



TITLE:

**TECHNICAL SPECIFICATION FOR
FLOOR FINISH AND ALLIED WORKS**

SPECIFICATION NO. PE-TS-999-600-C012

VOLUME - II B

SECTION - D | SUB-SECTION - D12

REV.NO. 00 DATE 09/04/2018

SHEET 22 OF 22

5.02.00

Measurement

The finished surface shall be measured in Sqm for area unless otherwise specified. Deduction shall not be made for opening or embedded articles having area not exceeding 0.1 Sqm.



TITLE:

**TECHNICAL SPECIFICATION FOR
SHEET WORK IN ROOF AND
SIDING**

SPECIFICATION NO. PE-TS-999-600-C013

VOLUME - II B

SECTION - D | SUB-SECTION – D13

REV.NO. 00 DATE 30/11/2015

SHEET 1 OF 6

VOLUME: II B

SECTION - D

SUB-SECTION – D13

SHEET WORK IN ROOF AND SIDING

SPECIFICATION NO. PE-TS-999-600-C013



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
SHEET WORK IN ROOF AND
SIDING**

SPECIFICATION NO. PE-TS-999-600-C013

VOLUME - II B

SECTION - D | SUB-SECTION - D13

REV.NO. 00 DATE 30/11/2015

SHEET 2 OF 6

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	ACCEPTANCE CRITERIA	5
4.00.00	I.S. CODES	5
5.00.00	RATES AND MEASUREMENTS	6

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDING	SPECIFICATION NO. PE-TS-999-600-C013 VOLUME - II B SECTION - D SUB-SECTION – D13 REV.NO. 00 DATE 30/11/2015 SHEET 3 OF 6
<u>SHEET WORK IN ROOF AND SIDING</u> 1.00.00 SCOPE This section covers supply, cutting & fabrication and erection of corrugated/plain asbestos, corrugated galvanized iron, aluminum, permanently colour coated troughed zinc-aluminium alloy coated M.S. sheet or other sheet for covering to roof and sides at various elevations as specified. 2.00.00 INSTALLATION 2.01.00 Storage of Materials All materials shall be stored by the Contractor in proper way to prevent all damage. 2.02.00 Workmanship The workmanship shall be according to best construction practice to give a watertight finish to the satisfaction of the Engineer. Fixing of gutters and down pipes shall be according to IS: 2527. 2.02.01 Asbestos Sheeting Asbestos sheets of profiles as specified shall be fixed with minimum 150 mm end lap and side laps as per manufacturer's specification. Hook bolts or J-bolts shall be 8 mm dia. at 305 mm centres. Six (6) mm dia. galvanized iron seam bolt and nut with G.I. flat washers and bitumen washers shall be used for stitching ridge cappings, corner pieces, ventilators, north light curves etc. 2.02.02 C.G.I. Sheeting and Aluminium Sheeting Side laps shall be 2 corrugations for roof and one corrugation for side sheeting. End laps shall be minimum 150 mm for roof and 100 mm for side sheeting. In ridges and hips where plain sheets are used, the end laps shall be minimum 100 mm. Holes in C.G.I. sheets shall preferably be made on the ground. The sheets should be placed on purlins/trestles and holes punched in the ridge of the corrugation from the outside inward for obtaining proper seating of limpet washers. Sheets shall be secured to sheet framing by 8 mm dia. galvanised iron hooks or J-bolts and maximum spacing of the bolts shall be 305 mm. The length of the hook or J-bolts shall be to suit the sections of the bearers. Sheets shall also be bolted at the ends at every third corrugation with 6 mm dia. galvanized iron seam bolts and G.I. flat washers and bituminous washers.		

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDING	SPECIFICATION NO. PE-TS-999-600-C013 VOLUME - II B SECTION - D SUB-SECTION – D13 REV.NO. 00 DATE 30/11/2015 SHEET 4 OF 6
2.02.03 Fibre Glass Reinforced Plastic Sheeting This shall be of thickness and profile as specified. Colour and light transmittance shall be as mentioned. Where used in conjunction with C.G.I. or asbestos sheeting, the end and side laps and fixing device shall be same as used for general sheeting. Where used in lieu of glass, the fixing shall be by means of timber or metal glazing beads. In all cases, the installation shall be completely watertight and able to withstand the designed wind-pressure. 2.02.04 PERMANENT COLOUR COATED (SANDWICHED INSULATED) METAL CLADDING SYSTEM i. Troughed zinc-aluminium alloy coated (both sides) M.S. sheet having 0.6mm minimum thickness (or high tensile steel sheet having minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used on external face (outer face) of cladding system. Weight of coating shall not be less than 150 gm/sq.m. The outer side (exposed face) shall be permanently colour coated with Polyfluro Vinyl Coating (PVF₂) of Dry Film Thickness (DFT) 20 microns (minimum) over primer. Inner side of external sheet shall be provided with suitable pre-coating of minimum 7 microns. ii. Galvanised M.S. sheets of minimum 0.6mm thickness shall be used as inner liner (internal face) of cladding system. The exposed face shall be permanently colour coated with silicon modified polyester paint of DFT 20 microns (minimum) over primer. Inner face of external sheet shall be provided with suitable pre-coating of minimum 7 microns. The rate of galvanization shall not be less than 275 gm/sqm. iii. The permanent colour coated sheet shall meet the general requirements of IS:14246 and shall conform to class 3 for the durability. iv. Inner sheet shall be fixed directly to side runners and Z spacers made out of at least 2 mm thick galvanized steel sheet of grade 375 as per IS:277. Inner sheet shall be fixed at the rate not more than 1.50M centre to centre to hold the insulation and external sheeting. The fasteners shall be of high quality corrosion resistant grade of self tapping / self drilling type provided with suitable cap. v. The insulation shall be of bonded mineral wool of minimum thickness 50mm conforming to IS:8183, having a density of 32 Kg/cu.m. for glass wool & 48 Kg/cu.m. for rock wool. 2.02.05 PERMANENT COLOUR COATED (NON-INSULATED) METAL CLADDING SYSTEM i. Troughed zinc-aluminium alloy coated not less than 150 gm/sq.m M.S. sheets having 0.6 mm minimum thickness (or High tensile steel sheet having		

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDING	SPECIFICATION NO. PE-TS-999-600-C013 VOLUME - II B SECTION - D SUB-SECTION – D13 REV.NO. 00 DATE 30/11/2015 SHEET 5 OF 6
	minimum yield strength of 350 Mpa of 0.5mm minimum thickness) shall be used for the cladding system. The outer side (exposed face) shall be permanently colour coated with PVF₂ paint of minimum DFT 20 microns over primer and the inner side (internal face) shall be coated with same paint of minimum DFT 12 microns over primer. These shall be fixed directly to runners. The sheets shall meet the general requirement of IS:14246 and shall conform to class 3 for the durability. ii. FLASHING, CAPS, TRIM CLOSURES ETC. All flashings, trim closures caps etc. required for the metal cladding system shall be made out of plain sheets having same material and coating specification as mentioned above for the outer face of the sandwiched metal cladding. 3.00.00 ACCEPTANCE CRITERIA The installations shall present a neat appearance and shall be checked for water tightness. The following shall be checked: a) Side and end laps b) Absence of cracks, holes or damages in sheet c) Spacing of bolts d) Provision of double washers (G.I. and asbestos or bituminous washers) e) Proper installation of flashing. 4.00.00 I.S. CODE 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 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: 3007 : Code of practice for laying of asbestos cement sheets. - IS: 2527 : Code of practice for fixing rainwater gutters and down pipes for roof drainage. - IS: 1626 : Specification for asbestos cement building pipes, gutters and fittings. - IS: 277 : Specification for galvanized steel sheets (plain and corrugated).	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR SHEET WORK IN ROOF AND SIDING	SPECIFICATION NO. PE-TS-999-600-C013 VOLUME - II B SECTION - D SUB-SECTION – D13 REV.NO. 00 DATE 30/11/2015 SHEET 6 OF 6
5.00.00	RATES AND MEASUREMENT	
5.01.00	Rates	
	Rates shall be unit rate for complete item described in “Schedule of Items” and shall include all wastage.	
5.02.00	Measurement	
	Sheeting work in roof & sides shall be measured in Sq.M. for net area of the work done. Profiled sheeting shall be measured flat and not girthed. Opening less than 0.40 Sqm shall not be deducted. No extra shall be paid for extra labour in cutting and for wastage etc. No payment shall be made for laps, flashings, sealing, fasteners etc. in sheeting works.	



TITLE:

**TECHNICAL SPECIFICATION FOR
SUSPENDED CEILING**

SPECIFICATION NO. PE-TS-999-600-C014

VOLUME - II B

SECTION - D | SUB-SECTION – D14

REV.NO. 00 DATE 30/11/2015

SHEET 1 OF 6

VOLUME: II B

SECTION - D

SUB-SECTION – D14

SUSPENDED CEILING

SPECIFICATION NO. PE-TS-999-600-C014



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
SUSPENDED CEILING**

SPECIFICATION NO. PE-TS-999-600-C014

VOLUME - II B

SECTION - D | SUB-SECTION - D14

REV.NO. 00 DATE 30/11/2015

SHEET 2 OF 6

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	INSTALLATION	3
3.00.00	SAMPLES	5
4.00.00	SHOP DRAWINGS	5
5.00.00	ACCEPTANCE CRITERIA	6
6.00.00	RATES AND MEASUREMENTS	6



TITLE:

TECHNICAL SPECIFICATION FOR SUSPENDED CEILING

SPECIFICATION NO. PE-TS-999-600-C014

VOLUME - II B

SECTION - D | SUB-SECTION – D14

REV.NO. 00 DATE 30/11/2015

SHEET 3 OF 6

SUSPENDED CEILING

1.00.00 SCOPE

This section covers supply and installation of suspended ceiling together with the suspension system as shown on drawing or specified in schedule of item with all materials, labour and equipments. The work shall also include providing of openings in the ceiling for lighting, air-conditioning diffusers etc. as shown on drawings or as instructed by the Engineer.

2.00.00 INSTALLATION

2.01.00 Suspension System

2.01.01 General

Suspension system shall consist of the grid supporting the ceiling panels, intermediate runner supports for the grid if any and hangers, wall angles etc. required to suspend the grid or the runners from structural works, slabs and beams.

All members of the suspension system shall be of sufficient strength and rigidity to carry, the ceiling boards or sheets in a true and level plane without exceeding a deflection of 1/360th of their span. All joints in ceiling panels shall run straight and cross joint shall be at perfect right angles. Angle moulds where shown on drawings shall be securely fixed to walls. All drillings of structural concrete and installation of suitable anchoring device for installation including welding of the suspension system shall be included in the rate. All M.S. sections used for supports etc. shall be given one coat of synthetic enamel paint over a coat of red lead primer.

2.01.02 Metal Grid Suspension System

Aluminium grid ceiling system shall be "Bead lock" as manufactured by W A Beard shell and Co. Pvt. Ltd. or Ajit India Limited or approved equal. Steel grid ceiling system shall be 'Jolly Snap Grid' as manufactured by Jolly Board Limited or approved equal.

Steel tees as intermediate members and steel channels, as end pieces will be assembled in the form of grid. Size of tees and channels shall be as required.

The cross-tees shall intersect main tee runners in pattern shown on drawing and positively locked together with intersection members. All perimeter areas shall have tee runners fixed to vertical wall surfaces and end channels shall be fixed to runners leaving return air space between vertical wall and channels,



TITLE:

TECHNICAL SPECIFICATION FOR SUSPENDED CEILING

SPECIFICATION NO. PE-TS-999-600-C014

VOLUME - II B

SECTION - D | SUB-SECTION - D14

REV.NO. 00 DATE 30/11/2015

SHEET 4 OF 6

unless otherwise shown on drawings. Angle cleats or other suitable fixing device shall be fixed to the structural beams above for fixing of hangers. Main runners shall be hung by M.S. flats, angles, rods or 12G or heavier galvanized tie wire hangers at maximum 1.2 metre centres. Extra hangers shall be provided at light fixtures that are supported from the ceiling system. The spacing of main and cross runners shall be as shown on drawings. Turnbuckles shall be provided in M.S. rods for adjustment in levels.

2.02.00 Ceiling Panels

2.02.01 Material

Ceiling panels shall be best quality material in thickness and properties called for in the "Schedule of items". The Contractor shall submit test certificates to the Engineer for approval before bulk supply. The ceiling panels may be of following type:

- a) Plaster of Paris board (decorative)
- b) Expanded polystyrene insulation board with plastic fascia.
- c) Fibre Insulation board.
- d) Bonded wooden particle board (Plain and decorative)
- e) Glass fibre reinforced polystyrene sheets.
- f) Flat asbestos sheets (with plastic fascia).

2.02.02 Installation of Ceiling Panels

Installation of Ceiling panels shall be strictly as per manufacturer's instruction.

For concealed grid system, tiles shall be fixed to the supporting grid in manner shown on drawing or as specified by the manufacturer. Where V joints in tiles are called for in drawings, these shall be in true lines. Where flush surface is required, the joints shall be filled with approved filler material and finished to give a neat uniform surface. Special care shall be taken to neatly finish the ceiling at junctions with walls, light fixtures, diffusers etc.

2.02.03 Aluminium Lineal Ceiling System

Aluminium lineal ceiling system shall be "Luxalon 84C " or approved equal and the installation shall be strictly as per manufacturer's instruction/ specification subject to approval of the Engineer.



TITLE:

TECHNICAL SPECIFICATION FOR SUSPENDED CEILING

SPECIFICATION NO. PE-TS-999-600-C014

VOLUME - II B

SECTION - D | SUB-SECTION - D14

REV.NO. 00 DATE 30/11/2015

SHEET 5 OF 6

Aluminium lineal ceiling shall comprise of plain panels, 84 mm wide and 12.5 mm deep with a 23.9 mm recessed flange, roll formed out of 0.5 mm thick aluminium alloy panels stove enamelled on both sides, fixed on roll-formed carriers made of enamelled 0.95 mm thick aluminium, 32 mm wide and 39 mm deep with prongs to hold panels in the module of 100mm, at maximum spacing 1.2 M centre to centre. The carriers shall be suspended from roof by 4 mm dia galvanised steel wire hangers with special height adjustment clips made out of spring steel at maximum spacing of 1.2 M c/c. Hangers shall be fixed to roof by 'J' hooks and nylon inserts. 25 mm thick resin bonded mineral wool (spintex 300 or equivalent) insulation bound in polythene shall be laid on top of panels. Lineal ceiling shall be fixed in pattern as per detailed drawings.

3.00.00 SAMPLES

Samples of Ceiling panels and metal suspension system components as noted below shall be submitted for Engineer's approval:

Panels : 3 samples approximately 300 mm square/long each

Suspension System : 3 samples of short length : each of main and secondary system

4.00.00 SHOP DRAWINGS

Shop drawings shall be submitted for approval as required and approval shall be obtained prior to delivery of suspended ceiling components. Shop drawings shall be co-ordinated with all related work and shall show the following information:

- a) A reflected ceiling plan of areas indicated to receive the ceiling showing electrical and mechanical features.
- b) Typical Intermediate framing for support where required.
- c) Hanger fastening details.
- d) Panels - unit support at ceiling penetrations.
- e) Details of splicing method for main and cross runners.
- f) A table indicating load bearing capacity of main and cross runner
- g) A note stating that the suspension system member furnished will not deflect more than 1/360 of the span under the indicated loading.

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR SUSPENDED CEILING	SPECIFICATION NO. PE-TS-999-600-C014			
		VOLUME - II B			
		SECTION - D		SUB-SECTION – D14	
		REV.NO.	00	DATE	30/11/2015
		SHEET	6	OF	6
5.00.00	ACCEPTANCE CRITERIA				
	Finished ceiling shall be at the correct plane and present a pleasing and uniform appearance, free from, sags, warps, disfigured, or damaged board. Cutouts for light fixtures, diffusers etc. shall be of exact dimensions and in exact locations.				
6.00.00	RATES AND MEASUREMENT				
6.01.00	Rates				
	Rates shall be for the complete item called for in the “Schedule of Items”. No extra payment will be made for alignment and adjustment of lighting fixtures, air-conditioning diffusers, access panels etc. The rate shall include all cutting and wastage from standard size sheets, runners/carries etc.				
6.02.00	Measurement				
	Actual area of work shall be measured in Sqm correct to second place of decimal. However, no deduction will be made for opening upto 0.25 Sqm. each in area.				



