



## Bharat Heavy Electricals Limited

(A Government of India Undertaking)

Power Sector – Eastern Region

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### **TENDER CHANGE NOTE 01 (TCN – 01) DT: 04-12-2006**

WITH REFERENCE TO THE NIT, PUBLISHED IN THE WEB SITES FOR THE WORK OF INSTALLATION OF CAST-IN-SITU DRIVEN & BORED RCC PILE, TESTING, CIVIL FOUNDATION WORKS AREA GRADING IN COMPLIANCE WITH STORM WATER DRAINAGE SYSTEM INCLUDING DISMANTLING OF EXISTING STAIRS/ STEEL STRUCTURES ETC AND OTHER MISCELLANEOUS CIVIL WORK FOR 1X250 MW UNIT #3 AT CESC-BUDGE BUDGE PROJECT AGAINST TENDER DOCUMENT NO PSER:SCT:BDG-C 707:06, FOLLOWING CHANGES MAY PLEASE BE NOTED AND COMPLIED.

01. Clarification on pre-bid discussion. (FILE 1)
02. Revised **BOQ cum schedule of rates-Rev.01** (FILE 2)
03. Revised Technical requirements of **BORED CAST-IN-SITU RCC PILES-SECTION-D21** (FILE 3). This supercedes earlier specification PART-III PILING – SPECIFIC REQUIREMENTS of VOL-II.
04. Revised Technical specification of **CONSTRUCTION AND INSTALLATION OF DRIVEN CAST-IN-SITU PILES- PILING-PART VI** (FILE 4). This supercedes earlier specification CONSTRUCTION AND INSTALLATION OF DRIVEN CAST-IN-SITU PILES- PILING-PART VI of VOL-II.
05. Introduction of Technical Specification for **PILING PART-V - TESTING OF CONCRETE PILES BY CONVENTIONAL LOADING SYSTEM.** (FILE 5)
06. **Layout showing Location of Bore holes** of CESC Budge Budge generating Station (File 6).
07. Introduction of Lab Test Reports

- **BIDDERS ARE REQUESTED TO NOTE THAT THE REVISED BOQ CUM RATE SCHEDULE (REV-01) SUPERSEDES ORIGINAL BOQ. BIDDERS SHALL SUBMIT THEIR OFFER ONLY AS PER REVISED BOQ (REV-01). OFFER FROM BIDDER IN SUPERSEDED BOQ WILL NOT BE CONSIDERED.**
- **BIDDERS ARE REQUIRED TO SUBMIT A DECLARATION IN TECHNO-COMMERCIAL OFFER THAT THEY HAVE SUBMITTED THEIR PRICE BID IN SEALED ENVELOP AS PER REVISED BOQ (REV.-01) ONLY.**

**BIDDERS ARE REQUESTED TO SUBMIT OFFER BY THE DUE DATE OF SUBMISSION OF OFFER i.e. 13-12-06.**

**ALL OTHER TERMS & CONDITIONS OF THE TENDER REMAIN UNCHANGED.**

SR MANAGER (SCT)

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**Regd. Office : BHEL House, Siri Fort, New Delhi- 110049**

**CLARIFICATIONS OF PRE-BID DISCUSSION ON 29/11/2006 AT PSER ,HQ, KOLKATA FOR THE WORK OF Installation of cast-in-situ driven & bored RCC pile, testing, Civil foundation works area grading in compliance with storm water drainage system including dismantling of existing stairs/ steel structures etc and other miscellaneous civil work for 1x250 MW unit # 3 at CESC-Budge Budge Project.**

**(TENDER NO - PSER:SCT:BDG-C 707:06)**

SI no	Description/ tender clause no	Tender clause / Clarifications asked by bidder	Clarifications by BHEL
<b>A. NIT</b>			
A.1	PRE-QUALIFICATION CRITERIA (SL. NO. 8)	DRIVEN PILING RIG (METCO) WITH 450 DIA & 550 DIA TUBE – 5 Nos.	Shall be read as : DRIVEN PILING RIG (METCO or Equivalent) WITH 450 DIA & 550 DIA TUBE – 5 Nos.
<b>B. BOQ- ( VOL-III )</b>			
B.1	St Nos. 101, 103, 105	Sheet piling if required, please specify a separate BOQ Item	Bidders to quote as per BOQ & Tender Specification
B.2	St. Nos. 1801	Please specify thickness of PVC Water Stop	Refer BOQ & Rate Schedule (Rev-01) attached
B.3	St. Nos. 2501(A), 2501 (B)	Please clarify whether design part included in these items	Refer BOQ & Rate Schedule (Rev-01) attached
B.4	St. Nos. 2505 a (i), 2505 b (i)	Please clarify dia of pile 600 mm. or 550 mm.	Refer BOQ & Rate Schedule (Rev-01) attached
B.5	St. Nos. 2506	Please specify testing to be carried out only 550 mm / 450 mm dia or both	Refer BOQ & Rate Schedule (Rev-01) attached
B.6	St. Nos. 2507(a)	Please specify testing to be carried out only bored piles	Refer BOQ & Rate Schedule (Rev-01) attached
B.7	St. Nos. 2507 (b)	Please specify testing to be carried out only bored piles	Refer BOQ & Rate Schedule (Rev-01) attached
B.8	St. Nos. 2401(A)	Unit not specified	Refer BOQ & Rate Schedule (Rev-01) attached
B.9	St. Nos. 2401(B)	Unit not specified	Refer BOQ & Rate Schedule (Rev-01) attached
B.10	St. Nos. 2409	In Description Column “----- BHEL will provide one 20 T capacity crane -----“	Refer BOQ & Rate Schedule (Rev-01) attached

**BOQ CUM RATE SCHEDULE FOR PILING CIVIL FOUNDATION WORKS FOR 1 X 250 MW BUDGE BUDGE EXTENSION UNIT - 3 (CESC)**

SL. NO.	ST. NO	DESCRIPTION PILE, PILE CAPS AND OTHER MISC. CIVIL WORKS	UNIT	QUANTITY TOTAL	RATE		AMOUNT IN RS.
					In Figures	In Words	
	<b>100</b>	EARTH WORK IN EXCAVATION, BACKFILLING AND DISPOSAL AS PER SPECIFICATION, DRAWINGS AND AS DIRECTED BY ENGINEER FOR THE FOLLOWING:-					
1	101	Earth work in excavation upto 2m depth below ground level for foundation, trenches, pipe lines, storm water drains etc including setting out, clearing & grubbing, removal of debris, dewatering if required, strutting, shoring/sheet piling if required, dressing the sides, levelling to grade and ramming the bottom, stacking/disposal of surplus excavated material within a lead of 1.0 KM etc complete for all types of soils including ash, laterite, morrum, weathered rock, decomposed rock, etc which can be excavated by means of crow bar, pick axe, etc and does not require chiselling or blasting.	<b>CUM</b>	33,300			
2	103	Earth work in excavation for depth exceeding 2.0m but not exceeding 4.0m below ground level for foundation, trenches, pipe lines, storm water drains etc including dewatering if required, strutting, shoring/sheet piling if required, dressing the sides, levelling to grade and ramming the bottom, stacking/disposal of surplus excavated material within a lead of 1.0 KM etc complete for all types of soils including ash, laterite, morrum , weathered rock, decomposed rock, soft rock etc which can be excavated by means of crow bar, pick axe, etc but does not require chiselling or blasting.	<b>CUM</b>	27,700			
3	105	Earth work in excavation for depth exceeding 4.0m but not exceeding 6.0m below ground level for foundation, trenches, pipe lines, storm water drains etc including dewatering if required, strutting, shoring/sheet piling if required, dressing the sides, levelling to grade and ramming the bottom, stacking/disposal of surplus excavated material within a lead of 1.0 KM etc complete for all types of soils including ash, laterite, morrum , weathered rock, decomposed rock, soft rock etc which can be excavated by means of crow bar, pick axe, etc but does not require chiselling or blasting.	<b>CUM</b>	1,500			
4	116	Disposal of surplus excavated earth/rock beyond an initial lead of 1km and upto a lead of 2 Km. dumping and levelling the dumped soil and levelling the area from where the material is transported, complete with all lifts as specified and directed by Engineer.	<b>CUM</b>	30,165			
5	116A	Disposal of surplus excavated earth/rock beyond an initial lead of 1km and upto a lead of 3 Km. dumping and levelling the dumped soil and levelling the area from where the material is transported, complete with all lifts as specified and directed by Engineer.	<b>CUM</b>	26,000			

**BOQ CUM RATE SCHEDULE FOR PILING CIVIL FOUNDATION WORKS FOR 1 X 250 MW BUDGE BUDGE EXTENSION UNIT - 3 (CESC)**

SL. NO.	ST. NO	DESCRIPTION PILE, PILE CAPS AND OTHER MISC. CIVIL WORKS	UNIT	QUANTITY TOTAL	RATE		AMOUNT IN RS.
					In Figures	In Words	
6	118	Back filling around foundations in plinths etc.to proper grade and level with selected materials within a lead beyond 1 Km but not exceeding 5 Kms.from available excavated soil including re-excavating loose thickness, watering and ramming in layers of 25 cm. thickness to 90% Standard Procter denisty by manual / mechanical means, compaction with mechanised compaction machine, dressing etc. complete including transportation.	CUM	45,500			
7	118b	Back filling around foundations in plinths, trenches, drains etc.to proper grade and level with selected good soil free from shingle, salts, organic materials, roots, sod or any other foreign substance including re-excavating loose thickness, watering and ramming in layers of 20 cm. thickness compacted to 75% of relative density for non cohesive soil by manual/ mechanical means, dressing etc. complete as directed by the engineer in charge including cost of material for all leads, loading, unloading, royalty and transportation. (payment for solid measure of the consolidated filling)	CUM	5,000			
8	119	Supply and filling sand (silver sand) under floors, in foundation and plinths including cost of sand, transporting for all leads, loading, unloading, spreading in layers in 25 cm loose thickness at all depths, watering, compaction with mechanised compaction machine or manually to minimum 80% of relative density, dressing and levelling etc complete.	CUM	220			
9	120	Providing and laying soling with brick jhama of sizes of 50mm to 100mm, at all position and depths below or above finished ground floor level, below foundations, below flooring,below erection common roads, providing hard standing, and hard surfacing, etc in one or more layers each of approximately 75mm thickness, hand packing, filling in interstices with quarry spalls and providing a layer of moorum/sand over layer of soling to make the surface even including watering, thoroughly compacting each layer with 10 tonne power roller with minimum 6 passes (or with vibrating plate of approved capacity at places not approachable by power roller) all as per the direction of the Engineer and as per specification.	CUM	5,450			

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SL. NO.	ST. NO	DESCRIPTION PILE, PILE CAPS AND OTHER MISC. CIVIL WORKS	UNIT	QUANTITY TOTAL	RATE		AMOUNT IN RS.
					In Figures	In Words	
	<b>200</b>	PROVIDING AND PLACING CONCRETE WORK INCLUDING COST OF LABOUR, MATERIALS AND EQUIPMENT FOR HANDLING, TRANSPORTATION, BATCHING, MIXING, PLACING, VIBRATING AND CURING, (EXCLUDING COST OF CENTERING, SHUTTERING AND REINFORCEMENT) COMPLETE AT ALL ELEVATIONS AS PER DRAWING, SPECIFICATIONS UNLESS SPECIFIED OTHERWISE AND AS DIRECTED BY ENGINEER FOR THE FOLLOWING: (CEMENT FOR THIS PUPOSE SHALL BE ISSUED BY BHEL AS PER SCC.					
10	201	Plain Cement Concrete of 1:4:8 for laying below below foundation, trench, drain etc as levelling course, all complete.	<b>CUM</b>	165			
11	202	Plain Cement Concrete of grade M10 as levelling course, under water retaining structures, equipment foundations, under foundations/floors etc all complete.	<b>CUM</b>	750			
12	204	Concrete of grade M-30 conforming to IS:456 with coarse sand and graded hard stone aggregate 20mm nominal size for all major equipment foundations at all heights/depths from finished ground floor level including addition of suitable plasticizer/ superplasticizer conforming to IS:9103 (latest) to achieve required slump in concrete all complete.	<b>CUM</b>	500			
13	205	Concrete of grade M-25 conforming to IS:456 with coarse sand and graded hard stone aggregate 20mm nominal size in foundations, under floors etc at any level below finished floor level, any shape, position or thickness etc complete including use of plasticizer/ superplasticizer conforming to IS:9103 (latest) to achieve required slump in concrete all complete.	<b>CUM</b>	10,520			
14	207	Concrete of grade M-25 conforming to IS:456 with coarse sand and graded hard stone aggregate 20mm nominal size in superstructure at all heights from finished floor level at any level, shape, position or thickness complete including use of plasticizer/ superplasticizer conforming to IS:9103 (latest) to achieve required slump in concrete all complete.	<b>CUM</b>	200			
15	207A	Concrete of grade M-20 conforming to IS:456 with coarse sand and graded hard stone aggregate 20mm nominal size in superstructure at all heights from finished floor level at any level, shape, position or thickness complete including use of plasticizer/ superplasticizer conforming to IS:9103 (latest) to achieve required slump in concrete all complete.	<b>CUM</b>	20			

