TECHNICAL SPECIFICATIONS

SPECIFICATION FOR PILES

PILES

1.0 BORED CAST-IN-SITU CONCRETE PILE

1.01 General

This specification covers the piling work required for the construction of Bored Cast-in-Situ piles.

The Tenderer may carry out additional investigation if felt necessary by him. Claims and objections of site and subsoil conditions shall not be entertained.

1.02.01 Codes

IS:2911 (Part 1/Section 2) – 1979 : 'Code of practice for design & construction of Bored Cast – in Situ concrete piles' shall be referred to in conjunction with this specification during the entire design & construction work. If for any material or workmanship, appropriate Indian Standards or Codes are not available or have not been adequately specified in the Technical Specification, such material & workmanship shall conform to other suitable references & codes.

1.02.02 Design

The piles shall be bored cast-in-situ cylindrical skin friction type RCC piles.

1.02.03 Materials

All the materials proposed to be used, shall be free from any objectionable substances, and it shall conform the following stipulation. Any testing required to prove the suitability of such materials should be carried out.

1.02.03.01 Reinforced Cement Concrete for Piles shall be with minimum Cement content of 400 kg/m3 for piles. The slump of concrete for piles shall be between 160 mm to 180 mm. the water-cement ratio shall not exceed 0.45 to achieve the specified slump using specified water cement ratio without compromising with strength, if required, suitable admixture shall be used subject to approval of the Purchaser.

1.02.03.02 Preliminary mix design shall be done in accordance with IS: 10262-1982 & SP: 23 subject to approval of the Purchaser. Cube tests, Slump test & other relevant tests for preliminary mix design and Routine cube test, slump test for regular concreting shall be carried out at site/ site laboratory at contractor's own cost. Concrete cube tests shall be done as per IS: 516- 1959. Frequency of cube test shall be guided by clause 15.2 of IS: '456- 2000. Slump tests (apparatus conforming to IS: 7320 -1974) shall be carried out at least once for each pile or more frequently, if desired by the Purchaser.

All materials which will be used in the Reinforced Cement Concrete work shall be of Standard quality conforming to IS or equivalent and shall have IS certification mark as far as possible unless otherwise approved by the Engineer-in-Charge. The contractor shall get all materials approved by Engineer-in-Charge prior to its procurement and before actual use. The Engineer-in-Charge shall have the right to determine whether all or any of the materials offered or delivered for use in the works are acceptable. Any material brought to site and not conforming to specification and instruction of Engineer-in-Charge shall be rejected and the contractor shall have to remove the same immediately from site at his own expense

Design Mix:

The concrete to be used shall be design Mix M30 Grade.

M-30 CONCRETE MIX DESIGN		
As per IS 10262-2009 & MORT&H		
A-1	**Stipulations for Proportioning**	
1	**Grade Designation**	**M30**
2	Type of Cement	OPC 53 grade confirming to IS-12269-1987
3	Maximum Nominal Aggregate Size	20 mm
4	Minimum Cement Content (MORT&H 1700-3 A)	400 kg/m^3
5	Maximum Water Cement Ratio (MORT&H 1700-3 A)	0.45
6	Workability (MORT&H 1700-4)	160-180 mm (Slump)
7	Exposure Condition	Normal
8	Degree of Supervision	Good
9	Type of Aggregate	Crushed Angular Aggregate
10	Maximum Cement Content (MORT&H Cl. 1703.2)	540 kg/m^3
11	Chemical Admixture Type	Superplasticiser Confirming to IS-9103
A-2	**Test Data for Materials**	
1	Cement Used	Coromandal King OPC 53 grade
2	Sp. Gravity of Cement	3.15
3	Sp. Gravity of Water	1
4	Chemical Admixture	BASF or Equivalent Chemicals Company
5	Sp. Gravity of 20 mm Aggregate	2.884
6	Sp. Gravity of 10 mm Aggregate	2.878
7	Sp. Gravity of Sand	2.605
8	Water Absorption of 20 mm Aggregate	0.97%
9	Water Absorption of 10 mm Aggregate	0.83%
10	Water Absorption of Sand	1.23%
11	Free (Surface) Moisture of 20 mm Aggregate	nil
12	Free (Surface) Moisture of 10 mm Aggregate	nil
13	Free (Surface) Moisture of Sand	nil
14	Sieve Analysis of Individual Coarse Aggregates	Separate Analysis Done