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 30/11/2015

SHEET 1 OF 23

VOLUME: II B

SECTION - D

SUB-SECTION – D15

**WATER SUPPLY, DRAINAGE
AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 30/11/2015

SHEET 2 OF 23

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	MATERIAL	3
3.00.00	INSTALLATION	6
4.00.00	TESTING AND ACCEPTANCE CRITERIA	17
5.00.00	I.S. CODES	20
6.00.00	RATE AND MEASUREMENT	21



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 30/11/2015

SHEET 3 OF 23

WATER SUPPLY, DRAINAGE AND SANITATION

1.00.00 SCOPE

This section covers supply of all materials labour and incidentals required for supply, laying and installation of under/over ground pipes for water supply, drainage and sanitation with all fittings, fixtures and jointing, construction of ancillary works like manholes, drop connections, gully chambers, septic tank, soak pits, surface drain etc.

The supply and installation of water supply/sanitation fixtures and accessories like water closets, urinals, wash basins, sinks, mirrors, shelves, towel rail, soap container etc. with all fittings, fixtures, water supply/sanitation pipes and water storage tanks etc.

2.00.00 MATERIAL

All materials, fittings, fixtures, and appliances shall be of the best quality conforming to relevant Indian Standard and shall be procured from approved manufacturers. Unless specifically allowed by the Engineer, the Contractor shall submit samples of fittings and fixtures, which will be retained by him for comparison when bulk supplies are received at the site. Ultimate choice of type, model, and manufacturer lies completely with the Engineer.

It shall be the responsibility of the Contractor to procure the materials selected by the Engineer. Hence orders are to be placed with the manufacturers in time, so that the materials are available at the site well ahead of their requirement.

The materials brought to the site, shall be stored in a separate secured enclosure away from the building materials. Pipe threads, sockets, and similar items shall be specially protected till final installation. Brass and other expansive items shall be kept under lock and key. Fragile items shall be checked thoroughly when received at the site and items found damaged shall not be retained at the site.

2.01.01 Pipes and Pipe Fittings

For water supply, galvanised mild steel pipe of medium grade confirming to IS: 1239 shall be used. The galvanising shall not be less than 400gm/sqm of pipe surface area. Galvanising shall be smooth and shall be subjected to testing as per IS: 2633 for uniformity of coating. The zinc coating shall be free from defects.

For Roof drainage and building sanitation works following type of pipe are coved in this Section:

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION - D15 REV.NO. 00 DATE 30/11/2015 SHEET 4 OF 23
	a) Cast Iron pipe b) Steel pipe (lined, coated with bituminous composition, out coated with cement concrete or mortar or galvanized) c) Concrete pipe d) Asbestos cement pipe e) PVC pipe f) Stoneware pipe g) Vitrified pipe h) Lead pipe (not to be used for portable water) 2.02.01 Fixtures All material, fittings, fixtures, appliances, accessories shall be of approved quality and shall be procured from reputed brands like Hindustan/Pasriware/Cera or equivalent or as approved by Engineer. The bidder shall procure the fixtures from the above named reputed manufacturers and shall mention in his bid the type & make of the fixtures he intends to use. All items brought to the site must bear the manufacturer's identification mark. Procurements shall be made well in advance and should get inspected & approved immediately by the Engineer. All fixtures shall be adequately protected, covered, and plugged till handing over. All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated. The chromium plating shall be of grade-2 (10micron thickness) confirming to IS: 4827. Powder coating shall be of approved colour and shall have minimum thickness (DFT) of 20micron. Stainless steel accessories shall be of grade SS-304 and from reputed manufacturer (like Salem Steel) and shall be polished bright finish. Unless specified in the contract the fixtures shall be as specified hereinafter. Water closet a) European type It shall consist of European type glazed vitreous china basin (confirming to IS: 2556, part-II), with siphon open front solid plastic seat and plastic cover, low level glazed stoneware flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium	



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 30/11/2015

SHEET 5 OF 23

plated. Colour of basin, cistern, seat and cover shall be as approved by the Engineer.

b) Squatting type

It shall consist of Orissa pattern glazed vitreous china squatting pan with integral foot rests (confirming to IS:2556, part-III) and high level cast iron flushing cistern with valve less fittings, supply connections and necessary fittings. All fittings shall be chromium plated. The flushing cistern shall be painted as specified by the Engineer.

Urinals

It shall consist of wall type glazed vitreous china urinals (conforming to IS:2556), cast iron automatic flushing cistern complete with supply connections, flush pipe, lead pipes, gratings, traps and all other necessary fittings. Frequency of automatic flushing shall be approximately once every five minutes. For every four urinals (maximum) located together may be served by one cistern of adequately capacity. All fittings shall be chromium plated.

Wash Basin

It shall be made of glazed vitreous china conforming to IS:2556, part-IV. The basin shall be flat back, wall hung by painted cast-iron brackets and complete with hot and cold CP brass faucets with nylon washers, PVC connection pipe with CP brass nuts, CP brass chain with rubber plug, 32mm dia. Chromium plated brass waste of standard pattern, 32mm dia. CP brass trap union complete with necessary fittings.

Sink

It shall be made of glazed vitreous china conforming to IS:2556, part-V. It shall be wall hung by painted cast iron brackets and complete with one CP brass faucet with nylon washers, PVC connection pipe with CP brass nuts, CP brass chain with rubber plug, 40mm dia. chromium plated brass waste of standard pattern, 40mm dia. CP brass trap union complete with necessary fittings.

Bathroom mirror

It shall be made of the best quality 6 mm thick glass and produced by a reputed mirror manufacturer. It shall be wall mounted with adjustable revolving brackets. The brackets, screws, and other fittings shall be chromium plated.

	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION – D15 REV.NO. 00 DATE 30/11/2015 SHEET 6 OF 23
	Glass shelves Class shelves shall consist of 6 mm thick clear glass with guardrails and shall be wall mounted with brackets. All brackets, guardrails, and screws shall be chromium plated. Towel rail Towel rails shall be 20 mm dia chromium plated MS pipes wall mounted with steel brackets. The brackets, screws etc. shall also be chromium plated. Soap holder It shall be made of chromium plated strong members. The holders shall be wall mounted with chromium-plated screws. Liquid Soap Dispenser It shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting and screws shall be chromium plated. Toilet roll holder It shall be made of glazed vitreous china with suitable cover cum cutter. Wall mounting screw shall be chromium plated. Valve, cocks, Taps All valves, stop cocks, taps etc. shall conform to relevant Indian standard specification and shall be of best quality from approved manufacturers. These shall be suitable for normal working pressures. Nominal size and material shall be as required / specified. 2.03.00 Water Storage Tank Water storage tank shall be PVC of approved brand and make (Syntex or equivalent). Reservoirs made of concrete masonry or fabricated steel shall be covered by respective work specifications. 3.00.00 INSTALLATION 3.01.00 General Basic layouts may be available in the drawings provided, the details might have to be supplemented by the Contractor and get the approval of the Engineer before installation. Special attention shall be given to economise the layout. Symmetry of layout is very important. Fittings meant for operation	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION – D15 REV.NO. 00 DATE 30/11/2015 SHEET 7 OF 23
	shall be located and oriented to allow easy reach and operation. Maintenance, repairs, and replacements of pipes, fittings, and fixtures must be conveniently possible. All pipe lines, locations of fittings and fixtures, etc. shall be as per drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, symmetry, and levels shall be strictly ensured. All items shall be fully secured against movement in any direction and so located as to allow easy maintenance. All pipelines, fittings, and fixtures shall be installed leak proof. When the works under scope of this specification linked up with works executed by others, the connections shall be such as to prevent any splashing or spilling or emission of foul odour and gases. 3.02.00 Portable water supply Pipe Lines 3.02.01 Laying In addition to fulfilling the functional requirements all pipelines shall be laid true to line, plumb and level and shall run on the surface of the walls, ceiling or in chases. Any deviation shall need approval of the Engineer. Meticulous care shall be taken to avoid chances of airlock and water hammer. Pipes shall be laid on continuous unyielding surface or on reliable supports at least one near each joint and spacing as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every direction and easy maintenance. All pipes used for water supply should be thoroughly and efficiently disinfected before taken in to use. 3.02.02 Back Flow The layout of pipe work shall be such that there is no possibility of back flow towards the source of supply from any cistern or appliances, whether by siphonage or otherwise. All pipe works shall be so laid or fixed and maintained as to be and to remain completely watertight, thereby avoiding waste of water, damage of property and the risk of contamination of the water conveyed. 3.02.03 Contamination There shall be no cross connection whatsoever between a pipe/fitting for conveying or containing wholesome water and a pipe/fitting for containing impure water or water liable to contamination or of uncertain quality of water which has been used for any other purpose. No piping shall be laid or fixed so as to pass into or through any sewer, scour outlet or drain or any manhole connected therewith.	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION – D15 REV.NO. 00 DATE 30/11/2015 SHEET 8 OF 23
3.02.04	Underground Piping Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic and other loads and frost, where applicable. The size and depth of the trench shall be as approved by the Engineer. Back filling shall be done with selected fine earth, unless otherwise permitted, in 150 mm layers and carefully consolidated. Special care shall be taken while filling in the vicinity of the pipe to avoid damage. Before backfilling, the laid pipe shall be fully tested and approved. Where the pipe rests on rock it may be bedded on a layer of fine selected material or concrete to avoid local point support. The trench shall be so treated by gradient and filling in the area that it does not act as a drainage channel.	
3.02.05	Concealed Piping Where desired by the Engineer or shown on the drawings the pipes shall be concealed in masonry or concrete of the structure. The Contractor may co-ordinate with the building Contractor for leaving the chases, openings, and conduits as necessary. However, the Contractor will rectify if required the chases, openings, and conduits, supplement and make good after laying and testing of the concealed pipelines.	
3.02.06	Jointing of Pipes All G.I. pipes shall be properly thread/weld jointed and made completely water tight and durable. Burr from the joints shall be removed after screwing. Union joints shall be provided for all required location to facilitate maintenance.	
3.02.07	Painting Where required, underground G.I. pipes shall be given 2 coats of bituminous paint on the outside after laying. When painting is to be done above ground G.I. pipes shall be given one coat of red lead or zinc chromate primer and top coats shall be minimum 2 coats of best quality paint as specified.	
3.03.00	RAINWATER DOWN COMERS	
3.03.01	Pipes Rainwater down comers shall be standard Cast Iron or Asbestos Cement Pipes. In case where specifically desired, M.S. pipes may also be used. M.S. pipes shall be painted outside with two coats of anticorrosive paints under a coat of primer. Rainwater down comers shall run along and be secured to walls, columns etc.	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION – D15 REV.NO. 00 DATE 30/11/2015 SHEET 9 OF 23
	Where desired by the Engineer these may have to be installed in chases cut in the structure. All pipes shall be well secured and supported by adequately strong brackets. The brackets may be wrought iron clevis type, split ring type, or perforated strap iron type as approved by the Engineer. For vertical runs each pipe shall hang freely on its brackets fixed just below the socket. Suitable spacer blocks shall be provided against the vertical surface to which the pipe is fixed. All bends and junctions shall be supplied with watertight cleanouts. Roof and floor drains and yard gullies shall be installed, if required, by cutting into the structure and grouted with 1:2:4 cement concrete. All gutters shall be provided with removable gratings. All horizontal pipes shall have a minimum fall of 1 in 100. 3.03.02 Khurras The khurras shall be constructed before the work in parapet wall is taken up and it shall be 45x45 cm in size, unless otherwise specified and shall be formed of cement concrete of M-20 grade. 3.03.03 Gutters The gutters shall be made of G.I. or A.C and procured from reputed specialised manufacturers. Each section shall be sufficiently rigid, edges and corners straight and the slopes perfectly uniform. G.I. gutters shall have the edges strengthened by suitable means. Unless noted otherwise the gutters shall have a minimum fall of 1 in 120. Adequate number of string supports shall be provided so that there is no sagging even when the gutter is full. Each joint must have a support. Unless otherwise specified the supports shall be fabricated M.S. brackets. All junctions shall be thoroughly watertight. The joints may be made by riveting, bolting or soldering. All joints between successive lengths of gutters shall have an overlap of at least 5 cm. The drop in the overlap shall always be in the direction of the fall of the gutter. Ends of gutters shall be closed watertight. Junction with rainwater down comers shall be made fully watertight and secured. 3.04.00 SOIL AND DRAINAGE PIPES 3.04.01 Gradients If not specified the minimum gradients of soil and drainage pipeline shall be as follows:	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION – D15 REV.NO. 00 DATE 30/11/2015 SHEET 10 OF 23
	100 mm nominal dia : 1 in 35 150 mm nominal dia : 1 in 65 230 mm nominal dia : 1 in 120 300 mm nominal dia : 1 in 200 3.04.02 Relation with water supply pipelines Unless specifically cleared by the Engineer, under no circumstances shall drainage and sewer pipes be allowed to come close to water supply pipelines. 3.04.03 Laying Each separate pipe shall be individually set for line and for level. Where lengths of sewer or drain pipes are laid in trench, properly painted sight rails shall be fixed across the trench at a height, equal to length of the boning rod to be used, above the required invert level of the drain or sewer at the point where the sight is fixed. More sight rails shall be required at manholes, change of gradient and intermediate positions if the distance for sighting is more than 50 ft. apart. The excavation shall be boned in at least once in every 6 ft. The foot of the boning rod shall be set on a block of wood of the exact, thickness of the wall of the pipe. Each pipe shall be separately and accurately boned between sight rails. 3.04.04 Support and Protection of Pipelines All pipes shall be laid with sockets leading uphill. Preferably the pipe shall rest on solid and even foundations for the full length of the barrel. However, the pipe manufacturer's instruction as approved by the Engineer shall be followed in the matter of support and jointing. To achieve full and continuous support, concrete for bedding and packing is the best. Where pipes are not bedded on concrete, the floor shall be left slightly high and carefully placed so that the pipe barrels rest on undisturbed ground. If anywhere the excavation has been carried too low packing shall be done in concrete. Where laid on rock or very hard ground which cannot be easily excavated to a smooth surface, the pipes shall be laid on a cradle of fine concrete floor of gravel and crushed stone over laid with concrete or on a well consolidated gravel and crushed stone bed as desired by the Engineer. PVC or similar pipes shall be laid directly on stable soil and packed with selected soil. The minimum support and protection for glazed stoneware pipes shall be as follows: a) When cover is less than 2 metre below ground level and where pipes are unavoidably exposed above ground surface, the pipes shall be completely encased or surrounded with concrete.	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION - D15 REV.NO. 00 DATE 30/11/2015 SHEET 11 OF 23
	b) Where pipes are laid on soft soil with the maximum water table laying at the invert of the pipe, the sewer shall be bedded on concrete. c) Where the pipes have to be laid on soft soil with the maximum water table rising above the invert of the pipe, but below the top of the barrel, the pipe sewer shall be haunched. d) Where maximum water table is likely to rise above the top of the barrel or wherever the pipe is laid on soft soil the pipe sewers shall be completely encased or surrounded with concrete. Vitrified clay pipes shall be laid on a bed of 150 mm thick cement concrete (1:3:6) nominal mix by volume. Cast iron pipes and concrete pipes may be supported on suitable concrete or brick support, where specified. The supports shall be unyielding and strong enough. At least one support shall be located close to ends. Spacing of intermediate supports shall be as decided by the Engineer. Pipes shall be secured to the supports by approved means. Anchoring of pipes where necessary shall be achieved by suitable concrete encasing designed for the expected thrust. 3.04.05 Entry into structures For entry of the pipe lines into any building of structure suitable conduits under the structure or sleeves shall be used. The conduits and sleeves shall be such as to allow easy repairs and replacement of the pipes. When openings or chases are required to be made in the structure for entry of pipelines, locations and sizes shall be marked and checked by the Engineer. After laying of the pipeline the openings and chases shall be mended. 3.04.06 Ducts Where solid, waste and ventilating pipes are accommodated in ducts, access to cleaning areas shall be provided. Connection to drain shall be through a gully with sealed cover to guard against ingress of sewer gas, vermin, or backflow. 3.04.07 Traps and Ventilating Pipes Pipes are carrying off the waste from water closets and waste water and overflow water from baths, wash basins, sinks to drains shall be trapped immediately beneath such fixtures. Traps shall have minimum water seal of 50 mm and shall be ventilated whenever such ventilation is necessary to maintain water seal of the trap. Ventilating pipes shall be carried up vertically from the drain to a height of at least 600 mm above the outer covering of the roof of the building or as shown on drawings. All vertical ventilating, anti-	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION – D15 REV.NO. 00 DATE 30/11/2015 SHEET 12 OF 23
	syphonage and similar pipe shall be covered on top with a cowl. The cowl shall be made of C. I. unless desired otherwise by the Engineer. 3.04.08 Manhole & Inspection Chambers At every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The maximum distance between manholes shall be 30 meter unless specially permitted otherwise. However, for truck route (for pipes above 900 mm dia.) this distance can be increased to 45 M. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 metres unless desired otherwise provision of IS: 4111 (Part-1) shall be followed for construction of a manhole. Manhole shall be constructed so as to be watertight under test. The change in alignment shall be carried out in such a manner as to provide no lodgement for any splashings in case of accidental flashing of the chamber. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement, sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide smooth flow. Connecting to existing sewer lines shall be through a manhole. Unless otherwise specified, 560 mm dia. circular cast iron manhole cover with frame, heavy-duty, conforming to IS: 1726 shall be provided. The covers shall be close fittings so as to prevent gases from coming out. 3.04.09 Cutting of Pipes Manufacturer's instructions shall be followed for cutting of pipes where necessary. Suitable and approved tools shall be used for the cutting so as to leave surface clean and square to the axis of the pipe. 3.04.10 Jointing Jointing of pipes shall be so planned as to avoid completely any movement or strain to the joints already made. If any joint is suspected to be damaged it shall be opened out and redone. All joints between pipes, pipes and fittings and manholes shall be gas-tight when above ground and watertight when underground. Method of jointing shall be as per instructions of the pipe and fittings manufacturer and as approved by the Engineer. However, in the absence of any instruction available from the manufacturer the methods as detailed hereunder shall be used. a) Cast Iron Pipes Socket and spigot pipes shall be jointed by the cast lead joints. The spigot shall be centred in the socket of the pipe by tightly caulking in sufficient	



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 30/11/2015

SHEET 13 OF 23

turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. When the gasket or hemp yarn has been caulked tightly a jointing shall be placed round the barrel and tightened against the face of the socket to prevent airlock. Molten lead shall then be poured in to fill the remainder of the socket and caulked with suitable tools right round the joint to make up for shrinkage of the molten metal on cooling and shall be finished 3 mm behind the socket face.