**BOQ CUM RATE SCHEDULE FOR PILING CIVIL FOUNDATION WORKS FOR 1 X 250 MW BUDGE BUDGE EXTENSION UNIT - 3 (CESC)**

SL. NO.	ST. NO	DESCRIPTION PILE, PILE CAPS AND OTHER MISC. CIVIL WORKS	UNIT	QUANTITY TOTAL	RATE		AMOUNT IN RS.
					In Figures	In Words	
16	211	Concrete of grade M-25 conforming to IS:456 with coarse sand and graded hard stone aggregate 20mm nominal size in precast works like trench covers, Rcc sleepers etc including formwork/moulds for thicknesses varying from 50mm to 250mm etc. all complete excluding the cost of reinforcement as directed by BHEL .	CUM	80			
17	212	Concrete of Grade M-20 conforming to IS:456 with coarse sand and graded hard stone aggregate 20mm nominal size in foundation,grade slab, etc complete.	CUM	20			
18		<b>DELETED</b>					
19	215	Breaking existing concrete work at any level including cutting reinforcements, removing the rubbish within a lead of 1Km., including making good the broken edges/surface with cement mortar, painting, finishing to match with existing finishing, scaffolding/supporting at any level, all complete and as directed by Engineer.	CUM	15			
	<b>300</b>	SUPPLYING, FIXING AND REMOVING FORMWORK AT ANY ELEVATION INCLUDING ALL LABOUR, MATERIAL, SCAFFOLDING COMPLETE INCLUDING POCKETS ETC. AS PER SPECIFICATIONS AND AS DIRECTED BY ENGINEER FOR THE FOLLOWING:					
20	301	Ordinary form work below finished ground floor level for foundations, footings, bases of columns, walls, columns pilasters, beams, mass concrete, trenches etc.	SQM	15,200			
21	302	Fairface form work below finished ground floor level for foundations, footings, base of columns, walls, columns, pilasters, beams, mass concrete, trenches etc for exposed concrete works.	SQM	6,500			
22	303	Ordinary form work above finished ground floor level for columns, beams, suspended floors, roofs, lintels, cantilevers, staircases, landings, balconies, domes, arches etc for all heights.	SQM	200			
23	304	Fairface form work above finished ground floor level for columns, beams, suspended floors, roofs, lintels, cantilevers, staircases, landings, balconies, domes, arches etc for all heights.	SQM	550			
24	307	Formwork in Pockets for foundation bolts, embedments, etc all complete.	SQM	100			
	<b>400</b>	REINFORCEMENTS (Reinforcement rod will be supplied by BHEL as per SCC)					

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SL. NO.	ST. NO	DESCRIPTION PILE, PILE CAPS AND OTHER MISC. CIVIL WORKS	UNIT	QUANTITY TOTAL	RATE		AMOUNT IN RS.
					In Figures	In Words	
25	401	Providing, straightening, cutting, bending, placing in position at any level, binding in position of mild steel reinforcements confirming to grade-1 of IS:432 (part-I) including cost of binding wire, labour, transportation to & from stores etc complete all as per specifications, drawings and as directed by Engineer.	MT	5			
26	402	Providing, straightening, cutting, bending, placing in position at any level, binding in position of tor steel reinforcements confirming of grade Fe-415 confirming to IS:1786 including cost of binding wire, labour, transportation to & from stores etc complete all as per specifications, drawings and as directed by Engineer.	MT	1,142			
27	508	Screed concrete 1:2:4 conforming to IS 456 with coarse sand and graded hard stone aggregate 12.5mm/6 mm nominal size for drain to maintain the required slope etc.complete.	CUM	47			
	<b>600</b>	SUPPLYING & INSTALLATION OF PREMOULDED JOINT FILLER IN BETWEEN EQUIPMENT FOUNDATIONS, MAT FOUNDATIONS, PILE CAPS, WALLS, BASEMENT SLABS ETC. COMPLETE INCLUDING LABOUR, EQUIPMENT AND MATERIALS, SEALING OF JOINTS INCLUDING COST OF SEALING COMPOUND (POLYSULFIDE BASE SEALANT AS PER IS:12118) ETC. COMPLETE AS PER SPECIFICATIONS AND DRAWINGS OR AS DIRECTED BY ENGINEER FOR THE FOLLOWING:					
28	601	12mm thick joints.	SQM	5			
29	602	20mm thick joints.	SQM	5			
30	603	25mm thick joints.	SQM	5			
	<b>700</b>	M.S. EMBEDMENTS					
31	701	Receiving, loading, unloading, storing, welding, tacking, and fixing of embedments, MS inserts, bolts, pipe sleeves, guide rails, angle pieces, rungs of various diameters, plates of dimensions as required including cost of all labour, and equipment, transportation, handling, welding, cutting, drilling, scaffolding and setting complete as per specifications, drawings and as directed by Engineer (BHEL will supply embedment parts).	MT	15			

**BOQ CUM RATE SCHEDULE FOR PILING CIVIL FOUNDATION WORKS FOR 1 X 250 MW BUDGE BUDGE EXTENSION UNIT - 3 (CESC)**

SL. NO.	ST. NO	DESCRIPTION PILE, PILE CAPS AND OTHER MISC. CIVIL WORKS	UNIT	QUANTITY TOTAL	RATE		AMOUNT IN RS.
					In Figures	In Words	
32	701A	Supply, fabricating and fixing of embedments, MS inserts, pipes, sleeves, flats, guide rails, angle/beams pieces, rungs of various diameters, plates of dimensions as required including cost of all labour, materials and equipment, transportation, loading, unloading, handling, welding, cutting, drilling, scaffolding and setting complete as per specifications, drawings and as directed by Engineer (all steel to be supplied by contractor).	MT	1			
33	702	Supply, fabrication, transportation, delivery at site and erection, installation and alignment of MS Foundation bolts ( Grade- 1 of IS: 432 & IS: 2062) assembly in concrete along with nuts, locknuts ( IS: 1363, IS: 1364 & IS: 3138), washers, anchor plates, stiffener plates, protective tapes etc. upto & inclusive of 63mm diameter and upto 3000mm long, for columns including pipe sleeves, templates wherever necessary etc. all complete as per specifications and directed by the Engineer.(all steel to be supplied by contractor).	MT	18			
	<b>1000</b>	BRICKWORK MASONRY INCLUDING SUPPLY OF MATERIAL, COST OF LABOUR, SCAFFOLDING ETC. COMPLETE AS PER SPECIFICATIONS, DRAWING AND AS DIRECTED BY ENGINEER FOR THE FOLLOWING:- (CEMENT FOR THIS PURPOSE SHALL BE SUPPLIED BY BHEL AS PER SCC)					
34	1001	Providing brick work in cement mortar 1:6 (1 part cement: 6 parts coarse sand) in walls, chambers etc. of <b>254mm</b> & above in thickness at all depths, places and positions <b>below plinth</b> including raking out joints, curing, scaffolding etc. all complete excluding plastering and painting, using bricks of class designation 7.5 or best locally available quality of nominal dimensions as per specification.	CUM	147			
35	1002	Providing <b>254mm thick</b> brick work in cement mortar 1:6 (1cement : 4 coarse sand) in walls, chambers etc. at all heights, places and position <b>above plinth</b> including raking out joints, curing, scaffolding, etc complete but excluding plastering and painting, using bricks of class designation 7.5 or best locally available quality of nominal dimensions as per specification.	CUM	25			

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SL. NO.	ST. NO	DESCRIPTION PILE, PILE CAPS AND OTHER MISC. CIVIL WORKS	UNIT	QUANTITY TOTAL	RATE		AMOUNT IN RS.
					In Figures	In Words	
36	1003A	Providing <b>127mm thick</b> brick work in cement mortar 1:6 (1 cement : 6 coarse sand) <b>for drain, road kerb , trench</b> , drain pit/ chambers etc. at all places <b>below plinth</b> level including raking out joints, curing, etc. all complete using <b>second class</b> bricks of nominal dimensions excluding plastering as per specification.	<b>SQM</b>	5,720			
37	1003B	Providing <b>127mm thick</b> brick work in cement mortar 1:6 (1 cement : 6 coarse sand) in partition walls, chambers etc. at all heights, places and position <b>above plinth/graded level</b> including raking out joints, curing, scaffolding etc. all complete using <b>second class</b> bricks of nominal dimensions excluding plastering as per specification.	<b>SQM</b>	50			
38	1007	Dismantling existing brick work at all level including stacking and removing the debris within a lead of 1Km., including transportation, loading, unloading, etc all complete and as directed by Engineer.	<b>CUM</b>	10			
39	1008	DELETED					
	<b>1200</b>	<b>CEMENT MORTAR PLASTER INCLUDING MAKING GROOVES WHEREVER REQUIRED, ALL MATERIALS, SCAFFOLDING, CURING ETC. COMPLETE AS PER SPECIFICATION, DRAWING AND AS DIRECTED BY ENGINEER FOR THE FOLLOWING:- (CEMENT FOR THIS PURPOSE SHALL BE PROVIDED BY BHEL AS PER SCC)</b>					
40	1202	Providing 12mm thick plaster inside/outside of the building/boundary wall in cement mortar 1:6 at all height, smooth finish as per specification.	<b>SQM</b>	100			
41	1204A	Providing 12 mm thick neat plaster in drains/culverts/manhole etc. as per specification.	<b>SQM</b>	200			
42	1302	Two or more coats of water proofing cement paint of approved brand and manufacture & of required shade to give an even shade on walls complete.	<b>SQM</b>	100			
	<b>1800</b>	<b>MISCELLANEOUS</b>					
43	1801	Providing and fixing PVC water stops (6.0 MM THICK) - 225mm wide	<b>RM</b>	40			
44	1801A	Providing and fixing PVC water stops (8.0 MM THICK) - 225mm wide	<b>RM</b>	10			
45	1811	Laying of earthing mats/rods including transportation from yard stores, loading, unloading, cutting to length, welding etc complete as per specification and as directed by Engineer.	<b>MT</b>	16			
	<b>2000</b>	<b>FENCING AND GATES.</b>					

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					In Figures	In Words	
46	2001A	Providing and fixing Barbed wire (6- horizontal layers and cross diagonals) fencing (9.38 Kg / 100 mtrs) fixed with GI staples etc, with structural MS angle (50mmx50mmx6mm) posts, 1200 mm high @ 1500 mm c/c, above ground level, embeded in concrete(1:2:4) foundation 250x250x500mm deep inside earth, including GI clips, two coats of Bitumenous anti corrosive paint etc complete as per specification, drawing and as directed by the Engineer.	<b>SQM</b>	1,500			
47	2002	Providing M.S gates 1500 x1200 size (made of MS angle 50x50x6 mm frame work with 12 mm dia rod @ 200 mm c/c vertical & horizontal, securely welded with the frame, with m s sliding door bolt 300mm long, incuding fixing welding, as per sketch /drawing with two coat of anticorrosive bitumenous paintng etc complete.	<b>MT</b>	8			
	<b>2100</b>	<b>WATER SUPPLY</b>					
48	2106A	Providing and fixing GI pipes (zindal or equivalent quality) complete with GI sockets, unions, elbows, tees, nipples etc and clamps including cutting and making good the walls or below ground etc complete - 15 mm dia light quality. (Pipe line Payment will be made on the centre line measurements of total pipe line including specials. No separate payment will be made for accesories, specials. Payment for excavation and backfilling will be paid separately as per respective items.).	<b>RM</b>	20			
49	2106	Providing and fixing GI pipes (zindal or equivalent quality) complete with GI sockets, unions, elbows, tees, nipples etc and clamps including cutting and making good the walls or below ground etc complete - 20 mm dia light quality. (Pipe line Payment will be made on the centre line measurements of total pipe line including specials. No separate payment will be made for accesories, specials. Payment for excavation and backfilling will be paid separately as per respective items.).	<b>RM</b>	30			
50	2107	Providing and fixing GI pipes (zindal or equivalent quality) complete with GI sockets, unions, elbows, tees, nipples etc and clamps including cutting and making good the walls or below ground etc complete - 25 mm dia light quality. (Pipe line Payment will be made on the centre line measurements of total pipe line including specials. No separate payment will be made for accesories, specials. Payment for excavation and backfilling will be paid separately as per respective items.).	<b>RM</b>	50			