15	Sieve Analysis of Combined Coarse Aggregates	Separate Analysis Done
15	Sp. Gravity of Combined Coarse Aggregates	2.882
16	Sieve Analysis of Fine Aggregates	Separate Analysis Done
A-3	**Target Strength for Mix Proportioning**	
1	Target Mean Strength (MORT&H 1700-5)	42N/mm^2
2	Characteristic Strength @ 28 days	30N/mm^2
A-4	**Selection of Water Cement Ratio**	
1	Maximum Water Cement Ratio (MORT&H 1700-3 A)	0.45
2	Adopted Water Cement Ratio	0.42
A-5	**Selection of Water Content**	
1	Maximum Water content (10262-table-2)	186 Lit.
2	Estimated Water content	160 Lit.
3	Super plasticizer used	0.5 % by wt. of cement
A-6	**Calculation of Cement Content**	
1	Water Cement Ratio	0.42
2	Cement Content (160/0.42)	380 kg/m^3
		Which is greater then 310 kg/m^3
A-7	**Proportion of Volume of Coarse Aggregate & Fine Aggregate Content**	
1	Vol. of C.A. as per table 3 of IS 10262	62.00%
2	Adopted Vol. of Coarse Aggregate	62.00%
	Adopted Vol. of Fine Aggregate (1-0.62)	38.00%
A-8	**Mix Calculations**	
1	Volume of Concrete in m^3	1
2	Volume of Cement in m^3	0.12
	(Mass of Cement) / (Sp. Gravity of Cement)x1000	
3	Volume of Water in m^3	0.16
	(Mass of Water) / (Sp. Gravity of Water)x1000	
4	Volume of Admixture @ 0.5% in m^3	0.0016
	(Mass of Admixture)/(Sp. Gravity of Admixture)x1000	
5	Volume of All in Aggregate in m^3	0.718
	Sr. no. 1 – (Sr. no. 2+3+4)	
6	Volume of Coarse Aggregate in m^3	0.445
	Sr. no. 5 x 0.62	
7	Volume of Fine Aggregate in m^3	0.273

	Sr. no. 5 x 0.38	
A-9	**Mix Proportions for One Cum of Concrete (SSD Condition) (Saturated Surface Dry Condition)**	
1	Mass of Cement in kg/m^3	**380**
2	Mass of Water in kg/m^3	**160**
3	Mass of Fine Aggregate in kg/m^3	**711**
4	Mass of Coarse Aggregate in kg/m^3	1283
	Mass of 20 mm in kg/m^3	**924**
	Mass of 10 mm in kg/m^3	**359**
5	Mass of Admixture in kg/m^3	**1.9**
6	Water Cement Ratio	0.42

A. Cement :

All types and brands of cement shall be subject to the approval of the Engineer.

a. Following types of cement shall be used.

i. All cement used for the work shall be 53 grade Portland cement. Portland cement shall comply with the requirements of the latest issue of the IS-12269.

ii. Cement shall be used in the order in which it is received. Cement which has remained in bulk storage at the mill for more than six months, or which has remained in bags in dealer's storage for over three months or which has been stored at project site for more than three months shall be retested before use. Cement shall also be rejected if it fails to conform to any of the requirements of these specifications.

iii. Cement shall be procured from the following brand list :
Birla Super, Ultratech, Ambuja, ACC or as approved.

Tests after Delivery:
Each consignment of cement may, after delivery on the site at the discretion of the Engineer-in- Charge, be subjected to any or all of tests and analysis required by the relevant Indian Standard Specifications. Facilities for testing shall be provided by contractor at his own cost.

Rejection of Cement:
The Engineer-in-Charge may reject any cement as a result of any tests thereof, notwithstanding the manufacturer's certificate. He may also reject cement which has deteriorated owing to inadequate protection from moisture or due to intrusion of foreign matter or other causes. Any cement which is considered defective by the Engineer-in-Charge shall not be promptly removed from the site of the work by the contractor at his own expense.