Joints in cast iron pipes with special jointing arrangements like 'Tyton' Joints etc. shall follow the instructions of the manufactures.

In special cases if flanged joints are accepted by the Engineer the joints shall be made leak proof by inserting approved type of rubber gaskets. The bolts shall be secured in stages to avoid uneven strain.

b) Concrete Pipes

Jointing of concrete pipes shall be generally of rigid type. Unless otherwise stated collar type joint shall be provided. IS: 783 shall be followed for general guidance.

The two adjoining pipes shall be butted against each other and adjoined in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The angular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement : 2 sand) which shall be rammed with caulking tool. After a day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured for 7 days.

c) Glazed Stoneware Pipes

Tarred gasket or hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly so as not to fill more than 1/4 of the total depth of the socket. The remainder of the socket shall be filled with a stiff mixture of cement mortar 1:1 (1 cement : 1 sand). A fillet shall be formed round the joint with a trowel, forming an angle of 45 deg. with the barrel of the pipe. The newly made joints shall be protected, until set and shall be cured by covering with damp cloth or other suitable materials.

d) Vitrified clay pipes

The vitrified clay pipe shall be made from refractory clay mixed with crushed pottery and stone and burnt at a high temperature. These shall be hard, compact, and glazed to make them acid resistant and impervious, and



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 30/11/2015

SHEET 14 OF 23

shall be obtained from approved manufacturer.

Special care shall be taken in handling these pipes. The pipes shall not be jointed until the earth has been partly refilled over the portion of the pipe between the joint holes. Before laying the second pipe, the socket of the first pipe laid shall be thinly painted all round on the inside with cement slurry (1 part of cement and 2 parts of clean, sharp sand). A ring of rope yarn (closely twisted hemp or jute) dipped in neat cement paste or tar or bitumen, shall be inserted in the socket of pipe and driven home with caulking tools. The rope shall fully encircle the spigot with a slight overlap and shall not occupy more than one-fourth of the total depth of the socket. Where the spigot end of the pipe is made for receiving the gasket, it shall be wrapped with two or three turns of tarred spun, as close to the end as possible, before inserting into the socket. The joint shall then be completely filled with cement mortar (1:1), which shall have very little water. A fillet shall be formed round the joint with trowel, forming an angle of 45 degrees with the outside pipe. Special care shall be taken so that any excess mortar etc. left inside the pipe joints is neatly cleaned off immediately after each joint is made. A semi-circular wooden scrapper or a rubber disc to which a long handle is fixed could be used for this purpose.

e) Lead Pipes

The joints in lead pipes shall be made as wiped solder joint. The minimum and the maximum length of the wiped solder joints shall be 8 cm. and 9 cm. respectively. The solders shall generally consist of two parts of lead and one part of tin.

f) Polyethylene Pipes

The joints shall be thermo welded or bolted as per manufacturer's instructions.

g) Jointing Cast Iron Pipes with Stoneware Pipes

Where any cast iron drain pipe, ventilating pipe or trap is connected with a stoneware or semi-vitrified waste pipe, the beaded spigot end of such cast iron drain pipe, waste or ventilating pipe or trap shall be inserted into a socket of such stoneware pipe and the joint made with mortar consisting of one part of cement and one part of clean sand after placing a ratted gasket or hemp yarn soaked in neat cement slurry round the joint and inserted in it by means of a caulking tool.

h) Jointing Stoneware with Cast Iron Pipes

Where any water closet pan or earthenware trap connected to such a pan is to



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 30/11/2015

SHEET 15 OF 23

be jointed with a cast iron soil pipe, the joint between the stoneware spigot and the cast iron socket shall always be of a flexible nature. Such joint shall be made with a mixture of bitumen and chopped asbestos fibre.

3.04.11 Trenches and other excavations

Width of the trench at the bottom shall be such as to provide 200 mm clearance on either side of the pipe for facility of laying and jointing.

Excavated material shall be stacked sufficiently away from the edge of the trench and the side of the spoil bank shall not be allowed to endanger the stability of the excavation. Spoil may be carted away and used for filling the trench behind the work.

Turf, top soil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement.

All excavation shall be properly timbered, where necessary.

Efficient arrangements for dewatering during excavation and keeping it dry till backfilling shall be made to the satisfaction of the Engineer. Sumps for dewatering shall be located away from the pipe layout.

Where the excavation proceeds through roads necessary permissions shall be secured by the Contractors from the appropriate authorities.

Special care shall be taken not to damage underground services, cables etc. These when exposed shall be kept adequately supported till the trench is backfilled.

The backfilling shall be done only after the pipeline has been tested and approved by the Engineer. Special care shall be taken under and sides of the pipe during hand packing with selected material. At least 300 mm over the pipe shall also be filled with soft earth or sand. Consolidation shall be done in 150 mm layers. The surface water shall be prevented from getting into the filled up trench. Traffic shall not be inconvenienced by heaping up unduly the backfilling material to compensate future settlement. All future settlements shall be made good regularly to minimize inconvenience of traffic where applicable.

3.04.12 Protection

Open end of each pipe shall be protected during installation by suitable covers or plugs so that the ends, threads, sockets, or spigot are not damaged and no foreign material can find its way into the pipeline. Fittings and fixtures liable to be misused or stolen during the construction phase shall be fitted only before testing and handing over.



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 30/11/2015

SHEET 16 OF 23

3.05.00 WATER STORAGE TANKS

Overhead/loft type water storage tank shall be made of PVC. These tanks shall be provided for each toilet block and placed on the roof/loft of the building. Tank shall be installed with proper supports and anchorage for applicable wind and seismic condition. Installation of tank shall be carried out according to the recommendation of IS: 12701. These tanks shall rest preferable on flat surface so as to distribute the load evenly. The tank shall be leakproof and water tight.

The outlet pipe shall be 50 mm above the bottom of the tank and provided preferably with strainers. The wash out or draining pipe shall be connected at the lowest point and flush with bottom of tank.

Tank shall be provided with all fittings for inlet, outlet, overflow pipes and ball valves.

3.06.00 SEPTIC TANK AND EFFLUENT DISPOSAL

3.06.01 Septic tank

Septic tank shall consist of the tank itself with inlet and outlets there from complete with all necessary earthwork and backfilling. The details of septic tank shall be as shown on drawings. This item shall also include ventilating pipe of at least 100 mm dia whose top shall be provided with a suitable mosquito proof wiremesh and cowl. Ventilating pipe shall extend to a height of about 2 meter when the septic tank is at least 15 meter away from the nearest building and to a height of 2 meter above the top of building when it is located closer than 15 meter. Ventilating pipes can be connected to the normal soil ventilating system of the building where allowed.

3.06.02 Effluent Disposal

The effluent from the septic tank shall be disposed by allowing it into an open channel or a body of water if the concerned authority approves or into a soak pit for absorption by soil or shall be allowed to be absorbed by soil through open jointed SW pipes laid in a trench filled with broken bricks.

3.06.03 Soak pit

The soak pit shall be complete. It shall consist of a 900 mm dia pit 1000 mm in depth below the invert level of the inlet pipe. The pit shall be lined with stone; brick or concrete blocks set in cement mortar (1:6) and filled with brickbats. Inlet pipe shall be taken down to a depth of 900 mm from the top as an anti-mosquito measure.

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION – D15 REV.NO. 00 DATE 30/11/2015 SHEET 18 OF 23
	After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25 mm inlet with a stop-cock, allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 5 Kg/sq.cm or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long mains or mains of a large diameter, by a power driven test pump, provided that the pump is not left unattached. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable less for at least five minutes. The end of the main shall be closed by fitting a watertight expanding plug and the plug shall be secured by struts to resist the end thrust of the water pressure in the mains. 4.02.02 Testing of Service Pipes and Fittings The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely watertight. All piping, fittings, and appliances shall be checked for satisfactory support and protection from damage, corrosion, and frost. 4.03.00 Testing of Drain and Sewerage Pipelines All soil pipes, waste pipes, ventilating pipes and all other pipes, when above ground, shall be gas tight. All sewers and drainpipes laid below ground shall be tested water tight. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review and instruction. The Engineer's discretion regarding tolerance shall be final. General guidance for the tests are given below:	



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION - D15

REV.NO. 00 DATE 30/11/2015

SHEET 19 OF 23

a) Smoke test

All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a smoke test conducted under a pressure of 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oily waste or tarpaper or similar material in the combustion chamber of a smoke machine. Chemical smokes shall not be used.

b) Water test

The pipes shall be subjected to a test pressure of at least 1.5 m head of water at the highest point of the section under tests. The tolerance figure of two litres per centimetre of diameter per kilometre may be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system, with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

Subsidence of test water may be due to one or more of the following cases:

- a) Absorption by pipes and joints
- b) Sweating of pipes or joints
- c) Leakage at joints or from defective pipes
- d) Trapped air.

Allowance shall be made for (a) by adding water until absorption has ceased and after which the test proper should commence. Any leakage and the defective part of the work shall be cut out and made good.

c) For straightness

- i) By inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball will roll down the invert of the pipe and emerge at the lower end; and
- ii) By means of a mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipeline is not straight.

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION – D15 REV.NO. 00 DATE 30/11/2015 SHEET 20 OF 23
4.04.00	Fittings and Fixtures etc. All fittings and fixtures shall be connected by water tight joints. No dripping of water shall be acceptable. 4.05.00 Testing Septic Tank The septic tank shall be tested for water tightness. It shall be filled up with water and allowed to soak for 24 hours. Then, it shall be topped up and allowed to stand again for 24 hours and loss of level recorded. The fall shall not be more than 15 mm in 24 hrs. 5.00.00 I.S. CODES Important relevant IS Codes for this specification are listed below: Latest editions shall always be consulted. IS: 404 : Lead pipes. IS: 407 : Brass tubes for general purposes. IS: 458 : Concrete pipes (with or without reinforcement) IS: 783 : Code of Practice for laying of concrete pipes. IS: 1172 : Code of basic requirements for water supply, drainage and sanitation. IS: 1200 : Laying of water and sewer lines, including appurtenant items. (Pt.XVI) IS: 1230 : Cast iron rain water pipes and fittings. IS: 1239 : Specification for Mild Steel Tubes and Mild Steel (Pt.I & III) Tubulars and other wrought steel pipe fittings (10 mm to 15 mm nominal diameter). IS: 1536 : Specification for centrifugally cast (Spun) iron pressure pipes for water gas and sewage. IS: 1537 : Specification for vertically cast iron pressure pipes for water, gas and sewage. IS: 1592 : Asbestos cement pressure pipes,	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION – D15 REV.NO. 00 DATE 30/11/2015 SHEET 21 OF 23
	IS: 1626 : Asbestos cement pressure pipes, gutters and fittings (Spigot and Socket types). IS: 2065 : Code of Practice for Water Supply in buildings. IS: 2501 : Copper tubes for general engineering purposes. IS: 2556 : Specification for vitreous sanitary appliances (vitreous china) Part – I - General requirement IS: 2633 : Method of testing, uniformity of coating on zinc coated articles. IS: 3076 : Low density polyethylene pipes for portable water supplies. IS: 3486 : Specification for Cast iron spigot and socket drain pipes (80 mm to 250 mm nominal diameter). IS: 3589 : Specification for Electrically welded steel pipe for water, gas and sewage (200 mm to 2000 mm nominal diameter). IS: 4827 : Specification for electro plated coatings of nickel and chromium on copper and copper alloy. IS: 4964 : High-density polyethylene pipes for portable water supplies. IS: 12701 : Rotational moulded polyethylene water storage tanks	
6.00.00	RATE AND MEASUREMENT	
6.01.00	RATE	
6.01.01	G.I. Pipes For Water Supply	
	Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, clamps, drain heads, cleanouts etc. with cutting, making chases and jointing of pipes, making good the walls.	
6.01.02	Rainwater Down-comers Rate shall include providing and fixing of the pipes including all specials and fittings, such as tees, bands, elbows, clamps, drain heads, cleanouts etc. The rate also include cost of jointing and making good the opening in structure.	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR WATER SUPPLY, DRAINAGE AND SANITATION	SPECIFICATION NO. PE-TS-999-600-C015 VOLUME - II B SECTION - D SUB-SECTION – D15 REV.NO. 00 DATE 30/11/2015 SHEET 22 OF 23
	6.01.03 Sanitary Fixtures Rate shall include providing and fixing of sanitary appliances & fixtures and at all elevation, including all accessories and fittings, connections pipes, waste trap and pipes all complete as per description of “Schedule of Items”. Rate shall also include the jointing of waste & traps to drain pipes. 6.01.04 Drainage and Sewer Pipes Rate shall be inclusive of providing, laying and jointing of pipes as specified. Rate also include cost of lead joints or other joint as specified, cost for painting and cutting and making good walls, floors etc. 6.01.05 Floor and Gully Traps Rate of traps is inclusive of all excavation, filling, repair, making good of opening in floor and walls, grating, painting etc. complete as described in “Schedule of Items”. 6.01.06 Manholes, Septic Tank, Soak Pit and Cover Rate of manholes, septic tank, soak pit shall be paid under respective items of work executed like brick work, plastering, concrete, reinforcement steel etc. provided for completion of the structure as per drawing and specifications. Manhole cover shall be paid separately as per description of item. 6.01.07 Water Storage Tank The rate for water storage tank is inclusive of supply and installation of tank with all fittings, inlets, outlets, valves etc. complete. 6.02.00 MEASUREMENTS 6.02.01 Pipe for Water Supply and Drainage For G.I.Pipe of water supply line, rainwater down comers, drainage and sewer pipe, the measurements shall be in running metres and shall be taken along centre line of pipe or specials. The pipe shall be measured separately according to dia. and class of pipe. Fixtures like bibcock, stopcocks, valves etc. shall be measured in numbers.	



TITLE:

**TECHNICAL SPECIFICATION
FOR WATER SUPPLY,
DRAINAGE AND SANITATION**

SPECIFICATION NO. PE-TS-999-600-C015

VOLUME - II B

SECTION - D | SUB-SECTION – D15

REV.NO. 00 DATE 30/11/2015

SHEET 23 OF 23

6.02.02

Sanitary Appliances & Fixtures and Allied Works

All sanitary appliances & fixtures like sink, washbasin, WC, shall be measured in numbers for the complete work as described in schedule of items.

Floor and gully traps shall be measured in numbers unless otherwise specified.

Water storage tank shall be measured in numbers for the capacity as specified in “Schedule of Items”.