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					In Figures	In Words	
50	2117	Providing & fixing P.V.C. water tank of 2000 litres capacity (Syntex or approved equivalent make) in position. The work to include making all necessary inlet & outlet pipes, fixture, ball cocks, valves etc all complete as per specification and at all heights and levels.	NO.	4			
	<b>2200</b>	<b>SANITARY WORKS</b>					
51	2201	Supply and fixing white vitreous china Wash Basin size 550x450 with R.S. or C.I. brackets painted white, 15mm chromium plated brass pillar cock, 32mm dia pvc waste pipe, 32mm dia chromium plated brass trap unions, cutting and making good the walls where required etc complete as per specifications	NO.	1			
52	2209	Providing, laying below ground level light duty non pressure NP3 class RCC pipes with collars jointed with cement mortar 1:4 etc complete - 300mm dia as per direction of BHEL.(Payment for excavation and backfilling will be paid separately as per respective items).	RM	25			
53	2210	Providing, laying below ground level light duty non pressure NP3 class RCC pipes with collars jointed with cement mortar 1:4 etc complete - 450mm dia as per direction of BHEL.(Payment for excavation and backfilling will be paid separately as per respective items).	RM	25			
	<b>2400</b>	<b>ERECTION ROADS</b>					
54	2401	Preparation of sub grade by AVERAGE 300 MM DEPTH OF excavating all types of soil, dressing to camber including Consolidation with power road roller of 8 to 12 tonne capacity minimum 8 passes, and disposal of surplus earth within plant boundary all complete as per specification.	CUM.	5,700			
55	2401A	Providing and transporting of cinder/ash from existing plant of Budgebudge power generating to fabrication area/equipment storage area or main plant area etc by means of mechanically / manually upto a lead of 500 Mtr including spraeding, dressing, consolidation and maintaining level as per BHEL sketc / drawings as per requirement.	CUM.	2,850			
56	2401B	Consolidation of sub grade with power road roller of 8 to 12 tonne capacity minimum 8 passes including rerolling etc complete.	SQM	19,000			
57	2402	Supplying and filling with river sand in compacted layers of 2x75mm including watering, consolidation to required camber including transportation, royalties complete.	CUM.	5,250			

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					In Figures	In Words	
58	2405	Providing & Laying water bound macadam base / sub base course in layers of required thickness with stone aggregate 63mm to 40mm size, stone screening and blinding material including screening sorting, spreading to template and consolidation with road roller including carriage, spreading and consolidation of blinding material morrum etc Including cost of material labour etc. all complete as per specification.	CUM.	600			
59	2406	Carefully dismantling of existing fencing (made of wooden / balli post, CGI sheeting and low height brick wall), shifting and re-erection of fencing using same wooden post, CGI sheet with new low height brick wall with GI J-hooks & nuts etc complete as per direction of BHEL.(Payment for excavation, backfilling, brickwork,plastering will be made separately as per respective items).	SQM	250			
60	2407	Earth work in excavation upto minimum depth of 0.3m below natural ground level for levelling and grading including dressing to specified levels & grades and ramming of graded surface including removal of vegetation, bushes, trees of girth measuring below 30 cms (measured at a height of 1.5 mtr above ground level), grass, etc, for all types of soils,ash including morrum etc. complete by dozing/mechanical means as per specification, drawing and as directed by the Engineer. Surplus earth, debris, vegetation, bushes, trees, etc unsuitable for filling shall be transported to areas within a lead of 1.5 KM lead.	SQM	44,000			
61	2408	Cutting and felling trees of the girth measuring 30 cms and above (measured at a height of 1.5 mtr above ground level), including cutting of trunks and branches, removing the roots and disposal of same within a lead of 500 Mtr.	Nos	150			
62	2409	Dismantling of steel structure at any elevation, lowering of material and carriage of the dismantled material up to a lead of one KM including cutting, including scaffolding, staging, tools & tackles, gas cutting, etc complete as per instructions of the Engineer.(BHEL will provide one 40T (OR ABOVE) capacity crane for ten days only based on advance intimation by the contractor for existing stair case dismantling only).	MT	150			

**BOQ CUM RATE SCHEDULE FOR PILING CIVIL FOUNDATION WORKS FOR 1 X 250 MW BUDGE BUDGE EXTENSION UNIT - 3 (CESC)**

SL. NO.	ST. NO	DESCRIPTION PILE, PILE CAPS AND OTHER MISC. CIVIL WORKS	UNIT	QUANTITY TOTAL	RATE		AMOUNT IN RS.
					In Figures	In Words	
63	2410	Sprinkling of water by water tanker fitted with perforated GI pipe (portable tanker minimum 3000 litre capacity) for roads and miscellaneous area within plant boundary, for dust suppression and reduction of suspended material at site for day to day work, as directed by BHEL Site Engineer (water for this purpose shall be provided by BHEL free of cost and utilisation of machine will be in terms of Tank hour put in actual use for water sprinkling).	Tank-Hour	1,920			
	<b>2500</b>	<b>PILING WORK</b>					
	2501	<p>Installation of bored <b>RCC cast in situ vertical pile</b> as per IS 2911 (Part 1, Section 2) with diameter and length as specified below (length to be measured from pile cut-off level to the bottom of pile) using cement concrete M25 grade conforming to IS 456 with 20 mm nominal size stone aggregates with cement content of minimum 380 Kg per cum of concrete including all materials except reinforcement, including boring/drilling in all types of strata from ground level to termination depth of pile including providing bentonite slurry and/or casing for stabilization of pile bore, flushing of pile bore, cleaning, providing plasticizer wherever required, breaking pile head to cut off level and exposing pile reinforcement for embedment in pile cap, empty boring if required from ground level to pile cutoff level as per construction procedure etc all complete as per specification, drawings and as directed by the engineer-in-charge.</p> <p>This should include mobilizing all necessary equipments, piling rigs/materials, plant, labour, etc to the site of work, erecting all rigs, equipment and plant and removal of same after completion of work complete with all consumables, etc. <b>This item doesnot include cost of reinforcement, cutting, binding, welding, placement, etc. for which item 2509 will be paid separately.</b></p> <p>Note:-Soil investigation data is being supplied with the specification. Initial load test of pile is being conducted separately at present and it will be provided to bidder at the start of work. Structural design of piles will be done by BHEL. Bidder has to install piles as per BOQ, specification &amp; drawing and ensure the rated capacity of pile and also conduct working pile test as per item below.</p>					
64	a	Pile of 550 mm diameter and 26.5 m length below cut off level(Approx. at EL(-)3.5m below plant FGL), Safe load carrying capacity of pile in axial compression=100MT, in tension=30MT, in lateral=5MT.	Each	200			

**BOQ CUM RATE SCHEDULE FOR PILING CIVIL FOUNDATION WORKS FOR 1 X 250 MW BUDGE BUDGE EXTENSION UNIT - 3 (CESC)**

SL. NO.	ST. NO	DESCRIPTION PILE, PILE CAPS AND OTHER MISC. CIVIL WORKS	UNIT	QUANTITY TOTAL	RATE		AMOUNT IN RS.
					In Figures	In Words	
65	b	Pile of 450 mm diameter and 30 m length below cut off level(Approx. at EL(-)3.5m below plant FGL), Safe load carrying capacity of pile in axial compression=60MT, in tension=18MT, in lateral=3MT.	Each	50			
	2502	Extra over following item for pile length more than the specified length.					
66	a	item no. 2501 a	m	100			
67	b	item no. 2501 b	m	10			
	2503	Rebate on the following item for pile length less than the specified length.					
68	a	item no. 2501 a	m	100			
69	b	item no. 2501 b	m	10			
	2504	<p>Installation and driving standard <b>Driven RCC cast in situ vertical piles</b> as per IS 2911 part 1 section 1 with diameter and length as specified below (length to be measured from pile cut-off level to the bottom of pile) using cement concrete M25 grade conforming to IS 456 with 20 mm nominal size stone aggregates with cement content of minimum 380 Kg per cum of concrete including all materials except reinforcement, including driving the casings in all types of strata from ground level to termination depth of pile including fixing the reinforcement cage in the required alignment, extracting the casings, curing of exposed concrete, providing plasticizer wherever required, breaking pile head to cut off level and exposing pile reinforcement for embedment in pile cap, empty driving if required from ground level to pile cutoff level as per construction procedure etc all complete with all consumables as per specification, drawings and as directed by the engineer-in-charge.</p> <p>This should include mobilizing all necessary equipments, piling rigs/ materials, plant, labour, etc to the site of work, erecting all rigs, equipments, plant and removal of same after the completion of work. <b>This item doesnot include cost of reinforcement, cutting, binding, welding, placement, etc. for which item 2509 will be paid separately.</b></p>					

**BOQ CUM RATE SCHEDULE FOR PILING CIVIL FOUNDATION WORKS FOR 1 X 250 MW BUDGE BUDGE EXTENSION UNIT - 3 (CESC)**

SL. NO.	ST. NO	DESCRIPTION PILE, PILE CAPS AND OTHER MISC. CIVIL WORKS	UNIT	QUANTITY TOTAL	RATE		AMOUNT IN RS.
					In Figures	In Words	
		Note:-Soil investigation data is being supplied with the specification. Initial load test of pile is being conducted separately at present and it will be provided to bidder at the start of work. Structural design of piles will be done by BHEL. Bidder has to install piles as per BOQ, Specification & drawing and ensure the rated capacity of pile and also conduct working pile test as per item below.					
70	a	Pile of 550 mm diameter and 22m length below cut off level(Approx. at EL(-)3.5m below plant FGL), Safe load carrying capacity of pile in axial compression=100MT, in tension=30MT, in lateral=5MT.	Each	1,660			
71	b	Pile of 450 mm diameter and 20m length below cut off level(Approx. at EL(-)3.5m below plant FGL), Safe load carrying capacity of pile in axial compression=60MT, in tension=18MT, in lateral=3MT.	Each	410			
	2505	Extra over following item for pile length more than the specified length.					
72	a	item no. 2504 a		800			
73	b	item no. 2504 b		250			
	2506	Rebate on the following item for pile length less than the specified length.					
74	a	item no. 2504 a		800			
75	b	item no. 2504 b		250			
	2507	Conducting routine load test on job pile in accordance with IS 2911 (Part-4) including necessary excavation, all arrangements of loading, unloading, test equipments, jacks, platforms, kentledge, dial gauges, recording of results, all materials, labour, submission of test report etc but <b>excluding the cost of installation of job pile</b> complete as per specification, drawing and as directed by the engineer-in-charge for the following.					
		<b>for lateral load test:</b>					
76	a	550 mm diameter pile-5 MT safe load capacity	Each	10			