B. Fine Aggregate:

Natural sand or manufactured sand shall be as follows:

Fine aggregate shall consist of natural sand, manufactured sand or an approved combination thereof and shall conform to IS-383 or 515. The grading zone of sand proposed for use shall be supplied by the Contractor and got approved from the Engineer.

The sand shall be of siliceous material, sharp, hard, strong and durable and shall be free from adherent coating, clay, dust, alkali, organic material, deleterious matter, lumps etc. The sand shall not contain silt more than a total of 2% by weight and shale, clay, silt and other structurally weak particles a total of 5% by weight. Chloride content in washed sand shall not be greater than 0.04% by weight.

Either natural or manufactured sand shall be prepared for use by such screening or washing or both as necessary, to remove all objectionable foreign matter while separating the sand grains to the required size fractions. Natural sand shall be washed, unless specific written authority is given by the Engineer to use sand that meets specification and standards of cleanliness without washing. The sand shall be washed in screw type mechanical washers in potable water to remove excess silt, clay and chlorides. The screening and washing of sand shall be completed at least one day before using it in concrete. The cost of screening and washing must be borne by the Contractor. The fine aggregate shall be taken from a source approved by the Engineer.

Sampling and Testing:
In case of doubt the Engineer-in-Charge may require the contractor to carry out tests, at the contractor's expense in accordance with – IS: 516 – Method of Tests for Strengths of Concrete; and IS: 2386- Method of Tests for Aggregates for Concrete.

C. Coarse Aggregate :

Coarse aggregates shall consist of hard, strong, durable particles of crushed stone and shall be free from thin elongated soft pieces, organic or other deleterious matter. It shall have no adherent coating. It will be from a source approved by the Engineer. Only quarries having jaw crushers with choke feeding arrangement production aggregates of nearly cubical shape shall be approved.

Coarse aggregate shall conform to I.S.383 or 515. Aggregates shall be properly screened and if necessary, washed clean before use to remove all vegetables and other perishable substances and objectionable amounts of other foreign matter, the cost of washing and screening being borne by the Contractor.

For heavily reinforced concrete members as in the case of ribs of main beams, nominal maximum size of aggregate shall usually be restricted to 5 mm less than the minimum lateral clear distance between the main bars, or 5 mm less than the minimum cover to the reinforcement, whichever is the smaller. However, if required under special circumstances, the Engineer may permit an aggregate nominal maximum size 25% more than this critical spacing/cover provided that proper vibrating is ensured.

The grading of coarse aggregate shall be such that not more than 5% shall be larger than the maximum size and not more than 10% shall be smaller than the smallest size. Between these sizes the coarse aggregate shall be well graded.

The aggregates shall be subjected to tests in accordance with IS-2386 or as may be directed by the Engineer.

D. Size of coarse aggregates:

Following shall be the maximum nominal size of coarse aggregate for the different items of works :

Table 2
Size of coarse aggregates in different types of works

Item of construction	Maximum nominal size of coarse aggregate
RCC well staining concrete, RCC well curb and RCC piles and plum concrete	63 mm
Well cap or pile cap, solid piers, and abutments and wing walls, pier caps and general item of work in bridge and building construction	40 mm
RCC works in cross girders, deck slab, wearing course, kerb, light posts, ballast walls, approach slab etc. and hollow type piers, abutments, wing walls and pier caps	20 mm
RCC bearings, shells and other thin walled members and in zones of congestion	20 mm
For any other item of construction not covered by items above	as specified in drawings or as desired by the Engineer.

E. Fly Ash (pulverized fuel ash) :

Fly ash conforming to Grade 1 of IS3812 may be used as part of replacement of Ordinary Portland Cement provided uniform blending with cement is ensured. However, the proportion of fly ash shall not be more than 25% of the total cementatious content in the given design mix.

F. Ground Granulated Blast Furnace Slag :

Ground Granulated Blas Furnace Slab obtained by grinding granulated blast furnace slag conforming to IS 12089 may be used as part replacement of ordinary Portland Cement provided uniform blending with cement is ensured.