The item of work executed for completion of manholes, septic tank & soak pit shall be measured in respective items of work like brick work, RCC, plastering etc. CI cover shall be measured in numbers as specified in “Schedule of Items”.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 30/11/2015

SHEET 1 OF 36

VOLUME: II B

SECTION - D

SUB-SECTION – D16

SPECIFICATION NO. PE-TS-999-600-C016

ROAD AND DRAINAGE



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 30/11/2015

SHEET 2 OF 36

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.0	CODES AND STANDARDS	4
3.00.0	EXECUTION	7
4.00.00	TESTING AND ACCEPTANCE CRITERIA	36
5.00.00	MEASUREMENT	36

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 30/11/2015 SHEET 3 OF 36
Standard Technical Specification For Road and Drainage 1.00.00 Scope The scope include all works required for the construction of road including construction of embankment, sub-base course, base course, tack coat, bituminous macadam, wearing course, liquid seal coat, shoulder and all incidental items of work specified or not shown but reasonably implied or necessary for the completion of the work etc. The scope also include all works required for the construction of drainage including construction of road side drains, RCC culverts, pipe culverts, drainage pipes, manholes and all other incidental items necessary for the completion of the work etc. 1.01.00 Works To Be Provided By The Contractor The works to be provided by the contractor unless specified otherwise shall include but not be limited to the following. a) Construction of roads including providing all materials, labour, supervision, services, equipments, tools and plants, transportation etc all required for the completion of the work. b) Submission of detailed scheme of all operations required for executing the work (e.g. material handling, placement, services, approaches etc) to the engineer for approval. c) Carrying out tests whenever required by the engineer to assess the quality of work and submission of the test results to the engineer after completion of the same etc. 1.02.00 Work To Be Provided By Others No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract. 1.03.00 Conformity With Designs The contractor shall carryout the work as per the construction drawings, specification and as directed by the engineer.		

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 30/11/2015 SHEET 4 OF 36
1.04.00	Materials To Be Used All materials required for the work shall be the best commercial variety and as approved by the engineer. 2.00.00	Codes and Standards All works under this specification shall conform to the latest revision and/or replacement of the following or any other IRC/IS Codes and Standard Practices unless specified otherwise. a) Specification for road and bridge works of Ministry of Shipping & Transport (Road Wing) Published by the IRC b) IRC: 19 - Standard specification and code of practice for Water bound Macadam c) IRC :SP 11 - Hand Book of Quality Control for Construction of Roads and Runways d) IS:456 - Indian Standard Code of Practice for Plain and Reinforced Concrete. e) IS:2212 - Code of Practice for Brick work f) IS: 783 - Code of Practice for Laying of Concrete Pipes g) IS: 1201 - Methods of testing tar and bituminous materials to 1220 h) IS: 73 - Specification for paving bitumen i) IS: 215 - Specification for Road tar j) IS: 216 - Coal tar pitch k) IS: 217 - Specification for cut-back bitumen l) IS: 454 - Specification for cut-back bitumen from waxy crude m) IS: 1834 - Specification for hot applied sealing compound for joint in concrete n) IS: 1838 - Specification for performed fillers for expansion joints in concrete, non extruding and resilient type Part I Bitumen impregnated fibre



TITLE:

TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 30/11/2015

SHEET 5 OF 36

Part II CNSL Aldehyde resin and coconut pith

- o) IS : 334 - Glossary of terms relating to bitumen and tar
- p) IS: 1077 - Common burnt clay building bricks
- q) IS : 3117 - Specification for bitumen emulsion roads (anionic type)
- r) IS : 1200 - Method of measurement of building and civil engineering work (Part-17)- Road work including airfield pavements
- s) Other specifications mentioned elsewhere in this specification.

In case any particular aspect of work is not covered specifically by the specification/Indian Standard Code of practices, any other standard practice as may be specified by the engineer shall be followed.

2.01.00

Quality Control

The Contractor shall establish and maintain quality control for all materials, procedures, workmanship and equipments used. All works shall conform to the lines, grades, cross sections and dimensions shown on the drawings, specification and as directed by the engineer. Permitted tolerances for road works are described hereinafter.

a) Horizontal Alignment

Horizontal alignment shall be reckoned with respect to the centre line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of $\pm 25\text{mm}$ therefrom. The corresponding tolerance for edges of the roadway and lower layers of the pavement shall be $\pm 40\text{mm}$.

b) Longitudinal Profile

The finished levels of the sub-grade and different pavement courses as constructed shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the engineer and shall not exceed the tolerances as mentioned below.

Sub-grade	$\pm 25 \text{ mm}$
Sub-base	$\pm 20 \text{ mm}$
Base course	$\pm 15 \text{ mm}$
Wearing course	$\pm 10 \text{ mm}$

Tolerance in wearing course shall not be permitted in conjunction with the



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 30/11/2015

SHEET 6 OF 36

positive tolerance on base course if the thickness of the wearing course is thereby reduced by more than 6 mm.

c) Surface Regularity of Sub-grade and Pavement Courses

The surface regularity of the completed sub-base, base course and wearing surfaces in the longitudinal and transverse directions shall be within the tolerances indicated in Table - I. The longitudinal profile shall be checked with a 3m long straight edge at the middle of each traffic lane along a line parallel to the centre of the road. The transverse profile shall be checked with a set of three camber boards at intervals of 10m.

TABLE –I

PERMITTED TOLERANCE OF SURFACE REGULARITY FOR PAVEMENT COURSES

Sl. No.	Type of Construction	Longitudinal profile with 3m straight edge				Cross Profile	
		Maximum permissible Undulation (mm)	Maximum number of undulations permitted in any 300m length with undulation exceeding (mm)				Maximum permissible variation from specified profile under camber template (mm)
			18	12	10	6	
1	2	3	4	5	6	7	8
1.	Earthen sub-grade	25	30	-	-	-	15
2.	Granular sub-base	15	-	30	-	-	12
3.	Water Bound Macadam with oversize metal (40-90 mm size)	15	-	30	-	-	12
4.	Water Bound Macadam with normal size metal (20-50 mm and 40-63 mm size), Bituminous Penetration Macadam	12	-	-	30	-	8
5.	Surface dressing** (two coat) over WBM (20-50 mm or 40-63 mm size metal), Bituminous penetration macadam	12	-	-	20	-	8
6.	Open graded premix carpet, mix seal Surfacing	10	-	-	-	30	6
7.	Bituminous macadam	10	-	-	-	20***	6

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE		SPECIFICATION NO. PE-TS-999-600-C016					
			VOLUME - II B					
			SECTION - D		SUB-SECTION – D16			
			REV.NO.	00	DATE	30/11/2015		
	SHEET	7	OF	36				
8.	Semi-dense carpet	10	-	-	-	20***	6	
9.	Asphaltic Concrete	8	-	-	-	10***	4	
Notes: 1. ** For surface dressing in all other cases, the standards of surface evenness will be the same as those for the surface receiving the surface dressing. 2. *** These are for machine laid surfaces. If laid manually due to unavoidable reasons, tolerance upto 50 percent above these values in this column may be permitted at the discretion of the Engineer. However this relaxation does not apply to the values of maximum undulation for longitudinal and cross profiles mentioned in columns 3 and 8 on the table. 3. Surface evenness requirements in respect of both the longitudinal and cross profiles should be simultaneously satisfied. 3.00.00 Execution 3.01.00 Setting Out Within 15 days of the award of contract, the contractor shall prepare and submit to the Engineer detailed drawings/schemes of embankment filling and excavation works as proposed to be executed by him showing the dimensions as per construction drawings and specification adding his proposals of drainage and dewatering of pits, watering and compacting the embankment fill etc. On receiving the approval from the Engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the Engineer and fix permanent points and markers for ease of future checking. These permanent points and markers will be checked by the Engineer and certified by him after which the contractor shall proceed with the work. It should be noted that this checking by the Engineer prior to the start of the work will in no way absolve the contractor of his responsibility of carrying out the work to true lines and levels as per the approved drawings. If any errors are noticed in the Contractor’s work at any stage, the contractor at his own risk and cost shall rectify the same. Profiles of the embankment made with Bamboo, earth or other convenient materials and strings shall be set up at suitable intervals for the guidance of the workmen. 3.02.00 Clearing and Grubbing Before commencement of earthwork, the surface area of ground to be occupied shall be cleared of all fences, trees, logs, stumps, bushes, vegetation, rubbish, slush etc. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below ground level or 300mm below formation level whichever is deeper. After the removal of roots of								

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 30/11/2015 SHEET 8 OF 36
	trees, the pot holes formed shall be filled with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the Engineer. The trees shall be cut into suitable pieces as instructed by the Engineer. Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be burnt or removed from the site to the approved disposal areas as may be specified. Useful materials, saleable timbers, firewood etc shall be the property of the Owner and shall be stacked properly at the work site in a manner as directed by the Engineer. 3.03.00 Filling in Embankment 3.03.01 General The material used for constructing the embankment shall be earth, moorum, gravel or a mixture of the above or any other material approved by the Engineer. The material shall be free from lumps and clods, boulders and rock pieces, roots and vegetation, harmful salts and chemicals, organic materials, loose silts, fine sands and expansive clays in order to provide a stable embankment. The filling and compaction operation should be such that the best available materials are saved for the top portion and will result in an acceptable and uniform gradation of material and provide impermeability and stability to the embankment when compacted. The size of the coarse material in the mixture of earth shall ordinarily not exceed 75mm. However the Engineer may at his discretion permit the use of material coarser than the specified if he is satisfied that the same will not present any difficulty as regard to the placement and compaction of the fill material are concerned. Ordinarily, only the materials satisfying the density requirements as given below in Table-II shall be employed for embankment construction.	

Table - II

Density Requirements of Embankment Materials

Sl. No.	Type of Work	Maximum laboratory dry density when tested as per IS: 2720 (Part - VII)
1.	Embankment upto 3m height	Not less than 1.44 gm/cc
2.	Embankment exceeding 3m height and embankment of any height subject to long period of inundation	Not less than 1.52 gm/cc
3.	Top 0.5m of the embankment below sub-base and shoulders (where earth shoulders are specified)	Not less than 1.65 gm/cc

Expansive clays exhibiting marked swell and shrinkage properties shall not be used for embankment construction.

The material for embankment construction shall be obtained from approved sources with preference given to the materials available from nearby road excavation or any other excavation under the same contract.

3.03.02 Setting Out

After the site clearance, the work shall be set out true to lines, curves, slopes, grades and sections as shown on the approved drawings or as directed by the Engineer. The contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboo, stones, lime, mortar, concrete etc required in connection with the setting out of the works and establishment of the bench marks. The limits of the embankment shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. To ensure the safety, the pegs should normally be fixed about 500mm away from the actual limits of the fill and to be painted in a distinct colour. The centreline of the embankment shall be pegged at regular intervals of 25/30m and at all skews/curves. The actual profile of the embankment shall be made at every third centre line peg with bamboo posts and strings. Preferably prototype profiles developed with wooden planks need to be fixed at every 200m and at the intersection points at curves. The profile shall be about 3m long.



TITLE:

TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 30/11/2015

SHEET 10 OF 36

3.03.03

Stripping and Storing top soil

The construction of the earthen embankment by filling shall conform to the dimensions, slopes and other details shown in the approved drawings. Before commencement of the embankment construction, the surface area of ground to be occupied after clearing and grubbing shall be stripped off to a minimum depth of 150mm or more as directed by the Engineer in order to remove all perishable materials and any soil which may become unstable on saturation or may interfere with the development or proper bonding between the foundation and embankment. It is not necessary to remove all the soil containing fine hair like roots but only the rather heavy mats are to be removed. In localities where most of the available embankment fill materials are not conducive to plant growth or when so directed by the Engineer, the top soil suitable for plant growth existing over the embankment foundation areas shall be stripped to specified depths not exceeding 150mm and stored for covering the embankment slopes where revegetation is desired.

3.03.04

Compacting Original Ground

In all cases, the original ground after stripping shall be compacted by rolling with a minimum six passes of 8-10 tonne roller and as directed by the Engineer.

Where the height of the proposed embankment is less than 0.5m and the original ground does not already have a relative compaction of atleast 95 percent of Standard Proctor density (maximum dry density), the same shall be loosened upto a depth of 0.5m and filled in layers not exceeding 250mm in loose thickness and each layer shall be watered and compacted to 100% maximum dry density of the fill material determined in accordance with IS:2720, Part-VII. However before relaying and compacting the loosened material, the surface below this level shall be suitably compacted as directed by the Engineer with a minimum six passes of 8 - 10 tonne roller.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced with approved materials suitably compacted. Embankment work shall not proceed until the foundation soil of the embankment is inspected by the Engineer and approved.

3.03.05

Filling

The embankment material shall be spread uniformly over the entire width of the embankment in layers not exceeding 250mm in loose thickness. Successive layers of embankment shall not be placed until the layer under construction has been thoroughly compacted to the requirements set down hereunder. Moisture content of the fill material shall be checked at the source of supply and if found less than that specified for compaction, the same shall

**TITLE:****TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 30/11/2015

SHEET 11 OF 36

be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case water shall be sprinkled directly from a hose line or from a truck mounted water tank and flooding shall not be permitted under any circumstances. After adding required amount of water, the soil shall be processed by means of harrows, rotary mixers or by any other approved method until the layer is uniformly wet.

If the material delivered to the road bed is too wet, it shall be dried by aeration and exposure to the sun till the moisture content is acceptable for compaction. Should circumstances arise where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended.

Moisture content of each layer shall be checked in accordance with IS:2720, Part-II and unless otherwise specified shall be so maintained making due allowance for evaporation losses that during compaction, the moisture content shall be in the range of 1 percent above to 2 percent below the optimum moisture content as determined in accordance with IS:2720, Part-VII.

Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the lower layers of the embankment and a maximum size of 60mm when being placed in the top 0.5m portion of the embankment below sub-base.

Hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer to minimise rutting or uneven compaction.

Where the embankment is to be constructed across a low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed layer to a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers.

3.03.06**Compaction**

Compaction equipment approved by the Engineer shall only be employed for construction. If directed by the Engineer, the Contractor shall demonstrate the efficiency of the plant he intends to use by carrying out compaction trials. Each layer shall be thoroughly compacted to the density as specified in Table-III. Subsequent layers shall be placed only after the finished layer has been tested and accepted by the Engineer.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 30/11/2015

SHEET 12 OF 36

Table - III

Compaction Requirements For Embankment

Sl. No.	Type of work/material	Field dry density as a percentage of maximum laboratory dry density as per IS : 2720, Part-VII
1.	Top 0.5m portion of embankment below sub-base and shoulders	Not less than 100
2.	Other portions of embankment	Not less than 95

When density measurements reveal any soft area in the embankment, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft area shall be removed and replaced with approved material and compacted to the density requirements and satisfaction of the Engineer.

3.03.07 Drainage

The surface of the embankment at all times during construction shall be maintained at such a cross fall as will shed water and prevent ponding.

3.03.08 Finishing Operations

Finishing operations shall include the work of shaping and dressing the shoulders, road bed and side slopes to conform the alignment, levels, cross sections and dimensions as shown on the drawings or as directed by the Engineer. Both the upper and lower ends of the side slopes shall be rounded off to improve the appearance and merge the embankment with the adjacent terrain.

3.04.00 Turfing With Sods

3.04.01 General

This work shall consist of furnishing and laying live sod of perennial turf forming grass on embankment slopes, shoulders or other locations as shown on the drawings or as directed by the Engineer. Unless otherwise specified the work shall be taken up following the construction of embankment provided the season is favourable for establishment of the sod.

3.04.02 Materials

The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically



TITLE:

TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 30/11/2015

SHEET 13 OF 36

free from weeds and other undesirable matters. At the time the sod is cut, the grass shall have a length of approximately 50mm and the sod shall be free from any debris.

Thickness of the sod shall be as uniform as possible with about 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that practically all the dense root system of the grass are retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than 250mm x 300mm in size but not so large so that it is convenient to handle and transport without damage. During wet weather the sod shall be allowed to dry sufficiently to prevent rearing during handling and during dry weather it shall be watered before lifting to ensure its vitality and to prevent dropping of soil during handling.

3.04.03 Placing The Sods

The area to be sodded shall be previously constructed to the required slope and cross section. Soil in the area shall be loosened, freed from all stones larger than 50mm size, sticks, stumps and any other undesirable foreign matters etc and brought to a reasonably granular texture to a depth not less than 25mm for receiving the sod.

Where required, top soil shall be spread over the slopes. Prior to placing the top soil, the slopes shall be roughened and wetted in order to have a satisfactory bond. The depth of top soil (to be spread) shall be 75mm.

Following soil preparation and top soiling (if required), fertilizer and ground limestone when specified shall be spread uniformly. After spreading, the materials shall be incorporated in the soil by discing or other means. The prepared sod bed shall be moistened if not already sufficiently moist and the sod shall be placed thereon within 24 hours after the same has been cut. Each sod strip shall be laid in close contact with each other and shall be lightly tamped with suitable wooden or metal tampers so as to eliminate air pockets and to press it into the underlying soil. At points where water may flow over the sod, the upper edges of the sod strips shall be turned into the soil below the adjacent area and a layer of earth shall be placed over it followed by thorough compaction.

3.04.04 Staking the Sods

Where the side slope is 2 to 1 or steeper and the distance along the slope is more than 2m, the sods shall be staked with pegs or nails spaced approximately 500 to 1000mm along the longitudinal axis of the sod strips. Stakes shall be driven approximately plumb through the sods and to be almost flushed with them.