**BOQ CUM RATE SCHEDULE FOR PILING CIVIL FOUNDATION WORKS FOR 1 X 250 MW BUDGE BUDGE EXTENSION UNIT - 3 (CESC)**

SL. NO.	ST. NO	DESCRIPTION PILE, PILE CAPS AND OTHER MISC. CIVIL WORKS	UNIT	QUANTITY TOTAL	RATE		AMOUNT IN RS.
					In Figures	In Words	
77		450 mm diameter pile-3 MT safe load capacity	Each	4			
		<b>for vertical compression test by Cyclic loading:</b>					
78	b	550 mm diameter pile-100 MT safe load capacity	Each	12			
79		450 mm diameter pile-60 MT safe load capacity	Each	8			
		<b>for uplift test:</b>					
80	c	550 mm diameter pile-30 MT safe load capacity	Each	4			
81		450 mm diameter pile-18 MT safe load capacity	Each	2			
82	2508	Carrying out pile integrity test on job pile including all arrangements for test, equipments, materials, labour, submission of test report etc <b>but excluding the cost of installation of job pile</b> complete as per specification and as directed by the engineer-in-charge.	Each	25			
83	2509	Providing, straightening, cutting, bending, welding, lapping, placing in position at any level, binding in position of HYSD steel reinforcements - TMT bars confirming of grade Fe-415 as per IS:1786 including cost of binding wire, labour, transportation etc.	MT	1,100			
84	2510	Carrying out 'Integrity Testing' PULSE ECHO TEST of concrete in the installed pile including necessary excavation, all arrangement for testing, recording of results, all materials, labour etc. complete.	<b>Each</b>	20			
	2511	Carrying out Cross hole test on installed pile including all arrangement for testing, recording of results, all materials, labour etc. complete.					
85		For bore pile 550 dia	<b>Each</b>	30			
86		for bore pile 450 dia	<b>Each</b>	30			

**BOQ CUM RATE SCHEDULE FOR PILING CIVIL FOUNDATION WORKS FOR 1 X 250 MW BUDGE BUDGE EXTENSION UNIT - 3 (CESC)**

SL. NO.	ST. NO	DESCRIPTION PILE, PILE CAPS AND OTHER MISC. CIVIL WORKS	UNIT	QUANTITY TOTAL	RATE		AMOUNT IN RS.
					In Figures	In Words	
87	2512	Conduct High Strain Dynamic Pile Testing on R C bored piles using Pile Driving Analyzer. The equipment shall have ability to record both force and velocity. Both strain and acceleration sensors shall be used to collect data & atleast 2 pairs shall be connected at diametrically opposite sides of the pile. The test and equipment shall conform to ASTM D4945-96 & include CAPWAP analysis. The test shall be conducted by an experienced independent test agency with atleast five years experience.	Each	15			
		<b>TOTAL</b>					
		For item not covered above, quote % above or below the CPWD schedule (DSR-2002)					
88		(i) Rate for complete	%				
89		(ii) Rate for supply only	%				
90		(iii) Rate for item excluding supply of materials	%				



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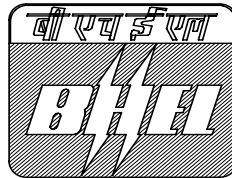
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**BORED CAST-IN-SITU RCC PILES**

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**Bharat Heavy Electricals Limited**

**Project Engineering Management**

**Power Sector, BHEL House**

**Asian Games Village Complex**

**Siri Fort, New Delhi-110049**



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**TECHNICAL SPECIFICATION FOR INSTALLATION OF BORED  
CAST-IN-SITU PILES****1.00.00 SCOPE**

This specification covers the installation of bored cast-in-situ reinforced concrete vertical piles of specified load carrying capacity and diameter for various structures. This specification also covers carrying out initial and routine load tests on piles to assess their vertical, horizontal and pull out load carrying capacities.

**2.00.00 GENERAL REQUIREMENT**

2.01.00 This specification along with specific requirements under Annexure-A covers the technical requirements for piling work.

2.02.00 The work shall include supplying and providing necessary materials, mobilization of all necessary equipments (Annexure-B), providing necessary engineering supervision through qualified and technical personnel, skilled and unskilled labour, etc. as required to carryout the complete piling work, and submission of records as per schedule.

2.03.00 The Contractor shall carryout all works as mentioned in Scope above. All works shall be executed to the satisfaction of the Engineer.

2.04.00 Pile capacities in vertical compression, horizontal, pullout loads for various pile diameters are given in Annexure-A.

2.05.00 The Contractor shall confirm and guarantee the "Safe Load" capacities by conducting both initial and working load test on piles as mentioned in the specific requirements.

2.06.00 The Contractor shall submit along with tender documents his tender design of piles based on soil data furnished by the Owner along with this specification. The ultimate load capacity of a pile may be estimated using suitable static formula and the minimum factor of safety shall be 2.5. However, safe load carrying capacity shall be conformed and guaranteed by conducting initial and routine load tests.

2.07.00 In case of initial or routine load test piles, if the Contractor fails to establish the safe load capacity as per his design, the Owner has the right to either derate the pile capacity on prorata basis or insist the Contractor to modify the pile design, to achieve the desired safe load capacity at no extra cost to the Owner.

2.08.00 Derating is acceptable up to 90 percent. In such case, additional piles shall be installed as per the design requirements.



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- 2.09.00 The Owner shall decide whether to derate or modify the design based on the design considerations such as providing additional piles in the designed pile cap, provision for extending the pile cap size, etc.
- 2.10.00 In case the Owner decides to modify the design instead of derating the pile, the contractor shall carry out the same and install separate test piles and test the same to guarantee the safe load at no extra cost to the Owner. However no extra shall be charged for the additional test piles as well as testing of these piles as per agreed contract conditions.
- 2.11.00 In case of working piles, if the pile does not meet the guaranteed capacity or rejected due to any other reason, the Contractor shall install extra piles at no extra cost to the Owner. Further, the extra cost, due to the increase in the pile cap size if any, on account of extra piles, shall be borne by the Contractor.
- 2.12.00 It is essential that all equipment and instruments are properly calibrated both at commencement and immediately after the completion of tests so that they represent true values. Certificates to this effect from an approved institution shall be furnished to the Engineer. If the Engineer so desires the Contractor shall arrange for having the instruments tested at an approved laboratory at no extra cost to the Owner and the test report shall be submitted to the Engineer. If the Engineer desires to witness such tests Contractor shall arrange to conduct the test in his presence.
- 2.13.00 The Contractor shall make his own arrangements for locating the coordinates and position of piles as per drawings supplied to him and for determining the Reduced Levels (RL) of these locations with respect to the benchmark indicated by the Engineer. 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 to the satisfaction of the Engineer so that the work can be carried out accurately according to specifications and drawings.
- 2.14.00 The contractor shall assure the quality of piling work including cleaning of pile bore, quality of concrete, integrity of piles, etc.
- 2.15.00 **AVAILABLE SUB-SOIL DATA**  
An abstract of the sub soil data is furnished in the tender document. However, the detailed soil investigation report shall be made available for reference of the bidder, if so required, at the office of the Owner. The soil data furnished is in good faith and only for the guidance of the Bidder, to arrive at design parameters and construction methods.

**3.00.00 MATERIALS**



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**3.01.00 General**

All materials viz cement, steel, aggregates, water, etc. which are to be used for pile construction shall conform to relevant IS codes for properties, storage and handling of common building materials. However, aggregates more than 20 mm size shall not be used.

**3.02.00 CONCRETE**

Concrete shall be manufactured either by central batching plant or Ready Mix concrete. However, for initial test piles suitable method as approved by the Engineer may be used. Concrete shall conform to IS: 10262 & IS: 456.

3.02.01 Technical Specification for Cement Concrete (Plain and Reinforced) works along with IS: 2911 Part I/Sec 2 shall be followed for concrete works of piles. Use of plasticiser to control the water cement ratio shall be permitted on specific approval from the Engineer. Water cement ratio shall not be greater than 0.5.

3.02.02 Grade and minimum cement content  
Minimum grade of concrete shall be as per Annexure-A conforming to IS: 456. Minimum cement content of 400 Kg/M<sup>3</sup> of concrete shall be used for M-20 grade concrete.

3.02.03 Slump of concrete  
The slump of concrete shall vary between 150 to 180 mm.

**3.03.00 REINFORCEMENT**

3.03.01 Longitudinal reinforcement in pile shall be high strength deformed steel bars conforming to IS: 1786 unless specified otherwise. Lateral reinforcement in pile shall be of mild steel conforming to IS: 432 Part-1 or HYSD bars as per IS: 1786.

3.03.02 The longitudinal reinforcement 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 nominal pile diameter. Minimum six numbers of bars shall be provided for longitudinal reinforcement. The diameter of longitudinal reinforcement bars shall not be less than 12mm. The stipulated minimum reinforcement shall be provided for the full length of pile.

3.03.03 The longitudinal reinforcement shall project 50 times its diameter above cut off level unless otherwise indicated.

3.03.04 The laterals shall be tied to the longitudinal reinforcement to maintain its shape and spacing. The laterals may in the form of links or spirals. The minimum diameter



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of the links or spirals shall be 6 mm and the spacing of the links or spiral shall not be less than 150 mm and in no case more than 250 mm.

3.03.05 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/pilebore by providing necessary laps as per IS: 456.

3.03.06 The minimum clear distance between the two adjacent main reinforcement bars shall normally be 100 mm for the full depth of cage.

3.03.07 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.

3.03.08 Laps shall be staggered as far as practicable and 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).

3.03.09 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.

3.03.10 Minimum clear cover to the longitudinal reinforcement shall be 50 mm, unless otherwise mentioned.

3.03.11 Bundling of bars is not permitted.

**4.00.00 PILE INSTALLATION**

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

**4.01.00 Equipment and Accessories**

4.01.01 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 Engineer.

4.01.02 List and details of equipment and accessories proposed to be used for the job shall be submitted along with the bid.

4.01.03 The capacity of the rig shall be adequate so as to reach the specified founding level.



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4.01.04 Provision shall be kept for chiselling within the pilebore, as specified elsewhere in this specification. Chiselling shall be carried out only with the approval of Engineer.

**4.02.00 Installation Criteria**

4.02.01 For determining the founding level of piles in soil as specified elsewhere, the Contractor shall have to perform Standard penetration test (SPT) as per IS: 2131 in a separate bore hole. The SPT shall be conducted at 1.0 m interval between the depths covering 5 metres each above and below the specified founding level. The bore shall be 100 mm diameter and method of boring shall conform to IS: 1892.

4.02.02 For determining founding level of piles in rock, as specified elsewhere socketing horizon shall be established by the Contractor by collecting rock cores of NX size in a separate borehole, and testing the same for uniaxial compressive strength (UCS). Cores shall be collected by double tube core barrel attached with diamond bit. Coring shall be done upto a depth as indicated in the "specific requirements." Coring in rock shall conform to IS: 6926.

4.02.03 In case it is not possible to test the cores so obtained for uniaxial compressive strength, cores shall be tested for point load strength index and correlated to obtain uniaxial compressive strength.

4.02.04 Number of boreholes for carrying out SPT in soil or uniaxial compressive strength in rock, shall vary from one in 100 to 150 piles or pile group of 150 Sqm depending on the site condition and as decided by the Engineer. However, at the location of initial load test piles, one such borehole shall be done.

4.02.05 A protocol between contractor and BHEL site shall be maintained regarding the strata at founding level. SPT value and UCS from the nearest borehole shall be indicated therein.

4.02.06 The founding level of the pile shall be decided based on the criteria elaborated in the specific requirements under Annexure-A. Concreting shall not be done until the above conditions for founding level are satisfied.

4.02.07 Approval of founding level by the Engineer shall in no way absolve the Contractor of his responsibility to guarantee the Safe load capacity of the piles as indicated in this document.

**4.03.00 Control of position and alignment**

4.03.01 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.



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- a) The maximum deviation of vertical piles shall not exceed 1.5 per cent in alignment.
- b) Piles shall not deviate more than 75 mm or  $D/4$  whichever is less (75mm or  $D/10$  whichever is more in case of piles having diameter more than 750mm) from their designed position at the working level.

**4.04.00 Boring**

4.04.01 Boring operations shall be done by rotary or percussion type drilling rigs using reverse mud circulation (RMC) method. Rotary hydraulic pulley shall be preferred.

4.04.02 The Contractor shall satisfy himself about the suitability of the method to be adopted for site. If DMC (direct mud circulation) or RMC is used Bentonite slurry shall be pumped through drill rods by means of high-pressure pumps. The cutting tool shall have suitable ports for the bentonite slurry to flow out at high pressure. If on mobilisation, the Contractor fails to make a proper bore for any reason, the Contractor has to switchover to other boring methods as approved by the Engineer at no extra cost to the Owner.