G. Water :

Water used for concrete shall be clear and free from injurious amounts of Oil, Acid Alkali, Organic matters or other harmful substances in such amount that may impair the strength or durability of structure. Potable water shall generally be considered satisfactory for mixing and curing concrete. The Engineer-in-Charge may require the contractor to prove at latter's

expense, that the concrete mixed with water proposed to be used should not have a compressive strength, lower than 90% of the strength of concrete mixed with distilled water. Chemical properties of water shall conform to I.S.456.

The Engineer-in-Charge may require the contractor to get the water tested from an approved laboratory at his own expenses and in case the water contains any sugar or an excess of acid, alkali, any injurious salts, etc. the Engineer-in-Charge may refuse to permit its use.

H. Reinforcement:

1. Corrosion resistant Steel reinforcement

The reinforcement shall confirm to IS: 1786, Fe-500 grade. The reinforcement shall be Corrosion resistant steel and it shall be either "TISCON CRS" from TISCO or HSCR-M from Vizag Steel or HCR from SAIL-M normally be mild steel in the form of round bars, conforming to IS: 432-Grade 1 unless specified otherwise.

2. Hard-Drawn Steel wire Fabric

When specified in the drawings, hard drawn steel wire fabric shall be used conforming to IS:1566, It shall be of approved type and of the weights and dimensions shown in the drawings.

3. Welding:

Field welding of reinforcing bars will not be permitted without the written consent of the Engineer-in-Charge. Where welding is permitted it must be at staggered locations. Tests shall be made to provide that the joints are of the full strength of bars connected. Welding of reinforcement shall be done in accordance with the recommendation of IS: 2751.

4. Storage

The steel reinforcement shall be stored in such a way as to avoid distortion and to prevent deterioration and corrosion.

5. Inspection of Reinforcement :

No concreting shall be commenced until the Structural EIC has inspected the reinforcement in position and until his approval has been obtained. A notice of at least 24 hours shall be given to the Project Engineer by the Contractor for inspection of reinforcement.

If in the opinion of the Project Engineer any material is not in accordance with the specification or the reinforcement is incorrectly spaced, bent or otherwise defective, the contractor shall immediately remove such materials from the site and replace the same and rectify any other defects in accordance with the instruction of the Project Engineer to his entire satisfaction

I. Other Specifications

1. General construction details and workmanship relative to reinforcement including bar bonds, lap splices and installation shall be in accordance with I S:2502- Code of Practice for Bonding and Fixing of Bars for concrete reinforcement, as well as the detailing of reinforcement given in I S:456.

2. Hot bending of bars shall not be allowed.

3. The number of sizes, shape and position of all the reinforcement shall, unless otherwise directed or authorized by the Engineer-in-Charge, be strictly in accordance with the drawings.

The reinforcement shall be adequately secured and held in position by metal chairs and spacers. Ties of inter-sections shall be made with 16 SWG soft black annealed binding wire.

4. The contractor must obtain the approval of the Engineer-in-Charge for the reinforcement placed, before any concrete is placed in the forms. The reinforcement of this time shall be free from loose rust or scale or other coating that will destroy or reduce bond.

5. Concrete spacer blocks of the same strength as parent concrete shall be used to ensure correct cover to the reinforcement. This clear cover shall be as shown on the drawings or as per instructions of the Engineer-in-Charge.

6. All the reinforcing bars shall be so tied as to form a rigid cage to prevent displacement before or during concreting.

J. Admixtures :

It is essential to use approved Melamine, Naphthalene or PC based admixtures for imparting special characteristics to the concrete, on satisfactory evidence that its use does not in any way adversely affect the properties of concrete, particularly its strength, volume changes, durability and has no deleterious effect on the reinforcement. They should not impair durability of concrete nor combine with the constituent to form harmful compounds. The workability, compressive strength and the slump loss of concrete with and without the use of admixtures shall be established during the trial mixes before the use of the admixtures. Minimum cement quantity shall not be reduced on account of use of admixtures.

