checked. The length and size of weld shall be as per approved fabrication drawing. It may be slightly over sized but should not be under sized. The profile of weld is affected by the position of the joint but it should be uniform. In case of butt and corner welds the

profile shall be convey and in case of submerged are fillet weld, it shall be slightly concave. The welds should have regular height and width of beads. The height and spacing or ripples shall be uniform. The joints in the weld run where welding has been recommended shall as far as possible be smooth and should not show any humps or craters in the weld surface. Welds shall be free from the unfilled craters on the surface, under cuts slags on the surface visible cracks. Such inspection shall be done after clearing the welds surface with steel wire brushes and chisel to remove the sputter metal, scales, slag, etc. If external defects mentioned above are noticed the work shall be dismantled and redone duly replacing the defective materials including the base members.

4.9.2 Rectification of Defective Welding Work

Wherever defects like improper penetration, extensive presence of blow holes, undercuts cracking, slag inclusion etc. are noticed by visual inspection/other tests, the welds at such locations shall be removed by gouging process. The joints shall be prepared again by cleaning the burrs and residual matters with wire brushes and grinding, if necessary and rewelded. The gouging as far as possible, be done using gouging electrodes. Flame gouging shall be resorted to only in special cases with specific permission of the Owner.

4.9.3 Acceptance of the Welded Structures

The acceptance of the welded work shall depend upon correct dimensions and alignment, absence of distortion in the structure, satisfactory results from the examination and testing of the joints and the test specimens as per I.S. soundness of the welds and upon general workmanship being good.

4.9.3.1 Random die penetration tests shall be conducted after welding of M.S. liner plates.

4.10 Erection marks

4.10.1 Before any steel work leaves the Contractor's fabrication shop, it shall be suitably marked in accordance with the approved fabrication drawing and according to an approved marking plan. Copies of all drawing showing such erection marks on the various steel works to be furnished to the Owner well in advance of the erection.

4.10.2 The erection marks assigned to various components of the structural steel

work shall also contain an erection sequence number indicating the sequence in which the various components are to be erected.

- 4.10.3 Erection marks shall be clearly painted on the work, each piece being marked in at least two places. Each piece shall also have its weight marked thereon. In order to help identification, each piece shall bear the erection marks and erection sequence number. Erection marks shall be painted on the structures, during the process of fabrication to facilitate their identification during inspection. Where a number of components are identical and bear the same erection marks, these components shall be further identified by assigning numerals in addition to the common erection mark.

4.11 Errors

Any error in shop work prevents proper assembling and fitting up of parts in the field, Moderate use of drift pins or moderate amount of reaming will be classified by Owner as defective workmanship. All charges incurred by Owner either directly or indirectly because of workmanship will be deducted from the amount due to Contractor before payment is made. The amount of such deduction will consist of the sum total of the costs of labour direct or indirect, material, plants, transportation, equipment, rental and overhead expense. In case Owner chooses to reject the material because of poor workmanship the cost of all handling and returning the material Contractor, if he so desires, shall entirely be to Contractor's account and in such cases, the cost of handling transport and delivery to site shall be borne by Contractor.

4.12 Protection Against Damage in Transit

All steel work shall be efficiently and sufficiently protected against damage in transit to site from any cause whatsoever to prevent damage or distortion during transit. Should there be any distortion of fabricated members the Contractor shall immediately report the matter to the Owner. Distorted steel shall not be used in fabrication unless the distortion are minor which in the opinion of the Owner can be removed by acceptable methods. These distortions shall be rectified by the Contractor by cold-bending. If heating is necessary to rectify the defects the details of the procedure shall be intimated to the Owner whose approval shall be taken before such rectification. The temperature of heat treatment shall not exceed the limits beyond which the original properties of steel are likely to be impaired.

4.13 Anti Corrosive Treatment for Mild Steel Liners and Permanent

Form Box

4.13.1 After inspection and issue of test and acceptance certificate, all steel surfaces shall be coated with a coat of direct to rust primer i.e. Densotrol or equivalent and thereafter these shall be provided with a final coat of minimum 200 microns of high built epoxy coal tar, as specified below. The fabricated mild steel liners to be used for the piling work shall be cleaned from grease or any other contaminant, by mechanical/manual cleaning. The primer shall be applied with a brush or spray to develop a dry film thickness or minimum 25 microns. The primer surface shall be left for curing for atleast 24 hours before it is coated with the final coat. The final coat shall consist of high built epoxy coal tar with a thickness of minimum 200 microns. The physical properties of primer and top coat shall be as given below.