4.04.03 Working level shall be above the cut off level. After the initial boring of about 1.0m a temporary guide casing of suitable length shall be lowered in the pile bore. The diameter of guide casing shall be of such diameter, so as 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 of 1.0m length. Additional length of casing may be used depending on the condition of the strata, ground water level etc.

4.04.04 Use of drilling mud (bentonite slurry) for stabilizing 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.

4.04.05 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 to the boring. The bentonite slurry mixing and recirculation plant shall be suitably designed and installed.

4.04.06 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.

4.04.07 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.



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**4.05.00****Chiselling**

4.05.01

Chiselling may be resorted to with the permission of the Engineer below the socketing horizon. The chiselling tool or bit shall be of adequate size and weight so as to reach the desired depth.

**4.06.00****Cleaning of Pile bore**

4.06.01

On completion of the pile bore upto the required depth, the bottom of the hole shall be cleaned very carefully before concreting work is taken up. Cleaning shall ensure that the pile bore is completely free from sludge/bored materials, debris of rock/boulder etc. Necessary checks shall be made as given in clause 5.0 to confirm the thorough cleaning of the pile bore.

4.06.02

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

4.06.03

Pile bore spoil along with used drilling mud shall be disposed off from site as directed by the Engineer.

4.06.04

Pile bore bottom shall be thoroughly cleaned to make it free from sludge or any foreign matter before and after placing the reinforcement cage.

**4.07.00 Adjacent Structures**

4.07.01

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

**4.08.00****Concreting**

4.08.01

The Contractor shall carry out concrete mix design in accordance with IS: 10262 and submit mix design calculations and get them approved from the Engineer well in advance for installation of piles. Adequate number of tests on cubes, etc. shall be carried out as mentioned in clause 5.0 to ensure concrete of the minimum specified strength in accordance with IS: 456 at requisite workability (slump).

4.08.02

Concreting shall not be done until the Engineer is satisfied that the bearing strata (soil/rock) met with at the termination level of pile.

4.08.03

The time interval between the completion of boring and placing of concrete shall not exceed 6 hrs. In case the time interval exceeds 6 hrs the pilebore shall be abandoned. However, the Engineer may allow concreting provided the Contractor extends the pile bore by 0.5 m beyond the proposed depth, and clean the pilebore. The entire cost of all operation and materials for this extra length shall be borne by the Contractor.



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- 4.08.04 Proper placement of the reinforcement cage to its full length shall be ensured before concreting.
- 4.08.05 Concreting shall be done by tremie method as specified by IS: 2911 (Part I /Sec.2). The level of drilling mud shall be maintained sufficiently above the ground water level.
- 4.08.06 The concreting operations shall not be taken up when the specific gravity of bottom slurry is more than 1.2 and sand content more than 7%. The drilling mud sample shall be collected from the bottom of pilebore as mentioned in clause 5.
- 4.08.07 Consistency of the drilling mud suspension shall be controlled throughout the concreting operations in order to keep the bore stabilized as well as to prevent concrete getting mixed up with the thicker suspension of the mud.
- 4.08.08 It shall be ensured that volume of concrete poured is at least equal to the theoretically computed volume of pile shaft being cast.
- 4.08.09 The temporary guide casing shall be withdrawn cautiously, after concreting is done upto the required level. While withdrawing the casing concrete shall not be disturbed.
- 4.09.00 Cut off level (COL)**
- 4.09.01 Cut off level of piles shall be as indicated in drawings released for construction or as indicated by the Engineer.
- 4.09.02 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 embedment in to pile cap.
- 4.09.03 When the pile cut off level is less than 1.0 metre below the working level, concrete shall be cast 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 a minimum of one metre above COL.
- 4.10.00 Sequence of Piling**
- 4.10.01 Each pile shall be identified with a reference number.
- 4.10.02 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.
- 4.11.00 Building up of Piles**



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4.11.01 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 atleast one grade higher concrete than that used for concreting of the same pile, ensuring proper continuity with the existing concrete and to the satisfaction of the Engineer. 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.

**4.12.00 Breaking off of Piles**

4.12.01 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 without affecting the quality of existing pile such as loosening, cracking etc. and to the satisfaction of the Engineer.

**4.13.00 Preparation of Pile head**

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

4.13.02 The exposed part of concrete above the COL shall be removed/chipped off and made to a uniform level at COL, but not before seven days of casting of pile.

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

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

4.13.05 All loose material, like debris due to chipping/breaking of pile head to the desired level, shall be removed and disposed off as directed by the Engineer.

**4.14.00 Rejection and Replacement of Defective Piles**

4.14.01 The Engineer reserves 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 defective shall be pulled out or left in place as judged convenient by the Engineer, without affecting the performance of adjacent piles. The Contractor shall install additional piles to substitute the defective piles as per the directions of the Engineer, at no extra cost to the Owner.

**4.15.00 Recording of Piling Data**



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4.15.01 The Contractor shall record all the information during installation of piles. Typical data sheet for recording pile data shall be as shown in Appendix D of IS: 2911 Part I/Sec.2. 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 Engineer within two days of completion of concreting of the pile.

**5.00.00 SAMPLING, TESTING AND QUALITY ASSURANCE**

5.01.00 Facilities required for sampling and testing of materials, concrete, etc. in field and in laboratory should 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 and as per the directions of the Engineer. Tests shall be done in the presence of the Engineer or his authorized representative. In case the Engineer requires additional tests, the Contractor shall arrange to get these tests done and submit to the Engineer the test results in triplicate within three days after completion of any test.

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

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

**5.04.00 Quality Assurance Programme**

- a) The Contractor shall submit and finalize a detailed Field Quality Assurance Programme within 30 days from the date of award of the contract, according to the requirements of this specification. This shall include setting up of a testing laboratory, arrangement of testing apparatus/equipment, deployment of qualified/experienced manpower, preparation of field quality plan, etc. On finalized field quality plan, the Owner shall identify, customer hold points, beyond which work shall not proceed without written approval from the Engineer. The testing apparatus/equipment installed in the field laboratory shall be calibrated/ corrected by the qualified persons as frequently as possible to give accurate testing results.
- b) Frequency of sampling and testing, etc. and Acceptance Criteria are given in Table - 1. The testing shall be done at field laboratory or any other laboratory approved by the Engineer. However, the testing frequencies set forth are the desirable minimum and the Engineer 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 appropriate specifications. The materials shall be tested to meet all the specified requirements before acceptance at manufacturers premises or at independent



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government approved laboratory. Tests indicated in the table are for cross checking at site the conformity of the materials to some of the specifications.

**5.05.00 Testing of Concrete**

5.05.01 Concrete and other materials shall be tested for quality, strength and other properties. Details of testing shall be as specified under technical specification for Cement concrete (Plain and Reinforced).

5.05.02 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.

5.05.03 For working piles, minimum one sample consisting of six test cubes shall be made from the concrete for the first ten piles, three to be tested after 7 days and three after 28 days. Thereafter, minimum one sample consisting of three test cubes for every 10 piles shall be tested for the 7-days & 28-days cube strength.

5.05.04 In preparation of test cubes or specimens vibrators shall not be used.

5.05.05 Concrete shall be tested for slump at every 1-hour interval during concreting of piles.

5.05.06 The frequency of sampling and testing of concrete and materials shall be done as per technical specification for cement concrete (Plain & Reinforced).

5.05.07 The acceptance criteria shall be as mentioned in Table-1.

**5.06.00 Testing for position and alignment**

5.06.01 Each pile shall be checked for its position with respect to specified location. Each pile bore shall be checked for its alignment.

5.06.02 Permissible limits for deviation shall be as specified under clause no. 4.03.

**5.07.00 Properties of Drilling mud**

5.07.01 Properties of drilling mud shall be checked as per requirement under Annexure C. Prior to the commencement of piling work and thereafter minimum once in a week or as found necessary by the Engineer, one sample consisting of 3 specimens shall be tested. Acceptance criteria applicable are as specified else where with 5% variation. This relaxation is not applicable for properties of drilling mud before concreting.

5.07.02 Density of the drilling mud shall be checked in each pile before concreting.

**5.08.00 Check for Pile bore**



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

5.08.02 For sampling of drilling mud from the pilebore the following method or any other suitable method shall be adopted.

- a) A solid cone shall be lowered by a string to the bottom of pilebore. A sampler tube closed at top with a central hole (hollow cylinder) is lowered over the cone, and then a top cover shall be lowered over the cylinder. Care shall be taken for proper fittings of assembly to minimize 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.
- b) Use of borehole camera for checking the pile bore spoil and strata is acceptable on approval of the Engineer.

**5.09.00 File Integrity test**

5.09.01 Low strain integrity test shall be conducted on 50% of the jobs piles and on all test piles or as directed by Engineer. The system shall have the computer readout facility and report on the findings of this shall be furnished to the Owner. This test shall be used to identify the job piles for routine load test.

Piles shall be trimmed to cut off level or sound concrete level. No pile cap blindage work should be undertaken prior to this test. The cast in-situ piles should not be tested before 14 days of casting.

5.09.02 The test shall be undertaken by persons trained and experienced and capable of interpreting the results with specific regard to piling. This test is limited to testing the integrity of the shaft and is not intended to replace the use of static load testing.

5.09.03 Low Strain Integrity Test Methodology:

- a) In this test, a low stress wave is set up in the pile shaft and is also known as Sonic Integrity or Sonic Echo test.
- b) A small metal/hard rubber hammer is used to produce a light blow on top of the pile. The shock wave travelling down the length of the pile is reflected back from the toe of the pile and recorded through a suitable transducer/ accelerometer in a computer for subsequent analysis.
- c) The primary shockwave, which travels down the length of the shaft, is reflected from the toe by the change in density between the concrete and sub strata. However, if the pile has any imperfections or discontinuities within



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its length these will set up secondary reflections, which will be added to the return signal.

- d) By analysis of the captured signal and knowledge of the conditions of the ground, age of concrete, etc. a picture of the locations of pile shaft defects can be built up. The observed signals are amplified into digital display as velocity versus length records providing information on structural integrity of piles.
- e) The stress wave velocity and approximate pile lengths are provided as input for the integrity testing. The stress wave velocity is dependent on the Young's Modulus and mass density of pile concrete.
- f) More than one recording of signals shall be done until repeatability of signals is achieved on the same pile.
- g) The tests shall be conducted at 3-6 locations to cover the entire cross section of the pile.

**6.00.00 PILE TESTING**

Pile load test shall be carried out as per IS:2911 Part-4 (latest edition) or as directed by Engineer.

**6.01.00 INITIAL LOAD TEST**

Initial load test shall be carried out on separately cast piles for confirmation of estimated pile capacities and to fix a more accurate driving criteria viz. set/bow, total number of blows and approximate depth etc. of founding level. At least 2 nos. of tests shall be conducted for each mode (vertical compression, pull out and lateral). The maximum test load shall be as mentioned in bill of quantities.

**6.02.00 ROUTINE LOAD TEST**

Routine load tests shall be carried out on job (working) piles for 0.5% of total no. of piles (for each mode and type). Maximum test load shall be 1.5 times the design safe load capacity. Piles showing unsatisfactory results as per load test results shall be treated as defective piles. Defective piles shall be removed or left in place and replaced by additional piles as directed by Engineer at no extra cost to the owner. Any additional cost towards design implications, if any, due to above shall be born by the contractor.

**7.00.00 CODES AND STANDARDS**

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



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of work is not specifically covered by Indian Standard Codes, any other standard practice, as may be specified by the Engineer, shall be followed.

- IS: 432 - Specification for mild steel and medium tensile steel bars (Part 1 & 11) and hard drawn steel wire for concrete reinforcement.
- IS: 456 - Code of practice for plain and reinforced concrete.
- IS: 1200 - Measurement of Building and Civil Engineering works (Part 23) Piling.
- IS: 1786 - Code of practice for twisted steel high strength deformed bars for concrete reinforcement.
- IS: 1892 - Code of practice for Subsurface Investigation for foundation.
- IS: 2131 - Method of Standard Penetration Test for Soils
- IS: 2911 - Code of practice for design and construction of pile Part I/Sec 2 foundations - Bored cast-in-situ concrete piles.
- IS: 2911 - Code of practice for design and construction of pile Part IV foundation - Load test on piles.
- IS: 6926 - Code of practice for Diamond core Drilling for Site Investigation for River Valley Projects.
- IS: 10262 - Recommended guidelines for concrete mix design.