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 30/11/2015 SHEET 14 OF 36
	3.04.05 Top Dressing After the sods have been laid in position, the surface shall be cleaned of any loose sod, excess soil and other foreign materials. Thereafter a thin layer of top soil shall be scattered over the top dressed surface and the area shall be thoroughly moistened by sprinkling water. 3.04.06 Watering and Maintenance The turfing so laid shall be well watered and protected until final acceptance. Watering shall be done in such a way that no erosion or damage to the sodded areas/embankment occur. The Contractor shall erect necessary warning signs and barriers, repair or replace the sods which are failing to show uniform growth of grass or damaged by his operation and shall maintain the sod at his own cost until final acceptance. 3.05.00 Shoulder Construction 3.05.01 Description This work shall consist of constructing shoulder on either side of the pavement in accordance with the requirements of this specification and in conformity with the lines, grades and cross sections shown on the approved drawings and as directed by the Engineer. 3.05.02 Materials Shoulder shall be made of selected earth or granular material as specified conforming to relevant IRC standards. 3.05.03 Construction Operations Except in the case of bituminous pavements, the shoulders shall be constructed in advance to the laying of pavement courses. The compacted thickness of each layer of shoulder shall correspond to the compacted layer of pavement course to be laid adjacent to it. After compaction, the inside edges of shoulders shall be trimmed vertical and the area enclosed between the shoulders shall be cleaned of all spilled materials before proceeding with the construction of the pavement layer. In the case of bituminous pavements, shoulder shall be constructed only after the pavement courses have been laid and compacted. Regardless of the method of laying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed without any damage to the	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 30/11/2015 SHEET 15 OF 36
	pavement and the area so affected shall be thoroughly cleaned. During all stages of shoulder construction, the required crossfall shall be maintained to drain off surface water. 3.06.00 Kerb 3.06.01 Material Kerb if required for the construction of footpath shall consist of precast concrete blocks with concrete grade of M-20. The blocks shall be of 100mm thick and of suitable length. The depth of blocks unless otherwise mentioned elsewhere shall be 375mm considering 225mm height of footpath above the road level. 3.06.02 Laying The kerb shall be laid by cutting trenches of 150mm deep. The width of the trench shall be minimum and just sufficient to insert the kerbs. The inside faces of the kerbs shall be in plumb and the gap between the block shall not be more than 10mm. The gap shall be filled with cement mortar as specified. The kerbs shall be thoroughly packed with a mixture of stone chips (50%) and moorum (50%) at the outside face. The laying and packing shall be done in a proper workmanlike manner acceptable to the Engineer. 3.07.00 Sub-base (Granular Sub-base) 3.07.01 Description This work shall consist of laying and compacting well graded material on the prepared sub-grade in accordance with the specification. The material shall be laid in one or more layers as shown on the drawings and shall conform to the lines, grades and cross sections shown on the drawings and as directed by the Engineer. 3.07.02 Materials The materials to be used for the work shall be natural sand, moorum, gravel, crushed stone, crushed slag, crushed concrete, brick metal, laterite, kankar etc or combinations thereof depending upon the grading required. The mixed materials shall be free from organic and other deleterious constituents and conform to one of the three grading given in Table - IV below.	

**Table - IV
Grading for Granular Sub-base Material**

Sieve designation	Percent by weight passing the sieve		
	Grading 1	Grading 2	Grading 3
80 mm	100	100	100
63 mm	90 - 100	90 - 100	90 - 100
4.75 mm	35 - 70	40 - 90	50 - 100
75 micron	0 - 20	0 - 25	0 - 30
Minimum CBR value for the fraction of material passing 20 mm sieve.	30 %	25%	20%

Note : The materials passing 425micron sieve for all the three gradings when tested according to IS : 2720, Part V shall have liquid limit and plasticity index not more than 25 percent and 6 percent respectively.

3.07.03 Physical Requirements

The fraction of materials passing 20mm sieve shall give a CBR value as specified in Table – IV when tested in accordance with IS : 2720, Part XVI after preparing the samples at maximum dry density and optimum moisture content corresponding to IS : 2720, Part VII and soaking the same in water for 4 days.

3.07.04 Spreading and Compacting

Immediately prior to laying of sub-base, the sub-grade already finished shall be prepared by removing all vegetations and other extraneous matters, lightly sprinkled with water if necessary and rolled with one pass of 8 - 10 tonne smooth wheeled roller.

The sub-base material shall be spread on the sub-grade with the help of a drag spreader, motor grader or other approved means. The thickness of loose layers shall be so regulated that the maximum thickness of each layer after compaction shall not exceed 150mm.



TITLE:

TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 30/11/2015

SHEET 17 OF 36

Moisture content of the loose material shall be checked in accordance with IS : 2720, Part II and shall be suitably adjusted by sprinkling additional water from a hose line, truck mounted water tank or other approved means so that at the time of compaction it shall be from 1 percent above to 2 percent below the optimum moisture content. While adding water, due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means if so directed by the Engineer until the layer is uniformly wet.

Immediately thereafter, rolling shall be done with 8 to 10 tonne smooth wheeled rollers or with any other approved plant. Rolling shall commence from the edges and progress towards the centre longitudinally except on super elevated portions where it shall progress from the lower to the upper edge parallel to the centre line of the pavement. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and camber shall be checked and any high spots or depressions which become apparent shall be corrected by removing or adding fresh material.

Rolling shall be continued till the density achieved is at least 100% of the maximum dry density of the material determined as per IS : 2720, Part VII. The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction plant and from compaction planes, ridges, cracks or loose materials. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and recompacted.

3.08.00 Water Bound Macadam Sub-base/Base Course

3.08.01 Description

Water bound macadam shall consist of clean crushed aggregates mechanically interlocked by rolling and bonded together with screenings, binding material wherever necessary and water, laid on the prepared sub-grade or sub-base as the case may be and finished in accordance with the specification and in conformity with the lines, grades and cross-sections shown on the approved drawings.

3.08.02 Materials

a) Coarse Aggregates - General Requirements

Coarse aggregates shall be either crushed or broken stone. The aggregates shall conform to the physical requirements set forth in Table - V.

Table – V

Physical Requirements of Coarse Aggregates for Water Bound Macadam

Sl.No.	Type of Construction	Test	Test method	Requirements
1.	Sub-base	Los Angeles Abrasion Value * or Aggregate Impact Value	IS : 2386 (Part IV) IS : 2386 (Part IV) or IS : 5640**	50 percent maximum 40 percent maximum
2.	Base	a) Loss Angeles Abrasion value* or Aggregate Impact Value b) Flakiness Index ***	IS : 2386 (Part IV) IS : 2386 (Part IV) or IS : 5640 ** IS : 2386 (Part I)	50 percent maximum 40 percent maximum 15 percent maximum

* Aggregates shall satisfy requirements of either of the two tests.

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

*** The requirements of Flakiness Index shall be enforced only in case of crushed or broken stone and crushed slag.

b) Crushed or Broken Stone

Crushed or broken stone shall be hard, durable and free from excess flat, elongated, soft and disintegrated particles, dirt and other objectionable matters.

c) Grading Requirements of Coarse Aggregates

The coarse aggregates shall conform to one of the gradings given in Table – VI. However the use of Grading-1 shall be restricted to sub-base courses only.

**Table - VI
Grading Requirements of Coarse Aggregates**

Grading	Size range	Sieve designation	Percent by weight passing the sieve
1.	90mm to 40 mm	100 mm 80 mm 63 mm 40 mm 20 mm	100 65 - 85 25 - 60 0 - 15 0 - 5
2.	63 mm to 40 mm	80 mm 63 mm 50 mm 40 mm 20 mm	100 90 - 100 35 - 70 0 - 15 0 - 5
3.	50 mm to 20 mm	63 mm 50 mm 40 mm 20 mm 10 mm	100 95 - 100 35 - 70 0 - 10 0 - 5

d) Screenings

Screenings to fill the voids in the coarse aggregate shall generally consist of the same material as the coarse aggregates. However where permitted, predominantly non-plastic material such as moorum or gravel (other than rounded river borne material) may be used for this purpose provided liquid limit and plasticity index of such material is below 20 and 6 respectively and fraction passing 75 micron sieve does not exceed 10 percent.

As far as possible, screenings shall conform to the grading set forth in Table-VII. Screenings of Type-A in Table-VII shall be used with coarse aggregates of Grading-1 in Table-VI. Screenings of Type-A or B shall be used with coarse aggregates of Grading-2. Screenings of Type-B shall be used with coarse aggregates of Grading-3.

**Table - VII
Grading For Screenings**

Grading classification	Size of screenings	Sieve designation	Percent by weight passing the sieve
A	12.5 mm	12.5 mm	100
		10.0 mm	90 - 100
		4.75 mm	10 - 30
		150 micron	0 - 8
B	10 mm	10 mm	100
		4.75 mm	85 - 100
		150 micron	10 - 30

e) Binding Material

Binding material to be used for water bound macadam construction shall comprise of a suitable material approved by the Engineer having plasticity index value less than 6 as determined in accordance with IS : 2720, Part V. Application of binding material may not be necessary when the screenings used are of crushable type such as moorum or gravel.

3.08.03

Construction Operations

a) The sub-grade/sub-base to receive the water bound macadam coarse shall be prepared to the specified grade and camber and made free of any dust and other extraneous materials. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm. Where water bound macadam is to be laid over an existing black topped surface, 50mm x 50mm furrows shall be cut at an angle of 45 degrees to the centre line of the road at 1m intervals in the latter before laying the coarse aggregates.

b) Inverted Choke

If water bound macadam is to be laid directly over the sub-grade without any other intervening pavement course, a 25mm course of screenings (Grading-B) shall be spread on the prepared sub-grade before application of coarse aggregates is taken up.

c) Spreading Coarse Aggregates

The coarse aggregates shall be spread uniformly over the prepared surface in such quantities that the thickness of each compacted layer is limited to 100mm for Grading-1 and 75 - 100mm for Grading-2 and 3. The spreading shall be

**TITLE:****TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 30/11/2015

SHEET 21 OF 36

done from stockpiles along the side of the roadway or directly from the vehicles. In no case shall the aggregate be dumped in heaps directly on the surface prepared to receive the aggregates nor shall hauling over permitted. The surface of the aggregates spread shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregates as may be required. No segregation of large or fine particles shall be allowed and the coarse aggregates as spread shall be of uniform gradation with no pockets of fine material. The coarse aggregates shall not normally be spread more than 3 days in advance of the subsequent construction operation.

d) Rolling

Immediately following the spreading of the coarse aggregates, rolling shall be started with three wheeled power rollers of 8 to 10 tonne capacity or with tandem or vibratory rollers of approved type. The weight of the roller shall depend upon the type of the aggregate and be indicated by the Engineer.

Except on super elevated portions where the rolling shall proceed from inner edge to the outer, rolling shall begin from the edges gradually progressing towards the centre. First the edge/edges shall be compacted with roller running forward and backward. The roller shall then move inwards parallel to the centre line of the road. Each pass of the roller shall uniformly overlap not less than one half the width of the track made in the preceding pass.

Rolling shall continue until the aggregates are thoroughly keyed and the creeping of aggregates ahead of the roller is no longer visible. During rolling slight sprinkling of water may be done if necessary. Rolling shall not be done when the sub-grade is soft or yielding or when it causes a wavelike motion in the sub-grade or sub-base course.

The rolled surface shall be checked transversely and longitudinally with templates and any irregularities found shall be corrected by loosening the surface, adding or removing necessary amount of aggregates and rerolled until the entire surface conform to the desired camber and grade. In no case shall the use of screenings be permitted to make up the depressions.

e) Application of Screenings

After the coarse aggregate has been rolled, screenings to completely fill the interstices shall be applied gradually over the surface. These shall not be damp or wet at the time of application. Dry rolling shall be done while the screenings are being spread so that vibrations of the roller cause them to settle into the voids of the coarse aggregates. The screenings shall not be dumped in piles but be spread uniformly in successive thin layers either by the spreading motion of hand shovels or by mechanical spreader or directly from trucks. Trucks operating for spreading the screenings shall be so driven as not to disturb the coarse aggregates.



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 30/11/2015

SHEET 22 OF 36

The screenings shall be applied at a slow and uniform rate (in three or more applications) so as to ensure filling of all voids. This shall be accompanied by dry rolling and brooming with mechanical brooms or hand brooms or with both. In no case shall the screenings be applied so fast and thick as to form cakes or ridges on the surface in such a manner as would prevent filling of voids or prevent the direct bearing of the roller on the coarse aggregate. These operations shall continue until no more screenings can be forced into the voids of the coarse aggregates.

The spreading, rolling and brooming of screenings shall be carried out in only such lengths of road which could be completed within one day's operation.

f) Sprinkling and Grouting

After the screenings have been applied, the surface shall be copiously sprinkled with water, swept and rolled. Hand brooms shall be used to seep the wet screenings into the voids and to distribute them evenly. The sprinkling, sweeping and rolling operations shall be continued with additional screenings applied as necessary until the coarse aggregates are thoroughly keyed, well bonded and firmly set to its full depth and a grout has been formed of screenings. Care shall be taken to see that the base or sub-grade does not get damaged due to the addition of excess quantity of water during construction.

g) Application of Binding Material

After the application of screenings, the binding material where it is required to be used shall be applied successively in two or more thin layers at a slow and uniform rate. After each application, the surface shall be copiously sprinkled with water and the resulting slurry shall be swept in with hand brooms or mechanical brooms to fill the voids properly and rolled during which water shall be applied to the wheels of the rollers if necessary to wash down the binding material sticking to them. These operations shall continue until the resulting slurry after filling the voids form a wave ahead of the wheels of the moving roller.

h) Setting and Drying

After the final compaction of water bound macadam course, the road shall be allowed to dry overnight. Next morning hungry spots shall be filled with screenings or binding material as directed, lightly sprinkled with water if necessary and rolled. No traffic shall be allowed on the road until the macadam is set. The Engineer shall have the discretion to stop hauling traffic from using the complete water bound macadam course if in his opinion it would cause excessive damage to the surface.

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 30/11/2015 SHEET 23 OF 36
3.09.00	Tack Coat 3.09.01 Description The work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction. 3.09.02 Materials The binder used for tack coat shall be bitumen of a suitable grade as approved by the Engineer and conforming to IS-73, IS-217 or IS-454 as applicable or any other approved cutback. 3.09.03 Construction Operations a) Preparation of Base The surface on which the tack coat is to be applied shall be thoroughly swept and scraped clean of dust and any other extraneous materials before the application of the binder. b) Application of Binder Binder shall be heated to the temperature appropriate to the grade of bitumen used and approved by the Engineer and sprayed on the base at the rate specified below. The rate of spread in terms of straight run bitumen shall be 5 kg per 10 square metre area for an untreated water bound macadam surface. The binder shall be supplied uniformly with the aid of sprayers. The tack coat shall be applied just ahead of the oncoming bituminous construction. 3.10.00 Bituminous Macadam Binder Course 3.10.01 Description This work shall consist of construction in a single course of 50mm/75mm thickness of compacted crushed aggregates premixed with a bituminous binder laid immediately after mixing on a base prepared previously in accordance with the specification and in conformity with the lines, grades and cross sections shown on the approved drawings. 3.10.02 Materials a) Binder The Binder shall be straight run bitumen of a suitable grade as directed by the	



TITLE:

**TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION – D16

REV.NO. 00 DATE 30/11/2015

SHEET 24 OF 36

Engineer complying with IS : 73.

b) Aggregates

The aggregates shall consist of crushed stone, crushed gravel (shingle) or other stones. They shall be clean, strong, durable, fairly cubical in shape and free from any disintegrated pieces, organic and other deleterious matter and adherent coats. The aggregates shall preferably be hydrophobic and of low porosity.

The aggregates shall satisfy the physical requirements set forth in Table - VIII.

Table – VIII

Physical Requirements of Aggregates For Bituminous Macadam

Sl. No.	Test	Test method	Requirements
1.	Los Angeles Abrasion Value *	IS : 2386 (Part IV)	35 percent maximum
2.	Aggregate Impact Value *	IS : 2386 (Part IV)	30 percent maximum
3.	Flakiness Index	IS : 2386 (Part I)	35 percent maximum
4.	Stripping Value	IS : 6241 (Part IV)	25 percent maximum
5.	Water Absorption	IS : 2386 (Part III)	2 percent maximum

*Aggregates may satisfy requirements of either of the two tests.

The aggregates for bituminous macadam for different thickness shall conform to Grading- A or B as given in Table-IX or X as the case may be.