The admixtures shall also have the property of set retarding. Before approval of super plasticizer, the Contractor will submit test reports as specified in ASTMC-486 from an approved laboratory as approved by the Engineer in Charge. Subsequent batches will be tested for IR analysis, UV analysis and solid content or any other tests as directed by Engineer in charge.

If two or more admixtures are used simultaneously in the same concrete mix, data should be obtained to assess their interaction and to ensure their compatibility.

K. Admixture Approvals:

Descriptive literature of: the grout, air-entraining admixtures, accelerating admixtures, Retarding Admixture, bonding agents, expansive admixtures, surface retarders, water reducing and High Range Water Reducing admixtures, membrane forming curing agents, curing sheets etc. proposed for use containing certified laboratory test results showing that they meet the approved standards shall be submitted 30 days prior to their use together with a certificate from the manufacturer stating that the products are suitable for the application or exposure for which they are being considered. In addition, a detailed plan shall be submitted for review, showing equipment and procedures for use in mixing and placing the admixtures and agents. All chemical admixtures furnished as liquids shall be in a solution of suitable viscosity for field use as determined by the Engineer in charge.

The admixtures shall not be paid for separately.

L. Storage of Materials :

A. Cement :

The Contractor shall make arrangements to the satisfaction of the Engineer for the storage of cement to prevent deterioration due to moisture and/or intrusion of foreign matter. Bulk cement shall be stored in approved waterproof bin or silo. Bagged cement shall be stored in suitable weather-tight warehouse in a manner to provide easy access for identification and inspection of each consignment. Stored cement shall meet the test requirements as per IS-269 at any time after storage, when a retest is ordered by the Engineer. Each consignment shall be stacked separately with the date of receipt flagged on it, not more than 12 bags stacked in height, the bags being arranged with headers and stretchers. Normally consignments shall be used in the order of receipt at site unless otherwise directed. In the case of large concrete pours, the Engineer will decide on the batch of cement to be used taking into consideration the quantity of cement with particular reference to the concerned concrete pours. Any additional work in handling and storage of cement contingent upon this requirement shall be to the contractor's account and no extra claim will be entertained. Cement shall be protected from exposure to moisture in transit, in storage at the works and until it enters the concrete mixers. The contractor shall keep accurate records of the deliveries of the cement and of its use in the work.

B. Aggregates :

Coarse and fine aggregates shall be stacked separately in such manner as to prevent contamination by foreign materials. All aggregates shall be stored on concrete or masonry platforms. Each size shall be kept separate with wooden, steel, concrete or masonry bulk-heads, or shall be stored in separate stacks, taking care to prevent the materials at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart. The aggregates shall be stored in easily measurable stacks of suitable heights as may be directed by the Engineer. Fly ash, silica fumes and Ground Granulated Blast Furnace Slag shall have separate silo like containers where intermediate handling is minimized.

1.02.04 Equipment & Accessories

The equipment & accessories should be compatible with the type of subsoil, method of installation, type of founding strata & required penetration in the founding strata.

The capacity of rig shall be adequate so as to bore up-to required depth with specified diameter. Rig shall be equipped with suitable chisel to penetrate through any local obstruction/ hard strata.

1.02.05 Construction

1.02.05.01 The permissible positional deviation in horizontal direction shall not exceed 1.5% from the designed location in case of piles having diameter more than 600mm.

1.02.05.02 Stabilization of the side of borehole shall be done by the use of bentonite slurry. Direct Mud Circulation (DMC) process shall be adopted. In such cases the bentonite slurry must

be used at least from the level of sub-soil water, as the hole shall then be always kept almost full with the fluid. The specific gravity of bentonite slurry shall be in the range of 1.05 to 1.10.

This shall be checked regularly for each or at any change in its specified consistency. Pressure of slurry pump shall be sufficient enough to clear out all cuttings efficiently from the hole. Prevention of side collapse of bore-holes shall be taken care by with use of temporary casing if necessary. At the last stage of boring or in intermediate hard layers chisel may be used. The piles shall be installed with due consideration for safely of adjacent structures by a method. Which leaves their strength unimpaired, and which develops and retains the required bearing resistance.