4.13.2 Technical data of Priming material

Binder content	45%
Total Solids	45%
Solvent	55%
Viscosity	16 (Ford Cup No.4)
Density	0.88
Flash point	+40 ⁰ C
Anti-porosity	80/99 in one and two layers, respectively.
Heat-resistance	170/220 continuously & short period strain.
Contact angle	5 ⁰ (Lorentzon & Westtress)
Covering Capacity	12-20 Sq.m./litre
Layer thickness	12/25 on glossy/coarse surface
Homogeneity	No sediment

Thinning	Normally, no thinner shall be used.
Drying time	Dust-free in 2 hrs, Solid in 4/5 hrs. Between layers from wet-in-wet to 2 hrs. for continuous penetration between layers.
Lustre	Semi-glossy
Colour	Lightly yellowish
YSAM group	2
Injurious to health	No
Physiological condition when welding	No dangerous gas generation
Application	Airless spray equipment or conventional painting with roll/brush.
Cleaning of equipment	White spirit

4.13.3 Technical particulars of final coat

System	Two Components Component A : Base Part Component B : Accelerator Part
Colour	Black
Mixing Ratio	1:1 by Weight
% Solid by Weight	More than 95%
Pot Lift (Temp.27°C Relative humidity 65%)	2 hours
Setting Time (At 22°C Relative humidity 65%)	4-5 hours
Fully cured	7 days

Density of cured mass	1.35
Flash Pt. of blended product	40°C (104°F)
Hardness	75 Shore D
Finish	Semi glossy
Water absorption after 6 mths.	Negligible
Covering Capacity	1.5 sq.m./Kg (400 Microns thk.)
Storage Life	1 year in sealed condition.

4.14 Shop Connections

Surfaces to be permanently in contact shall receive a priming coat immediately at the works except where jointed by welding.

5.0 Standards and Codes

The construction work of pile foundation shall conform to the following Indian/International Standards, which shall mean latest revisions, amendments/changes adopted and published, unless otherwise specified hereinbefore. Some of the important relevant applicable codes for this section are as follows :

IS : 226	Structural Steel (Standard Quality)
IS : 432	Specification for mild steel and high tensile steel bars and hard drawn steel wire for concrete reinforcement.
IS : 456	Code of practice for plain and reinforcement concrete
IS : 516	Methods of test for strength of concrete
IS : 800	Code of Practice for General Construction in Steel
IS : 813	Scheme of symbols for Welding
IS : 814	Specification for Covered Electrodes for Metal Arc Welding of Structural Steels
IS : 816	Code of Practice for use of Metal Arc Welding for General Construction in Mild Steel.

IS : 817	Code of Practice for Liquid Penetrant Flaw Detection.
IS : 1199	Methods of sampling and analysis of concrete.
IS : 1200 Part-I	Method of measurement of Building and civil Engineering work –arthwork.
IS : 1200 Part-23	Method of measurement of Building and civil Engineering work --Piling
IS : 1786	Cold worked steel high strength deformed bars for concrete reinforcement.
IS : 1838	Performed fillers for expansion joints in concrete non-extruding and resilient type (bitumen impregnated filler).
IS : 2062	Weldable structural steel
IS : 2074	Ready Mixed Paint, air drying, Red Oxide Zinc Chrome, Priming.
IS : 2386 Part-III	Specific gravity, density, voids absorption and bulking.
IS : 2502	Code of Practice for bending and fixing of bars for concrete reinforcement.
IS : 2505	General requirements for concrete vibrators immersion type.
IS : 2506	Screed board concrete vibrators.
IS : 2514	Concrete vibrating tables.
IS : 2911 (Part/Sec. 2)	Code of practice for design and construction of pile foundation-Bored cast-in-situ concrete piles.
IS : 3025	Methods of sampling and test (Physical and chemical) for water used in Industry.
IS : 3350	Methods of tests for routine control for water used in Industry.
IS : 3370	Code of Practice for concrete structure for the storage of liquids.
IS : 3613	Acceptance Tests for Wire Flux Combinations for submerged Arc welding of structural steels.
IS : 3658	Recommended Practice for Radiographic Examination of Fusion Welded Butt Joints in Steel Plates.
IS : 3764	Safety codes for Excavation work.

IS : 4353	Recommendations for Submerged Arc Welding of Mild Steel and Low Alloy Steels.
IS : 4656	Form vibrators for concrete.
IS : 4701	Code of practice for earth work on canals.
IS : 8500	Specification for weldable structural steel (medium and high strength qualities)
IS : 9103	Admixtures for concrete.
IS : 10262	Recommended guidelines for concrete mix design.