## **8.00.00 RATES AND MEASUREMENTS**

The clauses below shall apply for item rate contracts only. They shall not be applicable to turnkey/lump sum Contracts.

### **8.01.00 Rates**

8.01.01 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.

8.01.02 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,



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local regulations, acts, bye-laws, etc. and for execution of work to the satisfaction of the Engineer.

- 8.01.03 The quoted rate for each item shall be inclusive of mobilization of all plant, equipment, scaffolding, labour, materials, skilled and unskilled labour, and demobilization after completion of work, supervision, establishing the level and coordinates at each work.
- 8.01.04 The quoted rate for piling 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.
- 8.01.05 The quoted rate for piling as per description of item works shall be inclusive of 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.
- 8.01.06 The quoted rate for piling shall be inclusive of bailing out all the pile bore spoil from the pilebore, keeping the borehole free from bored material/debris etc. and disposing the bored/chiselled material along with the drilling mud upto 2 Km. beyond plant boundary or as directed by Engineer, flushing the pile bore by fresh bentonite before concreting, collection of samples from bottom of pilebore, transporting to laboratory, testing and reporting of results.
- 8.01.07 The quoted rate for piling shall include shifting of plant and equipment from one pile location to another pile locations, providing temporary casing pipe and removal of the same after completing, concreting, supply of necessary materials, equipment and manpower, cost of boring by approved method as specified, circulation of bentonite slurry and cleaning of borehole free from sludge, as specified, etc.
- 8.01.08 The quoted rate for piling shall also include chiselling, if any, required for socketing the pile in rock.
- 8.01.09 The quoted rate for the piling shall include concreting by termite method, length of pile above COL, withdrawal of guide casing, cost for preparation of pile head and disposal of debris etc., resulting from breaking off of pile upto COL, upto a distance of 2 Km from the plant boundary or as directed by Engineer.
- 8.01.10 The quoted rate for piling shall also include providing reinforcement and its cleaning, straightening, cutting, bending, binding with annealed wire, welding, tackwelding, providing concrete cover blocks, spacers, placing the reinforcement cage in pile casing/bore and other cost of tools and plants, materials, labours, carting the steel from store to piling site and return of unused steel to the Owners storage point, etc.



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- 8.02.11 Plasticiser/Admixture when used as directed by the Engineer shall be included in piling rates.
- 8.01.12 The quoted rate for piling 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.
- 8.01.13 The quoted rate for boring in separate borehole shall be inclusive of performing of SPT at regular intervals as specified and collecting rock cores from boreholes, upto the depth as specified shall be inclusive of transporting to laboratory, testing and reporting of the results.
- 8.01.14 Unit rate for low integrity test shall be inclusive of mobilization of the entire set of equipment, computer readout, printer, and equipment which may not have been included in the description but are essential for the satisfactory completion of the work as per internationally accepted practice. The rate quoted shall be inclusive of repeatability of test, preparation of pile top surface etc.
- 8.02.00 Measurement**
- 8.02.01 Piling length shall be measurement by linear measurement from pile cut-off level to the tip of pile in meters upto second place of decimal separately for each diameter and capacity of pile. The length of pile to be cast above cut off level, as per specification, and as approved by Engineer, shall be considered for cement reconciliation only. Theoretical diameter of piles shall be considered for reconciliation of cement consumption. No extra payment shall be made for the length from existing ground to cut-off level.
- 8.02.02 Reinforcement steel shall be measured for reconciliation purpose only and the measurement shall be done for providing and placing reinforcement in piles, by weight in tones, up to third place of decimal in the following manner:
- i) The weight shall be arrived at by multiplying the actual length measured alongwith standard hooks, rings or spirals, spacers, cranks, bends, authorized laps, etc. by sectional weight. These shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS code's sectional weight. Nothing extra shall be payable to the contractor on account of difference in weight, if any, due to different methods adopted for issue and measurement.
  - ii) Standard hooks, cranks, bend, authorized laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tones.
  - iii) Dowels, neither shown on the drawings nor instructed by the Engineer, but required for construction facilities shall not be measured.



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- 8.02.03 Breaking off of piles, due to subsequent change in design cut off level, shall be measured separately. This shall be measured in cubic metres upto second place of decimal. This will be payable only when the pile is cast and on the basis of written instruction of the Engineer for lowering of COL.
- 8.02.04 Measurements for the item of boring in a separate borehole shall be measured in metres from ground level upto the depth as specified, upto second place of decimal. Item of work of boring in soil and coring in rock shall be measured separately for the actual length of boring in soil and coring in rock.
- 8.02.05 The item for pile integrity test shall be measured in terms of no. of piles tested.



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### ANNEXURE-A

#### Specific Requirements for Bored Cast-in-situ RCC Piles

A1.0 Minimum cement concrete grade M-25  
Minimum cement content 400 Kg/M<sup>3</sup>

A1.1 Safe load  
Diameter of Pile

Diameter of Pile (mm)	Vertical/ Compression (MT)	Horizontal/ Lateral (MX)	Pullout/Tension (MT)
550	100	5	30
450	60	3	18

A2. Installation criteria  
The installed pile(s) shall satisfy the following criteria.

A2.1 In Soil  
a) Minimum length of the pile shall be 26.5 m below COL for 550mm diameter and 30m below COL for 450mm diameter.

A3. Average cut-off level for tender design and initial load test can be assumed as (-)3.5m below finished ground level.

A4. A protocol shall be signed between BHEL site and contractor regarding,  
Strata at the founding depth  
Installation criteria  
Socketing depth  
Density of bentonite before concreting  
Slump of concrete.  
Time interval between end of boring and start of concreting,



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**ANNEXURE-B**

**List of Equipments**

Sl.No	Description	Capacity No.
1.	Piling Rigs	
2.	Chisel	3 T min 6 T max
3.	High pressure Mud Pumps	10 HP min 25 HP max
4.	Bentonite mixing plants	
5.	Concrete batching plant	
6.	Soil testing equipments	

**Note:**

1. The no. and capacity of the piling equipment varies for each work.
2. Additional equipments shall be mobilized if required as per the directions of the Engineer to match the work schedule at no extra cost to the Owner.



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**ANNEXURE-C**

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 1.034 and 1.10 gm/ml depending upon the pile dimensions and type of soil in which the pile is to be installed. However, the density of bentonite suspension after mixing with deleterious materials in the pilebore may be upto 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.



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**ANNEXURE-D**  
**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 soil 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
    - Density -
    - Sand content -
14. SPT\* N values in soil (from the nearest bore hole).



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+UCS\*\* value in rock (from the nearest bore hole).

\* Standard penetration Test

\*\* Unconfined compression strength

15. Chiseling if any, from..... m to ..... m

16. Date and time of start and completion of concreting.

17. Method of placing concrete

18. Concrete quantity

**Actual**

**Theoretical**

19. Ref. Number of test cubes

20. Grade and slump of concrete

21. Results of test cubes

22. Reinforcement details:

Main Reinforcement

No. \_\_\_\_\_

Dia. \_\_\_\_\_

Depth \_\_\_\_\_

Stirrups: Type

No. \_\_\_\_\_

Dia. \_\_\_\_\_

Spacing \_\_\_\_\_

23. Any other information regarding obstructions, delay and other interruption to the sequence of work.



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**TABLE -1  
FREQUENCY OF SAMPLING AND TESTING**

Sl. No	Type of material work	Nature of Test/ characteristics	Method of Test & frequency	No. of test	Acceptance Criteria
1.	Pilebore size a) diameter b) length		Physical measurement	each pile	as per specification
2.	Founding level	to establish socketing horizon/ and or founding level & upto depth 5m below founding level.	in separate borehole meant for the purpose a) SPT in soils/ weathered rock b) Core & UCS value of rock	1 borehole for 100-150 piles or group of 150 Sqm	Annexure - B
3.	Bentonite (Mud) properties. a) Basic properties of bentonite before use. b) Contaminated mud from pile bore bottom before concreting	Liquid Limit, Marsh Viscosity, Specific gravity, sand content, swelling index, pH value. Density, sand content	in lab in lab	As per Cl. 5.7 Each Pile	As per Annexure C As per annexure C
4.	Position and Alignment	-	Physical or any Approved method	Each Pile	As per Cl. 4.3
5.	Cleaning of pilebore	-	As per Cl. 5.8	Each Pile	Pilebore be free from bored material cuttings debris/sludge
6.	Reinforcement (R/F) Spacing of longitudinal R/F cover laps binding of laterals		Physical inspection and measurement	each cage	As per approved design
7.	Concrete a) Workability b) Cubes	Slump cone test Compressive Strength test	Each pile As per spec.	As per Cl. 5.5 As per Cl. 5.5	As per specification. As per IS: 456
8.	Materials like aggregate, sand etc.	As per technical specification for concrete and relevant IS codes			
9.	Pile head		Physical	each pile	



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**PILING-PART VI**

**CONSTRUCTION AND INSTALLATION OF  
DRIVEN CAST-IN-SITU PILES**

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**SECTION DESCRIPTION**

- 1.0 SCOPE
- 2.0 CODES
- 3.0 MATERIALS
- 4.0 DESIGN CONSIDERATIONS
- 5.0 EQUIPMENT AND ACCESSORIES
- 6.0 CONTROL OF PILE DRIVING



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**1.0 SCOPE :**

- 1.1 This standard specification covers the construction and installation of driven cast-in-situ load bearing concrete piles.
- 1.2 For specific work requirements concerning construction or otherwise modifying or supplementing the provisions of this specifications, reference may be made to 'Specific Requirements' In the case of may conflict between the requirements set forth in specific Requirements and the provisions of this specification, the 'Specific Requirements' shall govern.

**2 CODES :**

- 2.1 IS :2911 (PartI/SecI). Indian Standard code of practice for Design and Construction of pile foundations : Part I Concrete Piles, section 1 Driven Cast – In- Situ load bearing concrete piles, shall be referred to in conjunction with these specifications during the entire design, construction and installation work.
- 2.2 Reference to any code shall always mean reference to the latest revised edition of the code including all its amendements upto date, unless otherwise specified. In the event of any conflict between the requirements of this specification and those of the refered codes, the former shall govern.

**3 MATERIALS :**

- 3.1 All materials, viz, cement, steel, aggregates, water etc, which are to be used in the construction work, shall conform to BHEL, Standard Specification for Material for Reinforced concrete Piles.

**3.2 CONCRETE :**

Concrete shall be manufactured either by central batching plant or Ready Mix concrete. Concrete shall conform to IS: 10262 & IS: 456.

- 3.2.1 Technical Specification for Cement Concrete (Plain and Reinforced) works along with IS: 2911 Part I/Sec 2 shall be followed for concrete works of piles. Use of plasticiser to control the water cement ratio shall be permitted on specific approval from the Engineer. Water cement ratio shall not be greater than 0.5.
- 3.2.2 Consistence of concrete shall be suitable to the method of installation of piles.
- 3.2.3 The minimum slump shall be 100mm when concrete in the pile is not compacted. It shall not exceed 175mm in any case.

The grade of concrete to be used for pilling shall be M-25. Minimum cement content in concrete shall be 380 kg/m<sup>3</sup>. When concreting under water or drilling mud, 10% additional cement over that required for the design mix of concrete for the required slump shall be used subject to a min. of 400 kg/m<sup>3</sup>.



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3.2.4 The average compressive stress under working load shall not exceed 25% of the specified works cube strength at 28 days calculated on the total cross sectional area of pile. Where the casing of pile is a) Permanent, b) of adequate strength and c) of suitable shape, the allowable compressive stress may be increased.

**4 DESIGN CONSIDERATIONS :**

4.1 Pile shall be designed in such a way that the load from the structure or supports should be transmitted to the soil without causing any soil failure and without causing such settlement under permanent/transient loading which may result in structural damage and /or functional distress. The pile shaft have adequate structural capacity to withstand all loads and moments which are to be transmitted to the subsoil.