1.02.05.03 Reinforcement as required shall be made into stiff cages sufficiently welded to withstand handling without any damage or distortion. Reinforcement shall be placed immediately after cleaning and inspection of the bottom of bore holes. The reinforcement should be supported away from the sides of the shaft by means of suitable space block to ensure concentric alignment in the shaft. Steps shall be taken to ensure correct positioning during concreting of reinforcement in the piles without any distortion.

1.02.05.04 Immediately before placing of reinforcement and concreting, the bored hole shall be cleaned of all the loose material, debris and all the water shall be removed. The pile tip zone shall thoroughly replace the old bentonite slurry used during the previous operations. This shall be carried out for about 45 minutes in two stages. Cleaning for about first 30 minutes shall be done before lowering of reinforcement cage & cleaning of about 2nd 15 minutes after lowering the reinforcement cage.

Concrete shall be so placed as to fill the entire volume of the tube or bore without the formation of voids caused by the faulty consolidation or entrapped air. Proper care shall be taken to ensure that the fluid alluvial soil does not penetrate between batches of the concrete.

In case of boreholes stabilized by bentonite slurry, concrete shall be placed by means of tremie pipe, which will be suitably closed at bottom at the start of concreting. The tremie pipe must extend upto the bottom of the borehole at the start and may be withdrawn in sections as the level of concrete rises in the borehole; but its discharge end shall at all times be embedded in the concrete to a minimum depth of 2 m. placing of concrete should be continuous and the pile holes will be maintained full with the bentonite slurry where used throughout the concreting operation. Slurry displaced from the borehole by the concrete shall be channeled away or pumped into suitable mud pond for re-use or disposal to waste.

In case of cased holes. After the required founding level is encountered, the bottom shall be sealed with concrete and the reinforcement cage shall be lowered. If the borehole is dry, concrete shall be deposited in such a manner so as to avoid any segregation of concrete followed by gradual withdrawal of casings. If water is present in the borehole, it shall be bailed out by bailer. If it is difficult to dewater by the bailer, concrete shall be placed under water by means of a placer. After the head of water has been neutralized by the head of the concrete, excess water shall be bailed out and concrete shall then be deposited by direct pouring from the top, as is done, if the bore hole is dry.

1.02.05.05 The concreted length of piles shall be measured from the toe of pile to cut off level of pile.

1.02.05.06 Temporary stoppage of work may be permitted only during boring stage. Thereafter right form boring or chiseling of final portion of pile length through subsequent activities of flushing, lowering of reinforcement cage, lowering of tremie, pre-concrete, flushing & upto concreting of full pile length, no halt whatsoever in the execution of work shall be permitted.

1.02.05.07 Boring for any pile shall not be carried out within a clear distance of four times of pile diameter from the adjacent pile, which has been freshly concreted within past 24 hours.

1.02.05.08 Concreting of Pile shall continue until the pile is fully formed upto a level of not less than 500 mm above cut off level of piles. Extraction of casing wherever used shall be done in

such a way that no necking or shearing of the concrete in the shaft takes place. Pile length above cut off level shall not be measured for payment and shall be trimmed off free of cost.

Trimming of pile top shall not be permitted before 7 days of concreting in case of mechanical chipping & 3 days in case of manual chipping.

1.02.06 Founding Strata/Length of Piles

All the piles shall be skin friction piles of length of at least 13.5m as per the soil investigation report recommendations for capacity of 91 MT for 600mm dia. Piles. SPT (standard penetration test) shall be carried out at founding level for at least one pile at every 10m distance subject to minimum of one test for every 25 piles or part thereof within a pile cap.