ANNEXURE - A

BIDDER TO FURNISH INFORMATION ALONGWITH THE BIDS

A1.0 Installation criteria/Technique to be adopted for boring of piles in all types of soils: (Refer Clause No.2.1.1).

NOTE :

1. The above mentioned details/ information are required to be furnished by the bidder alongwith their bid.
2. The installation criteria/technique required to be adopted for actual installation/execution of work shall be submitted by the Contractor.

ANNEXURE - B

BIDDER TO FURNISH INFORMATION ALONGWITH THE BIDS

List of Equipments

Sl.No.	Description	Make/Size	Capacity	Nos.
1.	Piling Rigs			
2.	High pressure Mud Pumps			
3.	Bentonite mixing plants			

NOTE :

1. The bidder shall furnish a complete list of equipments, tools and tackles which they intend to use for the work.
2. In order to complete the work successfully, if the bidder would have required additional mobilisation of the equipment specified above, these shall be done at no extra cost to the Owner.

ANNEXURE - C

ONLY FOR REFERENCE OF THE BIDDER. THESE SHALL APPLY FOR ACTUAL EXECUTION OF THE WORK

- C1.0 Bentonite suspension used for piling work shall satisfy the following requirements :
- a) Liquid limit of bentonite when tested in accordance with IS:2720 (Part V) shall be more than 300 percent and less than 450 percent.
 - b) Sand content of the bentonite powder shall not be greater than 7 percent.
 - c) Bentonite solution should be made by mixing it with fresh water using pump for circulation. The density of the freshly prepared bentonite suspension shall be between 1.024 and 1.10 gm/ml depending upon the pile dimensions and type of soil in which the pile is to be met. However, the density of bentonite suspension after mixing with deleterious materials in the pile bore may be upto a maximum of 1.25 gm/ml.
 - d) The Marsh viscosity when tested by a Marsh cone shall be between 30 to 60 seconds.
 - e) The differential free swell shall be more than 540 percent.
 - f) The pH value of the bentonite suspension shall be between 9 and 11.5.

ANNEXURE - D

ONLY FOR REFERENCE OF THE BIDDER. TO BE UTILISED/USED.

PILE DATA

1. Reference No. Location (Co-ordinates)_____ area.
2. Sequence of Piling
3. Pile diameter & Type
4. Working level (Platform level)
5. Cut off level (COL)
6. Actual length below COL
7. Pile termination level
8. Top of finished concrete level
9. Date and time of start and completion of boring
10. Depth of Ground water table in the vicinity
11. Type of strata at pile tip
12. Method of boring operation
13. Details of drilling mud as used :
 - i) Freshly supplied mud
 - liquid limit
 - sand content
 - density
 - marsh viscosity
 - Swelling index
 - pH value
 - ii) Contaminated mud

ANNEXURE - E

A. INSPECTION & TESTING (STANDARDS) FOR STRUCTURAL STEEL WORKS

Title : An indicative programme of inspection/testing

1.0 INSPECTION & TESTING

Contractor shall carry out a comprehensive inspections and testing programme during fabrication and erection. An indicative programme of inspection/testing envisaged by Owner is given below. This is however not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and carry out such a programme duly approved by the Owner. Such approval shall not relieve the Contractor of the responsibility about the correctness and adequacy of workmanship, materials etc.

1.1 Raw Materials Inspection

1.1.1 Steel

i) Specifications

Check the specification of steel and availability of the relevant Test Certificates.

ii) Physical Conditions

- a) Steel shall not be pitted and should be free from scales and rust.
- b) If the plates are bent or distorted, bent to distortion shall normally be removed by the cold treatment etc.
- c) Straightening under hot stage shall be resorted to only under specific permission from the Owner.
- d) If any rolling defect viz, laminations, cracks etc. are discovered in the steel during processing is shall be rejected.

iii) Storage

- a) Steel plates of different specifications shall be stacked separately.
- b) Steel of IS:2062 quality shall be given a distinctive identification mark.

- c) Steel sections shall be stacked over spacers supported on posts of about 50 cm height above ground. Passage and space between the stacks shall be sufficient for rigging operations.

1.1.2 Electrodes

- i) Electrodes for manual metal arc welding shall be procured envisaged in the welding procedure sheet predetermined before actual welding operation starts.
- ii) Electrodes shall be properly stored dry as required by the IS Code or by the manufacturer.
- iii) Electrodes shall bear the I.S.I or equivalent Certification mark.
- iv) The approval for all the consumables for welding shall be specifically obtained before hand.

1.1.3 Paints/Primers

- i) The relevant I.S or equivalent mark on sealed tins shall be checked.
- ii) A few tins shall be opened at random to check the condition of the paints. Paint from old stock and showing signs of solidification shall not be accepted.