4.2 The soil report data consisting of borelog data, laboratory test results and pile recommendations is attached alongwith for bidders. Safe pile load capacity to be adopted for working loads as below. Initial load test of pile is being conducted separately and the result/recommendations will be provided to bidder at the start of work at site.

4.3 Bidder has to conduct working load test of pile as per IS :2911 Part-IV and ensure the safe rated load capacities of pile. Structural design of pile will be done by BHEL. For driven cast in situ piles, bidder has to provide the set criteria for approval of BHEL/CESC/TCE as per the equipments mobilised for driving casing of driven piles to ensure end bearing strength of soil strata. The hammer weight of pile rigs for driving pile shall be preferably 5MT.

4.4 The construction of extension unit#3 is in continuation to existing unit#1&2. As the construction work for Unit#3 including driving of pile casing is to be done adjacent to existing unit#2, care has to be taken that no damage occurs to existing structure and functioning of sensitive instruments in existing unit. A vibration measurement exercise was done by BHEL/CESC/TCE while driving pile casing of 550mm diameter during initial pile load test and based on that extent of bored/driven pile is decided adjacent to existing structures.

Bidders has to follow the driving procedure as approved by BHEL. Progressive increase in blow height is to be adopted for driving pile casing in vicinity of existing structures with limited nos. of rigs operating at a time near existing structure in each zone.

Safe load capacity of pile

Diameter of Pile (mm)	Vertical/ Compression (MT)	Horizontal/ Lateral (MX)	Pullout/Tension (MT)
550	100	5	30
450	60	3	18

a) Minimum length of the pile shall be 22 m below COL for 550mm diameter and 20m below COL for 450mm diameter.



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Average cut-off level for tender design and initial load test can be assumed as (-)3.5m below finished ground level.

### 4.5 REINFORCEMENT :

- 4.5.1 The design of reinforcement cage and the minimum reinforcement shall be in accordance with IS :2911 (Part I Sec. I)
- 4.5.2 The reinforcement shall be normally provided upto the full depth of pile and the designed quantity of reinforcement will be curtailed at appropriate level as per design requirements in case of piles subject to compressive load only provided it could be ensured that there shall be no danger to green concrete due to driving of adjacent piles.
- 4.5.3 The minimum clear cover to reinforcement shall be 50mm . The lateral spacing of the reinforcement cage in spacing shall be chosen so as to impart adequate rigidity of the reinforcing cage during handling and installations. For aggressive soil conditions, the clear cover shall be suitably increased in case special cement is not used.
- 4.5.4 The longitudinal reinforcement shall be provided considering the combination of vertical (compression and tension) and horizontal loads. Minimum six numbers of bars shall be provided for longitudinal reinforcement. The diameter of longitudinal reinforcement bars shall not be less than 12mm. The stipulated minimum reinforcement shall be provided for the full length of pile.
- 4.5.5 The longitudinal reinforcement shall project 50 times its diameter above cut off level unless otherwise indicated.
- 4.5.6 The laterals shall be tied to the longitudinal reinforcement to maintain its shape and spacing. The laterals may be in the form of links or spirals. The minimum diameter of the links or spirals shall be 6 mm and the spacing of the links or spiral shall not be less than 150 mm and in no case more than 300 mm.
- 4.5.7 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/pilebore by providing necessary laps as per IS: 456.
- 4.5.8 The minimum clear distance between the two adjacent main reinforcement bars shall normally be 100 mm for the full depth of cage.
- 4.5.9 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.
- 4.5.10 Laps shall be staggered as far as practicable and 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).
- 4.5.11 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.
- 4.5.12 Bundling of bars is not permitted.

### 5 EQUIPMENT AND ACCESSORIES :

- 5.1 Equipment and accessories shall in general conform to requirements but not limited to that, stated in the relevant clause of IS :2911 (Part I/Sec I).

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<p>5.2 List of equipments and accessories to be used for a specific project shall be submitted along with the bids ; demonstrating that the piles would be installed to the design penetration. The equipment and accessories shall also be approved by Engineer-in-Charge at the time of mobilisation.</p> <p>5.3 Based on the site investigation data, contractor should also submit list of anticipated problems and remedial actions proposed by him to overcome these anticipated problems including requirement of mobilization and use of necessary equipments for the purpose.</p> <p><b>6. <u>CONTROL OF PILE INSTALLATION</u></b></p> <p>6.1 <u>CONTROL OF ALIGNMENT :</u></p> <p>Pile shall be installed as accurately as possible either vertical or to the specified inclination. As a guide for vertical pile, a deviation of 1.5% and for raker a deviation of 4% shall be normally permitted. Piles shall not be out of position by more than 75 mm from the designed location at the working level of piling rig. In case of a single pile in a column, positional tolerance shall not exceed 50 mm. In case of piles deviating beyond these limits and to such an extent that the resulting eccentricity cannot be taken care of by a redesign of the pile cap or pile tiles, piles shall be replaced or supplemented by one or more additional piles.</p> <p>6.2 <u>WITHDRAWAL OF CASING :</u></p> <p>6.2.1 It shall be ensured that volume of concrete poured in at least equal the volume of pile shaft being concreted and the rate of concreting should match with the rate of withdrawal of casings. It should be ensured that minimum 1 m height of concrete should always be maintained in the casing.</p> <p>6.2.2 When withdrawing the casing, the head of concrete in the hole shall always be more than the head of ground water table outside the casing to prevent inflow of water inside.</p> <p>6.3 <u>ADJACENT STRUCTURES :</u></p> <p>6.3.1 When Working near existing structures care shall be taken to avoid any damage to such structure. Fig 1 of IS :2974 (Part I) may be followed as a guide.</p> <p>6.3.2 In case of deep excavation adjacent to piles, proper shoring or other suitable arrangement shall be made to guard against the lateral movement of soil stratum or releasing the confining soil stress.</p> <p><b>6.4 SEQUENCE OF PILING</b></p> <p>6.4.1 In a pile group, the sequence of installation of piles shall normally be from the centre to the periphery of the group or from one side to the other.</p>			



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6.4.2 In case of compact soil specially, the consideration shall be given to the possibility of doing harm to a pile recently formed by driving the tube nearby before the concrete has sufficiently set.

6.4.3 Driving piles in loose sand tends to compact the sand which in turn increases the skin friction. Therefore, the order of installing such a pile in a group shall avoid creating a compacting block of ground into which further piles cannot be driven. In case where stiff clay or compact sand layer have to be penetrated, similar precautions need to be taken. This may be overcome by driving the piles from the centre outwards or by beginning at a selected edge or working across a group. However, in case of soft soils, the driving may have to proceed from outside to inside so that the soils is restrained from flowing out during operations.

### 6.5 JETTING

Jetting of casings by means of water shall not normally be permitted. In every special circumstances however, it may be carried out only with the express permission of the Engineer-in-Charge without impairing the bearing capacity of piles already in place, the stability of soil, or the safety of any adjoining building.

6.6 The top of concrete in a pile shall be brought above the cut-off level to remove all laitance and weak concrete before capping and to ensure good concrete at the cut-off level. The reinforcing cage shall be left with adequate protruding length above the cut off level for embedment into the pile cap.

6.7.1 As a general guide line for cut-off level upto 1.5m below working level, the concrete shall be cast to a min. of 300mm above cut off level. For each additional 0.3m increase in cut-off level below working level, an additional coverage of 50mm shall be allowed.

### 6.8 DEFECTIVE PILE

Defective pile shall be removed or left in place without affecting the performance of the adjacent piles or the cap as a whole. Additional piles shall be provided to replace them when required. Various pile testing items are provided in the BOQ and it is necessary that the installed pile shall pass the tests specified, failing which it will be treated as defective pile.

6.9.1 Any deviation from designed location alignment or load capacity of any pile shall be noted and adequate measures taken well before concreting of the pile cap and plinth beam.

6.9.2 During chipping of the pile cap, manual chipping may be permitted after three days of pile casting while pneumatic tool for chipping shall not be used before seven days after pile casting.

### 6.10 RECORDING OF DATA



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Typical data sheets for recording piling data shall be as shown in IS :2911, (PartI/Sec I).

**7.01.00 Rates**

- 7.01.01 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.
- 7.01.02 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 Engineer.
- 7.01.03 The quoted rate for each item shall be inclusive of mobilization of all plant, equipment, scaffolding, labour, materials, skilled and unskilled labour, and demobilization after completion of work, supervision, establishing the level and coordinates at each work.
- 7.01.04 The quoted rate for piling 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.
- 7.01.05 The quoted rate for piling as per description of item works shall be inclusive of 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.
- 7.01.07 The quoted rate for piling shall include shifting of plant and equipment from one pile location to another pile locations, providing temporary casing pipe and removal of the same after completing, concreting, supply of necessary materials, equipment and manpower, cost of boring by approved method as specified, circulation of bentonite slurry and cleaning of borehole free from sludge, as specified, etc.
- 7.01.08 The quoted rate for the piling shall include concreting by tremie method, length of pile above COL, withdrawal of guide casing, cost for preparation of pile head and disposal of debris etc., resulting from breaking off of pile upto COL, upto a distance of 2 Km from the plant boundary or as directed by Engineer.
- 7.01.09 The quoted rate for piling shall also include providing reinforcement and its cleaning, straightening, cutting, bending, binding with annealed wire, welding, tackwelding, providing concrete cover blocks, spacers, placing the reinforcement



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cage in pile casing/bore and other cost of tools and plants, materials, labours, carting the steel from store to piling site and return of unused steel to the Owners storage point, etc.

7.01.10 Plasticiser/Admixture when used as directed by the Engineer shall be included in piling rates.

7.01.11 The quoted rate for piling 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.

**8.01.00 Measurement**

8.01.01 Piling length shall be measurement by linear measurement from pile cut-off level to the tip of pile in meters upto second place of decimal separately for each diameter and capacity of pile. The length of pile to be cast above cut off level, as per specification, and as approved by Engineer, shall be considered for cement reconciliation only. Theoretical diameter of piles shall be considered for reconciliation of cement consumption. No extra payment shall be made for the length from existing ground to cut-off level.

8.01.02 Reinforcement steel shall be measured for reconciliation purpose only and the measurement shall be done for providing and placing reinforcement in piles, by weight in tones, up to third place of decimal in the following manner:

- i) The weight shall be arrived at by multiplying the actual length measured alongwith standard hooks, rings or spirals, spacers, cranks, bends, authorized laps, etc. by sectional weight. These shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS code's sectional weight. Nothing extra shall be payable to the contractor on account of difference in weight, if any, due to different methods adopted for issue and measurement.
- ii) Standard hooks, cranks, bend, authorized laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tones.
- iii) Dowels, neither shown on the drawings nor instructed by the Engineer, but required for construction facilities shall not be measured.

8.01.03 Breaking off of piles, due to subsequent change in design cut off level, shall be measured separately. This shall be measured in cubic metres upto second place of decimal. This will be payable only when the pile is cast and on the basis of written instruction of the Engineer for lowering of COL.



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**PILING PART-V  
TESTING OF CONCRETE PILES  
BY CONVENTIONAL LOADING SYSTEM**

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2. VERTICAL LOADING TESTS
3. LATERAL LOADING TEST
4. PULL OUT CAPACITY OF PILES
5. COMBINED VERTICAL AND LATERAL LOADING
6. SPECIAL TYPE OF LOADING

APPENDIX 1 – PILE LOADING TEST RECORD



## TECHNICAL SPECIFICATION FOR PILING.

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### 1. GENERAL

#### 1.1 Scope

1.1.1 This specification covers the requirements and methods of testing of a single pile for evaluating its safe capacity in :

- a) Vertical Loading (compression )
- b) Lateral loading
- c) Pull out.
- d) Combined vertical and lateral loading.
- e) Special type of loading such as vibratory loadings.

1.1.2 These specifications shall be applicable for all types of piles in general excepting sheet piles.

1.1.3 For specific work requirements or otherwise modifying or supplementing the provisions of this specification, refer to specific requirements. In case of conflict between requirements set forth in the specific requirements and the provisions of this specification, the specific requirements and the provisions of this specification, the specific requirements shall govern.