Table-IX

Aggregates Grading For 75mm Compacted Thickness of Bituminous Macadam

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
63 mm	100	
50 mm	90 - 100	
40 mm	35 - 65	100
25 mm	20 - 40	70 - 100
20 mm	-	50 - 80
12.5 mm	5 - 20	-
4.75 mm	-	10 - 30
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

Table-X

Aggregates Grading For 50mm Compacted Thickness of Bituminous Macadam

Sieve Designation	Percent by weight passing the sieve	
	Grading A	Grading B
50 mm	100	
40 mm	90 - 100	
25 mm	50 - 80	100
20 mm	-	70 - 100
12.5 mm	10 - 30	-
10 mm	-	35 - 60
4.75 mm	-	15 - 35
2.36 mm	-	5 - 20
75 micron	0 - 5	0 - 4

c) Proportioning of Materials

The binder content for premixing shall be 3.5 and 4.0 percent by weight of the total mix for aggregate Grading-A and B respectively unless directed otherwise by the Engineer. The quantity of aggregates to be used shall be sufficient to yield the specified thickness after compaction.

d) Variation in Proportioning of Materials

The Contractor shall have the responsibility for ensuring proper proportioning of materials and producing a uniform mix. A variation in binder content



TITLE:

TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 30/11/2015

SHEET 26 OF 36

upto ± 0.3 percent by weight of total mix shall however be permissible for individual specimens taken for quality control tests.

3.10.03

Construction Operations

a) Weather and Seasonal Limitations

Bituminous macadam shall not be laid during rainy weather or when the base course is damp or wet.

b) Preparation of Base

The base on which the bituminous macadam is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross sections as shown on the drawings and as directed by the Engineer. The surface shall be thoroughly swept and scraped clean and free of any dust and foreign matter.

c) Tack Coat

A tack coat shall be applied over the base.

d) Preparation and Transport of Mix

Hot mix plant of adequate capacity shall be used for preparing the mix. The temperature of binder at the time of mixing shall be in the range 150 Deg. - 165 Deg. C and to that of aggregates shall be in the range 125 Deg. - 150 Deg. C provided the temperature difference between the binder and the aggregate at no time exceeds 25 Deg. C. Mixing shall be thorough to ensure that a homogenous mixture is obtained in which all particles of the aggregates are coated uniformly. The mixture shall be transported from the mixing plant to the point of use in a suitable vehicle. The vehicle employed for transport shall be clean and be covered over in transit if so directed by the Engineer.

e) Spreading

After mixing, the mix shall be spread immediately by means of a self propelled mechanical paver with suitable screeds capable of spreading, tamping and finishing the mix to the specified lines, grade and cross sections. However in restricted locations and in narrow widths where the available plants cannot operate in the opinion of the Engineer may permit manual laying of the mix. The temperature of mix at the time of laying shall be in the range 110 Deg. - 135 Deg. C.

In multilayer construction, the longitudinal joint in one layer shall offset into the layer below by about 150mm. However, the joint in the topmost layer shall be at the centre line of the pavement.

**TITLE:****TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 30/11/2015

SHEET 27 OF 36

Longitudinal joints and edges shall be constructed true to the delineating lines parallel to the centre line of the road. All joints shall be cut vertical to the full thickness of the previously laid mix and the surface painted with hot bitumen before placing fresh material.

f) Rolling

After spreading of mix, the rolling shall be done with 8 to 10 tonne power roller or with any other approved plant. Rolling should start as soon as the materials are spread. Rolling shall be done with care to avoid any undulation in the pavement surface.

Rolling on the longitudinal joint shall be done immediately after the paving operation. After this, the rolling shall commence at the edges and progress towards the centre longitudinally except on superelevated portions where it shall progress from the lower to the upper edge parallel to the centre line of the pavement.

The initial or breakdown rolling shall be done as soon as it is possible to roll the mixture without cracking the surface and no mix pick up on the roller wheels. The second or intermediate rolling shall follow the break down rolling as early as possible and be done while the paving mix is still at a temperature that will result in maximum density. The final rolling shall be done while the material is still workable enough for removal of roller marks.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding fresh materials. The rolling shall then be continued till the entire surface has been rolled to compaction and there is no crushing of aggregates and till all the roller marks are eliminated. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. The roller wheels shall be kept damp if necessary to avoid the bituminous material from sticking on the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose.

Rolling operation shall be completed in every respect before the temperature of the mix fall below 80 Deg. C.

Rollers shall not stand on the newly laid material as it may lead to undue deformation. The edges along and transverse of the bituminous macadam laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted with a thin surface coat of appropriate binder before the new mix is placed against it.

The bituminous macadam shall be provided with a final surfacing without any delay. If there is to be any delay the course shall be covered by seal coat before allowing any traffic over it.

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 30/11/2015 SHEET 28 OF 36
	3.11.00 Open Graded Premix Carpet 3.11.01 Description This work shall consist of laying and compacting open graded carpet of specified thickness in a single course of suitable small sized aggregates premixed with bituminous binder on a previously prepared base to form wearing course in accordance with the specification. 3.11.02 Materials a) Binder The binder shall be bitumen of suitable grade as approved by the Engineer and satisfying the requirements of IS: 73, 217, 454 or any other approved cutback as applicable. b) Aggregates The aggregates shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be obtained by crushing rock, gravel or river shingle and be free of elongated and flaky pieces, soft and disintegrated materials, vegetable and any other deleterious matter etc. They shall preferably be hydrophobic type. The aggregates shall satisfy the quality requirements set forth in Table-VIII except that the flakiness Index shall be limited to a maximum of 30. c) Proportioning of Materials The materials shall be proportioned as per the quantities given in Table-XI for 20mm thick open graded premix carpet.	

Table - XI

Quantity of Materials Required For 10 Sq. M of Road Surface For 20mm Thick Open Graded Premix Carpet

Aggregates for Carpet

i)	Stone Chippings - 12mm size ; passing 20 mm sieve and retained on 10 mm sieve	0.18 Cu.m
ii)	Stone Chippings - 10 mm size; passing 12.5 mm sieve and retained on 6.3 mm sieve	0.09 Cu.m
	Total	0. 27 Cu.m

Binder for premixing (quantities in terms of straight run bitumen)

i)	For 0. 18 Cu.m of 12 mm size stone Chippings at 52 Kg per Cu.m	9.5 Kg
ii)	For 0.09 Cu. M of 10mm size stone Chippings at 56 Kg per Cu.m	5.1 Kg
	Total	14.6 Kg

3.11.03 Construction Operation

a) Weather and Seasonal Limitations

Open graded premix carpet shall not be laid during rainy weather or when the base course is damp or wet or when the atmospheric temperature in shade is 16 Deg. C or below.

b) Preparation of Base

The underlying base on which the bituminous carpet is to be laid shall be prepared, shaped and conditioned to the specified lines, grade and cross section in accordance with the drawing, specification and as directed by the Engineer. The surface shall be well cleaned by removing caked earth and other foreign matters with wire brushes, sweeping with brooms and finally dusting with sacks as necessary.



TITLE:

TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 30/11/2015

SHEET 30 OF 36

c) Tack Coat

A tack coat complying with clause 3.09.00 shall be applied over the base preparatory to laying of the carpet. However application of tack coat shall not be necessary when the laying of carpet follows soon after laying the bituminous course.

d) Preparation of Premix

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated to the temperature appropriate to the grade of bitumen approved by the Engineer in boilers of suitable design avoiding local overheating and ensuring a continuous supply. The aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before these are placed in the mixer. After about 15 seconds of dry mixing, the heated binder shall be distributed over the aggregates at the rate specified. The mixing of binder with chipping shall be continued until the chippings are thoroughly coated with the binder. The mix shall be immediately transported from the mixer to the point of use in suitable vehicles or wheel barrows. The vehicles employed for transport shall be clean and be covered over in transit if so directed.

e) Spreading and Rolling

The premixed material shall be spread on the road surface with rakes to the required thickness and camber or distributed evenly with the help of a drag spreader without any undue loss of time. The camber shall be checked by means of camber boards and inequalities evened out. As soon as sufficient length of bituminous material are laid, rolling shall be commenced with 6 to 8 tonne power rollers preferably with smooth wheel tandem type or with any other approved plant. Rolling shall begin at the edges and progress toward the centre longitudinally except on the superelevated portions where it shall progress from the lower to upper edge parallel to the centre line of the pavement.

When the roller has passed over the whole area once, any high spots or depressions which become apparent shall be corrected by removing or adding premixed materials. Rolling shall then be continued until the entire surface has been rolled to compaction and all the roller marks have been eliminated. In each pass of the roller, preceding track shall be overlapped uniformly by at least 1/3 width. The roller wheels shall be kept damp to prevent the premix from adhering to the wheels and being picked up. In no case shall fuel/lubricating oil be used for this purpose. Rollers shall not stand on newly laid material as it may lead to undue deformations.

The edges along and transverse of the carpet laid and compacted earlier shall be cut to their full depth so as to expose fresh surface which shall be painted

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 30/11/2015 SHEET 31 OF 36
	with a thin surface coat of approved binder before the new mix is placed against it. f) Seal Coat A seal coat conforming to clause 3.12.00 shall be applied to the surface immediately after laying the carpet. No traffic shall be allowed on the road till the seal coat has been placed. 3.12.00 Seal Coat 3.12.01 Description This work shall consist of application of a seal coat as specified for sealing the voids in the bituminous surface laid to the specified levels, grade and camber. <u>Type-A</u> : Liquid seal coat comprising of an application of a layer of bituminous binder followed by a cover of stone chippings. <u>Type-B</u> : Premixed seal coat comprising of a thin application of fine aggregate premixed with bituminous binder. 3.12.02 Materials a) Binder The binder shall be bitumen of suitable grade as directed by the Engineer and conforming to the requirements of IS : 73, 217 or 454 as applicable or any other approved cutback. The quantity of binder to be adopted in terms of straight run bitumen shall be 9.8 Kg and 6.8 Kg per 10 square metre area for Type-A and Type-B seal coat respectively. b) Stone Chippings for Type A Seal Coat The stone chippings shall consist of angular fragments of clean, hard, tough and durable rock of uniform quality throughout. They shall be free of elongated or flaky pieces, soft or disintegrated stone, vegetable or other deleterious matters etc. Stone chippings shall be of 6mm size defined as 100 percent passing through 10mm sieve and retained on 2.36mm sieve. The quantity used for spreading shall be 0.09 cu.m per 10 sq.m area. The chippings shall satisfy the quality requirements spelled out in Table- VIII except that the upper limit for flakiness Index shall be 30.	

c) Fine Aggregate for Type B Seal Coat

The fine aggregate shall be sand or fine grit and shall consist of clean, hard, durable, uncoated dry particles and shall be free from dust, soft or flaky material, organic matter or other deleterious substances. The aggregate shall pass 1.7 mm sieve and be retained on 180 micron sieve. The quantity used for premixing shall be 0.06 cubic metre per 10 square metre area.

3.12.03

Construction Operations

a) Preparation of Base

The seal coat shall be applied immediately after laying the bituminous course which is required to be sealed. Before application of seal coat, the surface shall be cleaned free of any dust or other extraneous matters.

b) Construction of Type-A Seal Coat

The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer and sprayed on the dry surface in a uniform manner preferably with the help of mechanical sprayers. Excessive deposits of binder caused by stopping or starting of the sprayer or through leakage or due to any other reason shall be suitably corrected before the stone chippings are spread.

Immediately after the application of binder, stone chippings in a dry and clean state shall be spread uniformly on the surface preferably by means of a mechanical grittier or otherwise manually so as to cover the surface completely. If necessary the surface shall be broomed to ensure uniform spread of chippings. Immediately after the application of the cover material, the entire surface shall be rolled with a 8 - 10 tonne smooth wheeled roller. Rolling shall commence from the edges and progress towards the centre except in superelevated portions where it shall proceed from the inner edge to the outer. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. While rolling is in progress additional chippings shall be spread by hand in whatever quantities required to make up the irregularities. Rolling shall continue until all aggregate particles are firmly bedded in the binder and present an uniform closed surface.

c) Construction of Type-B Seal Coat

Mixers of approved type shall be employed for mixing the aggregates with the bituminous binder. The binder shall be heated in boilers of suitable design to the temperature appropriate to the grade of bitumen approved by the Engineer. Also the aggregates shall be dry and suitably heated to a temperature as directed by the Engineer before the same are placed in the mixer. Mixing of

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION - D16 REV.NO. 00 DATE 30/11/2015 SHEET 33 OF 36
	binder with aggregates to the specified proportions shall be continued till the latter is thoroughly coated with the former. The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed. As soon as sufficient length has been covered with the premixed material, the surface shall be rolled with 6 - 8 tonne smooth wheeled power rollers. Rolling shall be continued till the premixed material completely seals the voids in the bituminous course and a smooth uniform surface is obtained. 3.12.04 Opening to Traffic In case of Type-B Seal coat, traffic may be allowed soon after the final rolling when the premixed materials are cooled down to the surrounding temperature. However in case of Type- A seal coat, the traffic shall not be permitted until the following day. 3.13.00 Repair of Existing Water Bound Macadam Surfaces Pot holes or patches and ruts in the water bound macadam base or surface course which is to be surface treated shall be repaired by removing all loose materials by cutting in rectangular patches and replacing with suitable materials. The repair shall be done as under. Pot holes, patches and ruts shall be drained of any water and cut to regular shape with vertical sides and then be filled either with i) coarse aggregates and screenings conforming to the specification for water bound macadam and compacted with rollers or other approved rammer etc or with ii) premixed material conforming to the specification for open graded premix carpet and compacted with rollers or other approved means after painting the sides and bottom of the holes with a thin application of bitumen or a combination of both as directed by the Engineer. 3.14.00 Road Side Drains 3.14.01 Drains The road side drains shall be made in sizes and slopes as shown on the approved drawings. The sides and bottom shall be neatly dressed after excavation. Proper connections shall be made to the culverts outside the plant area as per the drawings and instructions of the Engineer. The excavated spoils other than that required for backfilling shall be transported and filled in low areas within the plant area or in embankments as instructed by the Engineer. The lining for drains shall be as per the drawings. Lining of drains may be of bricks or cement concrete blocks of specified grade as shown on the approved drawing or as directed by the Engineer. If shown	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 30/11/2015 SHEET 34 OF 36
	on approved drawing, drains shall be of R.C.C. construction with necessary slopes. 3.15.00 Culverts Excavation in trenches for foundation of culverts and wing walls shall be done with side slopes as per the drawings and instructions of the Engineer after clearing the site etc. As described in the “Specification for Earthwork in Excavation and Backfilling”, backfilling in layers with watering and compaction shall be done after the construction of foundations. The construction of culverts shall be done true to the lines and levels as shown on the drawings. The specification for Masonry and/or Plain and Reinforced Cement concrete shall be followed as applicable. 3.16.00 Pipe Culverts and Drainage Pipes 3.16.01 Materials The drainage pipes shall be made of R.C.C and shall be either class NP-2 or NP-3 as shown on the approved drawings. Pipe culverts shall be made of reinforced concrete pipe and shall be of class NP4 or RDSO class for railways as shown in the drawing. All pipes shall meet the requirements of IS : 458 and shall be procured from approved manufacturers with collars as per manufacturer’s specification. The tenderer shall specifically mention the particular manufacturer’s product he proposes to use. Cement shall be ordinary Portland Cement as per IS:269. Coarse Aggregates shall be as per IS:383. Maximum size shall not exceed one third the thickness of the pipe or 20 mm whichever is smaller. Fine aggregates for concrete shall be as per IS:383. 3.16.02 Laying of Pipes Laying of concrete pipes shall correspond to IS:783 and as per the specification given below. a) The foundation bed for pipe shall be excavated true to lines and grades shown on the drawings and as directed by the Engineer. When trenching is involved, its width on either side of the pipe shall not be less than 150mm and not more than one third the diameter of pipe unless otherwise instructed/permitted by the Engineer. The sides of the trench shall be as nearly vertical as possible. Side slope, shoring, bailing out water etc as required shall be done by the Contractor. Side slips if there be any shall be removed by the Contractor. After laying of the pipes are completed, backfilling of the trenches shall be done as per “Specification for Earthwork in Excavation and Backfilling” to the	

**TITLE:****TECHNICAL SPECIFICATION FOR
ROAD AND DRAINAGE**

SPECIFICATION NO. PE-TS-999-600-C016

VOLUME - II B

SECTION - D | SUB-SECTION - D16

REV.NO. 00 DATE 30/11/2015

SHEET 35 OF 36

satisfaction of the Engineer. The surplus spoils shall be transported and filled in low areas within the plant area as instructed by the Engineer.

When bedrock or boulder stratum is encountered during excavation, the excavation shall be taken down to at least 200mm below the bottom of the pipe with prior permission of the Engineer and all rock/boulders in the area shall be removed and space filled with approved earth free from stone or fragmented materials, shaped to the requirements and thoroughly compacted to provide adequate support for the pipe.