1.2 Welding Procedure Qualification.

As per ASME section (ix) or equivalent Indian Standards, Welding procedures, Specification shall be submitted by the Contractor for review and approval of Owner.

1.3 Welders Qualification Test

As per ASME section (ix) or equivalent Indian Standard.

1.4.0 Inspection for Tack Assembly set up for:

- i) Level
- ii) Gap
- iii) Offsetting
- iv) Shrinkage allowance
- v) Fitment sequence
- vi) Principal overall size.

1.5 Preheating

Temperature control by thermochalk or suitable equivalent method.

1.6 Inspection of Main welds

- a) Fillet welds for
 - i) Size
 - ii) Dye Check
 - iii) Visual examination
 - iv) Dye penetration test/MPI shall be carried out.
- b) Buttwelds for
 - i) Dye check for root after back gauging shall be carried out.
 - ii) Mechanical testing of welds (Destructive Tests) Minimum on joint per liner length/piece.
 - iii) Non-destructive - as per FCL: SS:4
 - 100% visual examination.

B. FABRICATION CHECK LIST (STANDARD)

Title : Welding Tests on welds and Weld Defects

Mechanical testing of welds (Destructive test) Butt welds having one or more of the foillowing defects are not acceptable.

- i) Bend test : No crack on root/face on being bent through 180 deg. with mandrel of 4t where t is the thickness of plate.
- ii) Tensile test : Weld strength not to be less than part metal's strength.

VISUAL EXAMINATION

Following defects are not allowed :

- 1) Unsatisfactory appearance
- 2) Incomplete weld
- 3) Molten metal flow
- 4) Pits
- 5) Surface crack, lack of penetration

- 6) Insufficient length
- 7) Surface defects exceeding 5% of weld seam area

DYE PENETRATION TEST

All surfaces to be examined shall be free from :

- a) Relevant linear indications
- b) Four or more rounded defects in a line separated by 1/16" or less (edge to edge) except where the specification for the material establishes requirements for acceptance so far as defects are concerned.

C. TYPICAL WELDING PROCEDURE DATA SHEET

Contractor.....Address.....

Quality of weld metal.....Specification.....

Inspection and Test ScheduleSpecification.....

Material Specification.....Thickness.....Batch/Cast No.....

Joint Preparation (Fig.).....Gap.....

Location of Specimens.....

Weather Conditions.....Time of day.....Wind brake used.....

Electrode Group No..... Make.....Specimen.....

Pre and Post-Heating.....

Welding Position.....

Size of Reinforcement.....Whether removed.....

Welding Sequence.....

Backing Strip use.....Type.....

Welding Process.....

Current Conditions-Polarity.....

Size of Electrode.....

Amperage and Voltage.....

Number of Electrodes used per run.....

Cleaning method.....

Remarks.....

Engineer-in-Charge
TPTL
(Inspecting Authority)

Signature
For and on behalf of Contractor
Date :

D. FABRICATION CHECK LIST : ACCEPTANCE PROFORMA

No. _____

Dt. _____

Project

Work

Sub-Assy

Sl. No.	Characteristic	Asper DRG/FCL	Actual	Accept/Reject	Remarks
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TPTL Representative

Contractor's Representative

**PROFORMA OF UNDERTAKING BY THE PROPOSED AGENCY FOR
PILE FOUNDATION**

(On Non-Judicial Stamp Paper of appropriate value, wherever applicable)

To,

Teestavalley Power Transmission Limited (TPTL)
143-144, Udyog Vihar, Phase – IV,
Gurgaon -122 015 (Haryana).

Dear Sir,

Whereas Teestavalley Power Transmission Limited, having its Registered Office at 143-144, Udyog Vihar, Gurgaon -122 015 (Haryana) (hereinafter referred to be as the ‘Owner’), having invited bids for _____ (Name of the package & Specification No.) _____, in response to which M/s. _____ (Name of the Bidder), with its Registered office at _____ (Full Address _____) are submitting the bid vide ref _____ date _____ (hereinafter called the ‘Bid’).

We, _____ (Name of the Agency) with its Registered Office at _____ (Full Address _____) (hereinafter referred to as the ‘Agency’, which expression shall unless repugnant to the context and meaning therefore include its successor, administrator, executor and permitted assigns) do hereby undertake in the event of award of the Contract to execute the pile foundation work covered under the scope of the Contract, fulfilling all the requirements and construction schedule agreed under the Contract.

Signed on this day of _____ 2005 at _____

(Signature) _____
Authorised signatory on behalf of
M/s _____
(Name) _____
(Designation) _____

Note: Separate undertaking to be provided in case of more than one agency proposed.