#### 1.2 Definitions

1.2.1 Reference to Indian Standard codes shall always mean reference to the latest issue of the relevant standards, including all the amendments up to date.

#### 1.3 Codes

1.3.1 All testing shall be performed in accordance with the following codes and the provisions of these specifications:

IS : 2911 – (part-IV ) – Codes of practice for design and Construction of pile Foundations – load test on piles .

#### 1.4 Requirements

1.4.1 The load test shall be required to provide data regarding the load – deformation characteristics of the pile up to failure or otherwise specified and the safe design capacity.

1.4.2 Full details of the equipment proposed to be used and the test set up shall be submitted to the Engineer-in-Charge with detailed sketches for approval.



## TECHNICAL SPECIFICATION FOR PILING.

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Approval of the Engineer-in-Charge shall be also be obtained after the test set up is complete, prior to commencement of loading.

1.4.3 All measuring devices shall be tested satisfactory performance and accuracy at an approved institution and certificate to that effect obtained and submitted to the Engineer –in-charge, prior to use.

1.4.4 The test pile shall be constructed using the same equipment and technique as for the job piles.

1.4.5 A minimum time period of one week shall be allowed between the time of installation and testing in case of a precast pile and less than four weeks from the time of vesting in case of a cast-in situ pile.

1.4.6 Recodes

A full record giving all details of the test in the Performa in appendix-1 shall be submitted in TRIPLICATE to the Engineer-in-Charge immediately on COMPLETION of each test. The record shall also include the plot of load- time settlement characteristics of the piles.

## 2 VERTICAL LOADING TEST:

2.1 Equipment and test Set-up

### 2.1.1 Test pile

2.1.1.1 The test pile shall be decided by the Engineer-in-Charge. It may be one of the working piles or separate test pile.

2.1.1.2 The head of the test pile shall be brought to the proper level and provided with a pile cap with a moral and plane surface and with adequate space for proper seating of a jack and dial gauges.

2.1.1.3 Test pile surface shall be prepared for testing purposes on the expiry of one week after casting the pile.

### 2.1.2 Loading Systems

2.1.2.1 Loading shall be applied by the reaction method consisting of an hydraulic jack reacting centrally against a loaded platform. Supports of the platforms shall be adequately designed. Special anchor piles or any other suitable type of anchorage system may also be used. However, use of the uplift supply of neigh boring piles for providing the reaction shall normally not be permitted.

2.1.2.2 The loading system shall be adequate to ensure that the test can be carried up to the specified limit. The reaction to be made available for the test shall be at least 25% greater than the maximum jacking force required.

### 2.1.3 Measuring System

### **2.1.3.1 Loading on piles**

The load applied on the pile shall be recorded on a calibrated pressure gauge mounted on the jack.

### **2.1.3.2 Settlement of pile**

- a) Settlement of pile shall be recorded by dial gauges suspended from datum bars.
- b) The datum bars shall have rigid supports preferably of concrete pillars or steel section, embedded well into the ground. The supports shall be locked more than three times the piles diameter, subject to a minimum of 1.5 M, clear away from the pile face and also sufficiently away from the supports of the loaded plat from to avoid any disturbance on these accounts. Movements near the supports of the datum bar shall be avoided while the test is in progress.

## **2.2 Method of conducting Test**

The test shall be carried out by the direct method of loading in successive increments or by the cyclic loading method as specified and as directed by the engineer-in-charge.

### **2.2.1 Direct Method of Loading in Successive Increments**

The test shall be carried out as per the procedure outlined.

- a) The load shall be applied to the pile top in increments of about one fifth the rated capacity of the pile or as specified. Settlement readings shall be taken before and after the application of cash new load increment and at 2,4,8,15,30,60 minutes and at every two hours until application of the next load increment.
- b) Each stage of loading shall be maintained till the rate of movement of the pile top is not more than, 0.1 mm in first 30minutes, 0.2 mm per hours or until two labours have elapsed, which is later.
- c) (I) Yield of soil-pile system occurs causing progressive settlement of the pile exceeding a value of one tenth of the pile diameter.  
  
(II) The loading on the pile top equals twice the rated capacity or as specified in the case of a separate test pile and 1.5 times the rated capacity of the pile in case of a working pile.
- d) Where yielding of the soil does not occur, the full test load shall be maintained on the pile head for 24 hours or more if necessary and settlement reading shall be taken at 6hours interval during the period.

- e) Unloading shall be carried out in the same steps as loading. A minimum period of ½ hour shall be allowed to elapse between two successive stages of load decrement. The final rebound shall be recorded 6 hours after the entire test load has been removed.
- f) If so directed by the Engineer-in-charge, loading and unloading cycles shall be carried out for all load stages within the assumed working load.
- g) Assessment of Safe Load:  
  
The safe of the pile shall be the least of following values:
  - i) 2/3 of final load at which the total displacement attains a value of 12mm. Unless otherwise required, in given case on the basis of nature and type structure in which case, the safe load should be corresponding to the stated total displacement permissible.
  - ii) 50 percent of final load at which the total settlement equate the 10% of pile diameter in case of bored piles and 7.5 percent of bulb diameter in case of under – reamed piles.

**2.2.2 Cycle Loading Test**

The test shall be carried out as per the procedure outlined by IS : 2911 – (part – IV) and as described below:

- a. The load shall be supplied to the pile top in increments of about one fifth the estimated safe capacity of the pile or as specified. Settlement readings shall be taken before and the application of each new load increment and at 2,4,8,15,30,60 minutes and at every two hours until application of the next load increment.
- b. Alternate loading and unloading shall be carried out at each stage and the total and net settlements recorded as specified. If so directed by the Engineer-in-charge, more then one cycle of loading and unloading shall be carried out at any or all of the stages.
- c. Each stage of loading or unloading shall be maintained till the rate of movement of the pile top is not more then 0.2 mm per hour provided that the minimum period is two hours for loading and one hour for unloading. The following load stages shall however be maintained for longer periods as given below:
  - i) At 1.5 times assumed safe Capacity ( for routine test only ) - 24 hours.
  - ii) At load of twice assumed safe capacity ( for initial test only ) - 24 hours

This loading shall be continued till one of the following occurs:

- i) Yield of the soil pile system occurs causing progressive settlement exceeding one tenth of the pile diameter.
- ii) The loading on the pile top equals twice the estimated safe load in case of a separate test pile and 1.5 times the rated capacity of the pile in case of working pile.

d) Assessment of Safe Load :

The safe capacity of the pile shall be the lest of the following :

- i) The thirds of the final load at which the total settlement attains a value of 6 mm.
- ii) Two thirds of the final load at which the total settlement attains a value of 6 mm.
- iii) Half of the final load at which the total settlement equals one tenth of the pile.

### **3. LATERAL LOADING TEST :**

#### **3.1. Equipment and test set-up**

##### **3.1.1 Test Pile**

The test pile shall be decided by the Engineer-in-Charge. It may be one of the working piles or a separate test pile.

The test pile shall be cut off at the proper level and provided with a cap with vertical plane sides having an adequate area for proper seating of the jack and dial gauges.

##### **3.1.2 Loading System**

Loading shall be applied by an hydraulic jack of adequate capacity, abutting the pile horizontally and reacting against a suitable system. The reaction may be provided by the wall of the excavated-pit when the test is being conducted below ground level or by a neighbouring pile in which case thrust pieces shall be inserted on either end of the jack to make up the gap.

##### **3.1.3 Measuring System**

3.1.3.1 Lateral load applied on the pile shall be measured by a calibrated pressure gauge mounted on the jack, having a least count of 500 Kg.

3.1.3.2 Deflection of the pile hand shall be measured by dial gauges, fixed to datum bars and having a least count of 0.01 mm. The datum bars shall be provided with rigid supports as described in Clause 2.1.3.2 (b) above.

### **3.2 Method of Conducting Test :**

The test shall be carried out in accordance with the provisions of IS :2911– (part-D) and as detailed below :

3.2.1 Loading shall be applied in increments of 500 kgs. Or as specified.

3.2.2 Each stages shall be maintained for a period till the rate of movement of the pile head is not more then 0.1 mm / 30 min. or 1 hr. whichever is greater.

3.2.3 Loading shall be continued till one of the following occurs:

- a) Deflection of the pile head exceeds 12 mm.
- b) The applied load on the pile is twice the assumed lateral load capacity of the pile in case of a separate test pile and  $1 \frac{1}{3}$  Times the rates capacity in the cast of a working pile.

### **3.2.4 Assessments of Safe Load :**

The safe load shall be the smaller of the following :

- i) Half the final lod for which the total deflection is 12 mm.
- ii) Loading corresponding to 5 mm total defection.

NOTE: The deflection is at the cut off level of the pile.

## **4. PULL OUT CAPACITY OF PILES**

### **4.1 Equipment and test Set up**

#### **4.1.1 Test pile**

The test pile shall be decided by the Engineer-in-Charge. The test shall be conducted on a separate pile installed separate pile installed specifically for this purpose.

4.1.1.2 the test pile shall be built upto the proper length and the proper length and the head provided with suitable arrangements for anchoring the load applying system.

#### **4.1.2 Loading System**

4.1.2.1 Load shall be applied using an approved reaction system uplift force on the pile may be applied directly to the test pile or through a lever system. The reaction may be provided by neighbouring piles or blocks may be constructed for the purposes. A hydraulic jack shall be used for load application.

#### **4.1.3 Measuring System**



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4.1.3.1 Load applied by jack shall be measured by a calibrated pressure gauge with a least count of 1000 kgs.

4.1.3.2 Movement of the pile shall be measured by dial gauges, fixed to datum bar and having a least count of 0.01 mm. A minimum of two dial gauges, placed diametrically opposite shall be used. Datum bars shall be provided with rigid supports as described in 2.1.3.2 (b) above.

### 4.2 Method of Conducting Test

The test shall be conducted as outlined below:

4.2.1 Loading shall be applied to the pile top increments of one fifth rated capacity of pile.

4.2.2 Each stage shall be maintained for a period till the rate of movement of the pile head is not more than 0.1 mm / 30 min. or one hour, whichever is greater.

4.2.3 Loading shall be continued till one of the following occurs:

- a) Yield of soil pile system occurs causing progressive movement of the pile exceeding 12 mm.
- b) The loading on the pile top equals twice the estimated safe load or as specified.

### 4.3 Assessment of Safe Load

The safe capacity of the pile shall be the smaller of the following:

- a) Two-thirds of the load at which the total displacement is 12 mm or the load corresponding to a specified permissible up lift, and
- b) Half of the load at which the load-displacement curve show as a clear break (downward trend).

## 5. COMBINED VERTICAL AND LATERAL LOADING :

### 5.1 Equipment and Test Set-up

5.1.1 The equipment and test set up shall be same described in Clause 3. in addition a platform shall be constructed on the pile top, and loaded to 1.0 times the pile capacity in vertical loading.

The pile shall be first subjected to the full vertical load. The lateral load shall commence after all settlements due to the vertical load have ceased and while the full vertical load is in position.



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5.1.2 The loading system, measuring system and recording of results shall be the same as described in Clause – 3.

**5.2 Method of Conducting Test and Assessment of Safe Load**

This shall be in accordance with the provision of Clause 3.2 above.

**6. SPECIAL TYPE OF LOADING**

This shall include evaluating the pile response to vibratory loads, both horizontal and vertical in nature. The test set up and method of conducting the test shall be covered under specific requirements.

APPENDIX

FILE NO.....DATE OF .....WT. OF HAMMER.....

TYPE.....DRIVING .....AVR. DROP OF HAMMER.....

DLAMETER (CM).....CASTING.....TOTAL NO. OF BOWS.....

LENGTH BELOW                      COMMENCEMENT OF TEST... SUM OF TEMPORARY

G.L.(M).....COMPRESSION IN CMS.....

LOCATION ..... COMPLETION OF TEST..... GROUND LEVEL .....

TYPE OF TEST : DIRECT/CYCLE LOADING

DATE	TIME	TOTAL TIME	SETTLEMENT		AVRSETTLEMENT		SOUND REMARKS											
			LOAD ON	LOAD OFF	TOTAL LOAD	(DEFLECTION) GAUGE	I	II	TOTAL	NETT								

HR.MINS TONNES TONNES MM MM MM MM M