Filling of trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur and shall be done as per the "Specification for Earthwork in Excavation and Backfilling". When two or more pipes are to be laid adjacent to each other, they shall be separated by a distance equal to at least half the diameter of the pipe subject to a minimum of 450 mm. Laying of pipes shall start from the outlet and proceed towards inlet. All pipes and fittings shall be gradually lowered into the trench or placed on the supports by approved means taking due care to avoid any damage. Under no circumstances the pipes shall be dropped into the trench or on supports from heights.

b) Pipe bedding shall be first class projection bedding for positive projecting pipes as per IS : 783 having a projection ratio not greater than 0.70. The pipe shall be carefully laid on bedding made up of fine granular materials in an earth foundation; the bedding shall be carefully shaped to fit the lower part of the pipe exterior for at least ten percent of its overall height and in which the fill material is thoroughly compacted in layers not exceeding 150mm in depth around the pipe for the remainder of the pipe laid in trench.

When indicated on the drawings or directed by the Engineer, the pipe shall be bedded on a cradle constructed of concrete having a mix not leaner than M-15. The shape and dimension of the cradle shall be as indicated on the drawing or as directed by the Engineer. The pipe shall be laid on the concrete bedding before the concrete is set.

c) The drop walls shall be made with first class brickwork in 1:4 cement mortar.

d) The pipe culverts shall be made with proper care with respect to the invert of the pipe, gradient if any etc as specified on the drawings and as instructed by the Engineer.

e) Where R.C.C pipes are encased in concrete at road crossings or at other places the pipes need be suitably supported avoiding reinforcements of concrete blocks, joints properly done before concreting is taken up. Concreting of total height of block may be done in a single operation or may be done upto some height for pipes to be properly laid in position and the balance height of the block shall be concreted subsequently.

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROAD AND DRAINAGE	SPECIFICATION NO. PE-TS-999-600-C016 VOLUME - II B SECTION - D SUB-SECTION – D16 REV.NO. 00 DATE 30/11/2015 SHEET 36 OF 36
	f) The R.C.C. pipes shall be joined with cement mortar. Cement mortar shall consist of 1 part of cement and 2 part of clean sand with only enough water for workability. Procedure of jointing shall be as per IS : 783. 3.16.03 Relation With Water Supply Pipeline Unless specifically cleared by the Engineer, under no circumstances shall the drainage pipes be allowed to come close to water supply pipelines. 3.17.00 Manholes and Inspection Chambers The maximum distance between the manholes shall be 30m unless specifically permitted otherwise. In addition, at every change of alignment, gradient or diameter there shall be a manhole or inspection chamber. The distance between the manhole or inspection chamber and gully chamber shall not exceed 6 meters unless permitted otherwise. Manhole shall be constructed so as to be water tight under test. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide a smooth flow. Connection to the existing pipelines shall be through a manhole. Manholes shall be provided with standard covers usually of C.I. or as directed by the Engineer. The cover shall be closely fitted so as to prevent gases from coming out. 4.00.00 Testing and Acceptance Criteria All testing as mentioned in the specification and as mentioned in Clause No. 900 of the “Specification for Roads and Bridge Works, 1983” published by IRC on behalf of Ministry of Shipping and Transport (Roads Wing) shall be carried out by the Contractor as per the direction of the Engineer. 5.00.00 MEASUREMENT Method of measurement shall be as per the latest version of IS:1200, Part-17 and as directed by the Engineer.	



TITLE:

**TECHNICAL SPECIFICATION FOR
FABRICATION OF STRUCTURAL
STEEL WORK**

SPECIFICATION NO. PE-TS-999-600-C017

VOLUME - II B

SECTION - D SUBSECTION -D17

REV.NO. 0 DATE 16/03/2016

SHEET 1 OF 40

VOLUME: II B

**SECTION - D
(PART I)**

SUB-SECTION – D 17

FABRICATION OF STRUCTURAL STEEL WORK



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



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SPECIFICATION NO. PE-TS-999-600-C017

VOLUME - II B

SECTION - D

SUBSECTION -D17

REV.NO. 0

DATE 16/03/2016

SHEET 2

OF 40

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	GENERAL	3
3.00.00	WORKMANSHIP	19
4.00.00	INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY	29
5.00.00	INFORMATION TO BE SUBMITTED	33
6.00.00	RATES AND MEASUREMENTS	34

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 3 OF 40
SUB-SECTION – D XVII FABRICATION OF STRUCTURAL STEEL WORK 1.00.00 SCOPE This specification covers supply, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and rivets, bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork covered under the scope of the contract. 2.00.00 GENERAL 2.01.00 Work to be provided for by the Contractor The work to be provided for by the Contractor, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following a) Preparation of complete detailed fabrication drawings and erection marking drawings required for all the structures covered under the scope of the contract based on the approved design drawings. As decided by the Engineer, some or all of these detailed drawings will have to be submitted for approval. b) To submit revised design with calculations and detailed fabrication drawings in case any substitution of the designed sections are to be made. c) To submit design calculations for joints and. connections developed by the contractor along with detailed fabrication drawings. d) Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary rivets, bolts, nuts, washers, tie rods and welding electrodes for field connections, e) Furnish shop painting of all fabricated steelwork as per requirements of this Specification. f) Suitably mark, bundle, and pack for transport all fabricated materials. g) Prepare and furnish detailed Bill of Materials, Drawing Office Dispatch lists, Rivet and Bolt List and any other list of bought out items required in connection with the fabrication and erection of the structural steelwork. h) Insure, load and transport all fabricated steelwork field connection materials to site. i) Maintain a fully equipped workshop at site for fabrication, modification		

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 4 OF 40
	and repairs of steelwork at site as may be required to complete the works in accordance with the Contract. 2.02.00 Work by others No work under this specification will be provided for by any agency other than the contractor, unless specifically mentioned otherwise elsewhere in the contract. 2.03.00 Codes and standards All work under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard specification, any other standard practice, as may be specified by the Engineer shall be followed: IS : 226 - Structural steel (Standard Quality) IS : 800 - Code of Practice for general construction in steel. IS : 806 - Code of practice for use of steel tubes in general building construction. IS : 808 - Rolled steel beams, channels, and angle sections IS : 813 - Scheme of symbols for welding IS : 814 - Covered electrodes for metal arc welding of structural steel IS : 815 - Classification and coding of covered electrodes for metal arc welding of structural steels. IS : 816 - Code of practice for use of metal arc welding for general construction in mild steel IS : 817 - Code of practice for training and testing metal arc welders IS : 818 - Code of practice for safety and health requirements in electric and gas welding and cutting operations IS : 822 - Code of practice for inspection of welds IS : 919 - Recommendations for limits and fits for Engineering IS : 961 - Structural Steel (High Tensile)	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017			
		VOLUME - II B			
		SECTION - D		SUBSECTION -D17	
		REV.NO.	0	DATE	16/03/2016
		SHEET	5	OF	40
IS : 1148 - Rivet bars for structural purposes IS : 1149 - High tensile rivet bars for structural purposes IS : 1161 - Steel Tubes for structural purposes IS : 1200 - Method of measurement of steelwork and ironwork (Part 8) IS : 1239 - Mild Steel Tubes IS : 1363 - Black hexagon bolts, nuts and lock nuts (dia. 6 to 30 mm) and black hexagon screws (dia 6 to 24 mm) IS : 1364 - Precision and semi-precision hexagon bolts, screws, nuts and locknuts (dia, range 6 to 39 mm) IS : 1367 - Technical supply conditions for threaded fasteners IS : 1442 - Covered electrodes for the metal arc welding of high tensile structural steel IS : 1608 - Method for tensile testing of steel products other than sheet strip, wire and tube IS : 1730 - Dimensions for steel plate, sheet, and strip for structural and general engineering purposes. IS : 1731 - Dimensions for steel flats for structural and general engineering purposes IS : 1852 - Rolling and cutting tolerances for hot-rolled steel products IS : 1977 - Structural steel (ordinary quality) St-42-0 IS : 2062 - Steel for General Structural Purposes IS : 2074 - Ready mixed paint, red oxide Zinc chromate priming IS : 2595 - Code of Practice for Radiographic Testing IS : 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and Steel IS : 2633 - Method for testing uniformity of coating on Zinc Coated Articles IS : 3757 - High strength structural bolts					

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 6 OF 40
	IS : 4759 - Specifications for Hot-Dip Zinc Coatings on Structural Steel and other allied products IS : 7205 - Safety Code for Erection of Structural Steelwork IS : 7215 - Tolerances for fabrication of steel structures IS : 7280 - Bare wire electrodes for submerged arc welding of structural steels. IS : 9595 - Recommendations for metal arc welding of carbon and carbon manganese steels. 2.04.00 Conformity with Designs The contractor shall design all connections, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Engineer keeping in view the maximum Utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Engineer. Provision of all relevant Indian Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract. 2.05.00 Materials to be used 2.05.01 General All steel materials required for the work will be supplied by the contractor unless otherwise specified elsewhere in the contract. The materials shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance. All materials shall be of tested quality only unless otherwise permitted by the Engineer and/or Consultant. If desired by the Engineer, Test Certificates in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks, if permitted by the Engineer, a random sample shall be tested at an approved laboratory from each lot of 50 tones or less of any particular section. The arc welding electrodes shall be of approved reputed manufacture and conforming to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and amperage (Polarity in case of D.C. supply) for which the electrodes are suitable.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 7 OF 40
2.05.02	Steel All steel materials to be used in construction within the purview of this specification shall comply with any of the following Indian Standard Specifications as may be applicable: a) IS : 2062 - Steel for general structural purposes b) IS : 961 - Structural steel High Tensile c) IS : 1977 - Structural steel (Ordinary quality) St-42-0 In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable.	
2.05.03	Rivet Steel	
	All rivet steel used in construction within the purview of this Specification shall comply with one of the following Indian Standard Specifications as may be applicable: a) IS : 1148 - Rivet Bars for structural purpose b) IS : 1149 - High tensile rivet bars for structural purposes. Where high tensile steel is specified for rivets, steps shall be taken to ensure that the rivets are so manufactured that they can be driven and heads formed satisfactorily without the physical properties of steel being impaired.	
2.05.04	Electrodes	
	All electrodes to be used under the Contract shall be of approved reputed manufacture, low hydrogen electrode and shall comply with any of the following Indian Standard Specifications as may be applicable a) IS : 814 - Covered electrodes for metal arc welding of structural steel b) IS : 815 - Classification and coding of covered electrodes for metal arc welding of mild steel and low alloy high tensile steel c) IS : 1442 - Covered electrodes for the metal arc welding of high tensile structural steel d) IS : 7280 - Bare wire electrodes for submerged arc welding of	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 8 OF 40
structural steels 2.05.05 Bolts and Nuts All bolts and nuts shall conform to the requirements of Indian Standard Specification IS: 1367 - Technical Supply Conditions for Threaded Fasteners. Materials for Bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable. a) Mild Steel All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 Kg/mm² and a minimum elongation of 23 per cent on a gauge length of 5.6 $\sqrt{A}$, where "A" is the cross sectional area of the test specimen i) IS: 1367: Technical supply conditions for threaded fasteners ii) IS: 1608: Method for tensile testing of steel products other than sheet, strip, wire and tube b) High Tensile Steel The material used for the manufacture of high tensile steel bolts and nuts shall have the mechanical properties appropriate to the particular class of steel as set out in IS: 1367 or as approved by the Engineer. 2.05.06 Washers Washers shall be made of steel conforming to any of the following Indian Standard Specifications as may be applicable under the provisions of the Contract: a) IS : 2062 - Steel for general structural purposes b) IS : 961 - Structural Steel (High Tensile Quality) c) IS : 1977 - Structural steel (Ordinary Quality) St-42-0 d) IS : 6649 - Hardened washers 2.05.07 Paints Paints to be used for shop coat of fabricated steel under the purview of this		

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 9 OF 40
	contract shall conform to the Indian Standard Specification IS: 2074 - Ready mixed Paint, Red oxide Zinc Chromate Priming. 2.06.00 Coal Bin 2.06.01 Shape of bins shall be circular, polygonal, square, or rectangular in plan. Bottom hopper portion may have be conical-cum-hyperbolic or any other profile shape as shown in the drawing. Bin shall be termed as bunkers or silos according to their shape and plane of rupture of coal. 2.06.02 For general requirements, fabrication and construction details IS: 9178 (Pt.I & 11) shall be followed as general guidance. The bins shall be fabricated and erected in segments. 2.06.03 The Coal bins shall be made of mild steel plates joined together with full strength butt weld and provided with stiffeners at regular interval. Stiffeners shall be provided on the external face and it may be welded with external face. 2.06.04 Bending of plates and rolled sections to the required shape for fabrication shall be done by plate bending machine or cold bending process Without resorting to heating, hammering, angle smithy and black smithy process. 2.06.05 Poking hole (manual or pneumatic) and striking plate shall be provided to facilitate coal flow. Poking holes shall have circular MS pipe and cover cap as detailed in the drawing. 2.07.00 New Erection Marks 2.07.01 Additional structures involving new erection marks may be required to be added at any stage of work. 2.07.02 All such new erection marks shall be detailed and included in marking schemes and fabrication carded out thereafter. 2.07.03 All such new erection marks shall be considered under item of original fabrication work. As a result of additional structures becoming necessary if the work is delayed beyond the time schedule stipulated, the Engineer shall give suitable extension of time provided he is satisfied about the reasonableness of the delay involved. However, no claim for extra payments or revision of rates due to delay shall be entertained.	

 Maharatna Company	TITLE:	SPECIFICATION NO. PE-TS-999-600-C017			
	TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	VOLUME - II B			
		SECTION - D		SUBSECTION -D17	
		REV.NO.	0	DATE	16/03/2016
		SHEET	10	OF	40
2.08.00	ELECTRO FORGED STEEL GRATINGS				
2.08.01	Factory made fabricated electro forged gratings unit with steel conforming to IS: 2062 shall be supplied, fabricated, transported, erected and aligned in floorings, platforms, drain and trench covers, walkways, passages, staircases with edge binding strips and anti skid nosing in treads etc.				
2.08.02	All grating units shall be rectangular in pattern and electro forged. The size and the spacing of the bearing bars and cross bars shall be as detailed in fabrication drawings. The contractor shall submit the grating design for different spans and load intensities along with fabrication drawings. The depth of the grating unit shall be 40 mm, unless specified otherwise.				
2.08.03	The gratings shall be made up in panel units designed to coincide with the span of the structural steel framing or openings as indicated in the design/ scope drawings. Maximum possible standardization of the grating panel sizes shall be tried and designed.				
2.08.04	The grating unit shall be accurately fabricated and finished, free from wraps, twists, or any defects that would impair their strength, serviceability, and appearance.				
2.08.05	Grating work shall include cut outs and clearance opening for all columns, pipes, ducts, conduits or any other installation penetrating through the grating work. Such cut outs and clearances shall be treated as specified in subsequent clauses.				
2.08.06	The gratings shall be notched, trimmed and neatly finished around flanges and webs of the columns, moment connections, cap plates, and such other components of the steel structures encountered during the placement of the gratings. In all such cases, the trimming shall be done to follow the profile of the components encountered. After trimming, the binding strip shall be provided on the grating to suit the profile so obtained.				
2.08.07	Opening in gratings for pipes or ducts that are 150mm in size or diameter or larger shall be provided with steel bar toe plates of not less than 5mm thickness and appropriate width, set flush with the bottom of the bearing bars.				
2.08.08	Penetrations in gratings that are more than 50mm but less than 150mm in size or diameter shall be welded with plates of size shown in the detailed drawings set flush with the bottom of the grating panel.				
2.08.09	Unless otherwise indicated on the drawings, grating units at all penetrations shall be made up in split section, accurately fitted and neatly finished to provide for proper assembly and erection at the job site.				