1.02.07 Pile Load Test

1.02.07.01 Maximum load in case of routine tests shall be limited to 1.5 times of the corresponding safe design load.

1.02.07.02 For all types of Routine load tests the testing arrangement, procedure & interpretation shall follow relevant criteria set out in IS: 2911 (part 4)- 1985 along with the following stipulations:

i) Load test shall be carried out after 28 days from the date of casting unless otherwise directed.

ii) Test load shall be applied at cut-off level, if the test level is below the ground water table. Suitable arrangement for dewatering shall be made.

iii) Loading shall be applied by reaction method consisting of a hydraulic jack placed centrally against a suitable loaded platform / anchorage system. Reaction system shall be well designed & capable of taking 1.25 times of the maximum load to be applied.

iv) Test load shall be applied to pile in a static manner. Stage loading shall be applied in equal increments of 20% of estimated safe design load. Unloading may be done in higher decrements with at least 5 stages. For Cyclic load test, each stage of loading shall correspond to unloading upto zero load. At each stage of loading & unloading, deflection of pile top shall be recorded accurate to 0.02 mm at an interval of 1, 2, 4, 8, 15, 30, 60, 120 minutes upto a time when the deflection rate reduces to 0.1 mm in 30 minutes or 0.2 mm in one hour or till two hours whichever occurs earlier.

v) Increments of loads shall be continued upto maximum load of 1.5 times of safe design load for Routine test or failure (soil –pile yielding or structural failure) whichever occurs earlier.

vi) Where failure does not occur, the final test load shall be maintained for 24 hours and deflection records shall be taken at every 6 hours interval, including initial 2 hours detailed records, as mentioned earlier.

vii) Assessment of safe load for different types of test shall follow relevant clauses of IS: 2911 (part 4) – 1985.

viii) After completion of load test, the following records/ reports shall be furnished:

a) Tabular & Graphical representation of Load vs. Settlement during loading and unloading.

b) Tabular & Graphical representation of the Time vs. Settlement for each load.

c) Graphical analysis of initial cyclic load test results to separate skin friction & end-bearing as per Annexure .IS 2911 (part 4)

d) Remarks concerning any unusual occurrence (if any) during boring installation or testing or piles.

1.02.08 Standard of Acceptance

The piles shall be accepted as satisfactory only when the work has been executed in accordance with this specification. IS Codes and the standards stated hereinafter and instructions given by purchaser at site from time to time:

a) The total volume of concrete shall not be less than actual shaft volume and not more than 40% of the calculated volume, the calculated volume for this purpose shall be the cross sectional area inside the bore multiplied by the length of the shaft. The concrete shall show the specified strength as indicated by the cube test results.

b) The toe of pile shall be at approved bearing level in each case.

c) Tolerances specified below shall be satisfied:

Casting tolerances for three conditions of placing concrete in pile bore holes with and without casing:

The ground surface or the piling platform level is defined as commencing surface.

The three conditions refer to a situation where the cut-off level is at a depth of H m below the commencing surface such that the H is from 0.15 to any depth for condition (a) and below or between 0.15 and 10 m for (b) & (c).

The conditions are as follows:

i) Concrete placed in dry bore holes using permanent casing or cut-off level in stable ground below base of casing: the casting tolerance in meters is specified to be 0.3 + H/10.
ii) Concrete placed in dry bore holes using temporary casing other than as (a) above: the casting tolerance in meters is specified to be 0.3 + H/12 + C/8, where C is the length of temporary casing below commencing surface.
iii) Concrete placed under water or a drilling fluid: the casting tolerance in meters is specified to be 1.0 + H/12 + C/8, where C is the length of temporary casing below commencing surface .

If an individual pile fails to meet the requirements specified in any of above clause/s, such pile shall be deemed to be defective. When any pile is found defective, one or more pile shall be installed as a replacement of defective pile as necessary.

1.02.09 Record

A record for each pile indicating the following data shall be maintained.

a) The date and time of commencement and completion of the piling operation.
b) The particulars of the equipment and method of boring and concreting.

c) The location and type of pile, pile number, with a reference to approved drawings.

d) The diameter of the pile and verticality.

e) Bored depth, concreted depth, empty boring and nature of stratum at founding level.

f) The volume of concrete poured, quantity of cement, w/o ratio used and slump of poured concrete.

g) Details of reinforcement provided.

h) The sequence of installation of pile groups.

i) During boring operation, a separate record for rate of advancement of borehole in terms of effective time vs. boring depth shall be maintained for each pile. The effective time implies the time required exclusively for boring operation barring the time for other activities such as temporary stoppage, cleaning of hole, in – situ tests, if taken etc.