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 12 OF 40																					
	these defects noticed on visual or microscopic inspection shall render the material liable to rejection. 2.09.05 There shall be no flaking or loosening when struck squarely with a chisel faced hammer. The galvanized steel member shall withstand minimum four one minute dips in copper sulphate solution as per IS: 2633. 2.09.06 When the steel section is removed from the galvanizing kettle, excess spelter shall be removed by 'bumping'. The processes known as 'wiping' or 'scrapping' shall not be used for this purpose. 2.09.07 Defects in certain members indicating presence of impurities in the galvanizing bath in quantities larger than that permitted by the specifications or lack of quality control in any manner in the galvanizing plant, shall render the entire, production in the relevant shift liable to rejection. 2.09.08 All structural steel shall be treated with sodium dichromate or an approved equivalent solution after galvanizing; so as to prevent white storage stains. 2.09.09 If the galvanizing of any member is damaged, the Engineer shall be shown of the extent of damage, if so directed the galvanizing may have to be redone in the similar manner as stated above at no extra cost to the Owner. 2.10.00 STAINLESS STEEL HOPPERS (As per BOQ item) 2.10.01 Material In case SS Hopper is to be fabricated & erected as per BOQ item with SS415M, following specification shall be followed. Stainless steel hopper of grade SS 415M as manufactured by SAIL or equivalent shall be provided in the lower portion of bunker hopper. SS 4 15M having the following chemical composition shall be used. <table> <thead> <tr> <th>Material</th><th>%</th><th>Remarks</th></tr> </thead> <tbody> <tr> <td>Carbon</td><td>10.03%</td><td>Max.</td></tr> <tr> <td>Silicon</td><td>1.60%</td><td>Max.</td></tr> <tr> <td>Manganese</td><td>0.80% to 1.50%</td><td></td></tr> <tr> <td>Phosphorous</td><td>0.03%</td><td>Max.</td></tr> <tr> <td>Sulphur</td><td>0.03%</td><td>Max.</td></tr> <tr> <td>Chromium</td><td>10.80% to 12.50%</td><td></td></tr> </tbody> </table>	Material	%	Remarks	Carbon	10.03%	Max.	Silicon	1.60%	Max.	Manganese	0.80% to 1.50%		Phosphorous	0.03%	Max.	Sulphur	0.03%	Max.	Chromium	10.80% to 12.50%		
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 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 14 OF 40
	procurement rate for the weight of stainless steel pieces not returned to the store. c) In case the contractor does the cutting of the stainless steel without approved cutting plan then all the wastage (i.e. the difference between the weight of stainless steel plate cuts and the actual finished weight considered for the measurement for payment) shall be subjected to the penal recovery at the rate mentioned above. 2.10.04 Cuffing Cutting may be affected by shearing, or by using plasma. The cut edges of all plates shall be perfectly straight and uniform through out. Cutting shall be done as per the cutting plan shown in the fabrication drawing. Should the Engineer find it necessary, the edges shall be ground smooth afterwards by contractor within the unit rates quoted by him. All the edge s shall be ground smooth before they are welded. 2.10.05 Jointing Welding shall join stainless steel. All weld joints (along the inclined plane) shall be staggered. Any common welding process can weld stainless steel viz. MIG, metal arc or plasma using the covered compatible electrodes as per IS: 5206 or by inert gas arc welding as per IS: 2811. Shielding gas shall be Argon + Hydrogen mixture or Argon + Oxygen mixture. However, Argon + Oxygen mixture shall be preferred. Carbon-di-oxide mixture shall be avoided. 308L and 315L electrodes/fillers shall be used for the welding of Stainless Steel to Stainless Steel and Stainless Steel to Mild Steel respectively. However, the welding process and the type of the electrodes to be used for welding shall be as per welding procedure, as approved by the Engineer. On the basis of the welding procedure, the Contractor shall conduct qualification test. 2.10.06 Bending The stainless steel plates shall be subjected to cold forming and bending in order to get the desired shape and profile. 2.10.07 Welding sequence The type of electrodes, welding sequence, preheat and interpass temperature and post weld heat treatment shall be as approved by the Engineer. 2.10.08 Acceptance Criteria of Fabricated Structures The acceptance of the fabricated structure work shall depend upon correct dimensions and alignment, absence of distortion in the structure, satisfactory results from the inspection and testing of the welded structure joints and the	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 15 OF 40
	test specimens, general workmanship being good meeting the tolerance requirements given in IS: 7215. 2.11.00 BEARINGS 2.11.01 PTFE (Poly tetra fluorethylene) slide bearing a) General The bearings shall consist of upper and lower units. The upper unit shall include a sole plate with mirror finish stainless steel facing bonded to the bottom surface of the sole plate. The lower unit shall consist of a relevant laminated elastomers pad surfaced with PTFE. A rigid confining medium substructure bonds the PTFE to the pad. When the upper and lower units are mated the stainless steel slides on the PTFE surface with an extremely low coefficient of friction. These bearings shall be designed as per the performance requirements. The bearing shall be of reputed make and manufacturer as approved by Engineer, for required vertical loads, as per the construction drawings and for a maximum displacement of ± 50 mm. b) Material PTFE bearing shall be sliding against highly polished stainless steel and the coefficient of friction between them shall be less than 0.06 at 55 kg/cm². In order to prevent cold flow in the PTFE surface it shall be rigidly bonded by a special high temperature resistant adhesive to the stainless steel sub-strata. The stainless steel surface, which slides against the PTFE, is mirror polished. The stainless steel shall be bonded to the top plate by special high strength adhesive. The thickness of the stainless steel shall be between 1.0 to 1.5mm. The resilient bearing pad shall consist of multiple layers of lightweight fabric impregnated with a high quality elastomer compound vulcanized into slabs of uniform standard thickness as per the requirement. This shall withstand vertical (compressive) load not less than 500 kg/cm² and shear loads upto 40 kg/cm². c) Installation The seating area for PTFE bearing shall be prepared accurately level and furnished with a thin layer of epoxy resin mortar. The bearing will be placed on this layer while it is still workable and the bearing is levelled. The bearing should not be displaced as the beam is lowered into position. When the mortar and adhesive are fully set and the beam slightly above the top of the bearing. The upper surface of the bearing shall then be coated with sufficient thickness of epoxy resin mortar so that when the beam is lowered on to the temporary supports it comes into full contact	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 16 OF 40
	with the mortar and some is squeezed out. The surplus shall be troweled off and after the mortar is fully set the temporary supports removed. 2.12.00 Storage of material 2.12.01 General All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged, shall be removed from the contractor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed and the cost incurred thereof shall be realised from the Contractor. The Contractor shall maintain upto date accounts in respect of receipt, use, and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in contractor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks. 2.12.02 Steel The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground section wise and lengthwise so that they can be easily inspected, measured, and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather. 2.12.03 Electrodes The electrodes for electric arc welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating. 2.12.04 Bolts, Nuts and Washers Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length, and quality. 2.12.05 Paints Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 17 OF 40
2.13.00	Quality Control The Contractor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the Contractor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer's representative shall be made at the Contractor's fabrication shop whether located at Site or elsewhere. The Contractor shall co-operate with the Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing free of cost all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the Contractor. Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work. The quality control procedure shall cover but not be limited to the following items of work a) Steel: Quality manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used. b) Rivets, Bolts, : Manufacturer's certificate, dimension checks, Nuts & Washers material testing. c) Electrodes : Manufacturer's certificate, thickness and quality of flux coating. d) Welders : Qualifying Tests e) Welding sets : Performance Tests f) Welds : Inspection, X-ray, Ultrasonic tests g) Paints : Manufacturer's certificate, physical inspection reports h) Galvanizing : Tests in accordance with IS 2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS : 4759 - Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products.	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017	
		VOLUME - II B	
		SECTION - D	SUBSECTION -D17
		REV.NO. 0	DATE 16/03/2016
		SHEET 18	OF 40
2.14.00	Standard dimensions, forms and weights The dimensions, forms, weights and tolerances of all rolled shapes rivets, bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards.		
2.15.00	Fabrication Drawings The contractor shall within thirty (30) days after the award of the Contract submit to the Engineer the Schedule of Fabrication and erection of structural Steelworks, for approval. Within one week after receipt of approval on design of any steel structure (part or full) based on the approved design. As decided by the Engineer, six (6) copies each of some or all of the detailed fabrication drawings will have to be submitted for approval. The sequence of preparation of fabrication drawings shall match with the approved fabrication and erection schedule. The above-mentioned approval for fabrication drawings will be accorded only towards the general conformity with the design requirements as well as specifications. The approval of drawing however shall not relieve the contractor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents. The fabrication drawings shall include but not limited to the following: - Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections. - Dimensional drawings of base plates, foundation bolts location etc. - Comparison sheets to show that the proposed alternative section, if any, is as strong as the original sections shown on the Design Drawings. - Complete Bill of Materials and detailed drawings of all sections as also their billing weights. - Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof. These drawings shall give all the necessary information for the fabrication, erection, and painting of the steelwork in accordance with the provisions of this Specification. Fabrication drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Fabrication drawings shall give complete information necessary for fabrication of the various components of the steelwork,		

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 19 OF 40
	including the location, type, size, and extent of welds. These shall also clearly distinguish between shop and field rivets, bolts, and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the fabrication drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked up stresses and distortion. Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification. IS: 813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length. The Contractor shall be responsible for and shall carry out at his cost any alterations of the work due to any discrepancies, errors or omissions on the drawings or other particulars supplied by him, whether such drawings or other particulars have been duly approved or not in accordance with the Contract. 3.00.00 WORKMANSHIP 3.01.00 Fabrication 3.01.01 General All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS: 800 - Code of Practice for general construction in steel and other relevant Indian Standards or equivalent. 3.01.02 Straightening Material Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification on IS: 1552 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600°C. 3.01.03 Cutting Shearing, cropping, or sawing shall affect cutting. Use of a mechanically controlled gas-cutting torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under expert hand, subject to the approval of the Engineer.	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 20 OF 40
	To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld metal deposited on them, shall be reasonably free from gouges, occasional notches or gouges not more than 4 mm deep will be permitted. Gouges greater than 4 mm that remain from cutting shall be removed by grinding. All re-entrant corners shall be shaped notch free to a radius of at least 12 mm. Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion. 3.01.04 Planning of edges Planning or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer. 3.01.05 Clearances The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams web shall be not more than 3 mm at each end, but where for practical reasons greater clearance is necessary, suitably designed cheatings shall be provided. 3.02.00 Riveted and bolted construction 3.02.01 Holes Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of rivet or bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter. Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the rivet or bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the rivet or black bolt passing through them. Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of BS as specified in IS: 919. Parts to be connected shall be firmly held together by	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 21 OF 40
	tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly. Holes for rivets or bolts shall not be formed by gas cutting process. 3.02.02 Assembly All parts of riveted members shall be well pinned or bolted and rigidly held together while riveting. Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the rivets or bolts shall be reamed. Poor matching of holes shall be cause for rejection .The component parts shall be so assembled that they are neither twisted not otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained. Rivets shall ordinarily be hot driven, in which case their finished heads shall be approximately hemispherical in shape and shall be of uniform size throughout the work for rivets of the same size full, neatly finished and concentric with he holes. Rivets shall be heated uniformly to a temperature not exceeding 1 125°C they shall not be driven after their temperature has fallen below 540°C. Rivets shall be driven by power riveters, of either compression or manually operated type, employing pneumatic, hydraulic or electric power. Hand driven rivets shall not be allowed unless in exceptional cases specifically approved by the Engineer. After driving, rivets shall be tight, shall completely fill the holes and their heads shall be in full contact with the surface. In case of countersunk rivets, the countersinking shall be fully filled by the rivet, any proudness of the countersunk head being dressed off flush, if required. Riveted members shall have all parts firmly drawn and held together before and during riveting and special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole. All loose, burnt, or otherwise defective rivets shall be cut out and replaced and special care shall be taken to inspect all single riveted connections. Special care shall also be taken in heating and driving long rivets. The Contractor shall prove the quality of riveting by cutting some rivets chosen at random by the Engineer. No extra payment will be made to the Contractor for such cutting and replacing. Riveting work, for any particular section or group, will be considered satisfactory when at least 90% of the corresponding cut rivets is found to be sound. If the ratio is below 75%, all the rivets in the particular section or group shall be cut, removed and replaced and tested again at the	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 22 OF 40
	Contractor's expense. For cases between 75% and 90% the engineer shall have the option to instruct cutting and replacing any number of further rivets at the Contractor's cost as he deems necessary. Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if shown on drawing or directed by the Engineer. Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project through the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer one spring washer or lock nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified on the Drawings. 3.03.00 Welded Construction 3.03.01 General Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS: 817. 3.03.02 Preparation of material Surface to be welded shall be free from loose scale, slag, rust, grease, paint, and any other foreign material except that mill scale, which withstands vigorous wire brushing, may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas cutting shall, wherever practicable, be done by a mechanically guided torch. 3.03.03 Assembling Parts to be fillet welded shall be brought in, as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces, which are not completely sealed by, welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2°). The work shall be positioned for flat welding whenever practicable.	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 24 OF 40
	the parent material is less than 40 mm thick and the temperature is between (-) 5°C and 0°C, the surface around the joint to a distance of 100 mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is hand warm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20°C. All requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard. 3.03.13 Peening Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool, peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening. 3.03.14 Equipment These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and capacity as recommended by the manufacturers of electrodes or as may be approved by the engineer. 3.04.00 Finish Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butt over the whole section with a clearance not exceeding 0.1 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc; after welding/riveting together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles of channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 1.0 mm. 3.05.00 Slab bases and caps Bases and caps fabricated out of steel slabs, except when cut material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face, which is to be grouted direct to a foundation, need not be machined if such face is true and parallel to the upper face. To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 25 OF 40
	3. 12.00 Lacing bars The ends of lacing bars shall be neat and free from burns. 3. 13.00 Separators Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used. 3.14.00 Bearing Plates Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings. 3.15.00 Floor Grating All grating units shall be rectangular in pattern and of pressure locked assembly. The size and spacing of bearing bars and cross bars shall be as approved in detailed drawings. Alternatively diamond pattern grating if approved may be used. The grating shall be made in panel units designed to span as indicated in structural steel framing drawing or as directed by the Engineer. The grating units shall be finished free from warps, twists, or any other defects. Grating work shall include cutouts and clearance openings for all columns, pipes, ducts, conduits etc. The gratings shall be notched, trimmed, and neatly finished around components of the steel structures encountered. Binding strip shall be provided on the grating to suit the profile. Openings in gratings shall be provided with steel bar toe plates of not less than 5 mm thickness and 100 mm width. Unless otherwise indicated on drawings, all penetrations of grating units shall be made up in split section, accurately fitted, and neatly finished. Grating units shall be provided with all necessary clips, bolts, lock washers etc. for proper assembly and installation on supporting steel members. Maximum deviation in linear dimension shall not exceed 12 mm. 3.10.00 Chequered Plates Minimum thickness of chequered plate floorings, covers etc. shall be 6 mm O/P. Chequered plate shall be accurately cut to the required sizes and shapes and the cut edges properly ground. Stiffeners shall be provided wherever required from design consideration.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 26 OF 40
3.11.00	Architectural Clearances Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances. 3.11.00 Shop connections a) All shop connections shall be otherwise riveted or welded as specified on the Drawings. b) Heads of rivets on surfaces carrying brick walls shall be flattened to 10 mm thick projection. c) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the contractor will have to make the desired changes at no extra cost to the exchequer. 3.13.00 Castings Steel castings shall be annealed. 3.14.00 Shop erection The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before dispatch. The parts shall be shop-erected with a sufficient number of parallel drifts to bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in such a way as will facilitate the check of interchange ability.	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 29 OF 40
	erection. Damages, if occur, shall be made good in accordance or as directed by the Engineer. 4.00.00 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY 4.01.00 Inspection Unless specified otherwise, inspection to all, work shall be made by the or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification. The Contractor shall provide free of charge, such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract. The Contractor shall guarantee compliance with the provisions of this Specification. 4.02.00 Testing and Acceptance Criteria 4.02.01 General The Contractor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own Cost. The Contractor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test. 4.02.02 Steel All steel supplied by, the Contractor shall conform, to the relevant Indian Standards. Except otherwise mentioned in the contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 M.T or less of any particular section for tests to conform to relevant Indian Standards. Cost of all tests shall be born by the contractor. All material shall be free from all imperfections, mill scales, slag intrusions, laminations, fittings, rusts etc. that may impair their strength, durability, and appearance.	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 30 OF 40
4.02.02	Welding a) The weld surface shall be cleaned with steel wire brush to remove spatter metal, slag etc. and 100% of welds shall be inspected visually for size, length of weldment and external defects. Weld gauges shall be used for checking weld sizes. The surface shall be clean with regular beads and free from slags, cracks, blow-holes etc. b) Non-destructive examination shall be carried out to determine soundness of weldments as follows: i) 10% at random on fillet-joints. ii) 100% on all butt-joints. c) Should the ND tests indicate defects like improper root penetration, extensive blowholes, slag intrusion etc., such welds shall be back gauged, joints prepared again and rewelded. All defects shall be rectified by the Contractor at no extra costs. d) All electrodes shall be procured from approved reputed manufacturers with test certificates. The correct grade and size of electrode, which has not deteriorated in storage, shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tones of welded fabrication, the Engineer may ask for 1(one) test-destructive or non-destructive including X -ray, ultrasonic test or similar, the cost of which shall be borne by the Contractor.	
4.02.04	Rivets, bolts, nuts and washers All rivets, bolts, nuts, and washers shall be procured from M/s. Guest Keen William Ltd. or equivalent and shall confirm to the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards. Cost of all such testing shall have to be borne by the Contractor. In addition to testing the rivets by hammer, 2% (two per cent) of the rivets done shall have to be cut off by chisels to ascertain the fit, quality of material and workmanship. The removal of the cut rivets and re-installing new rivets shall be done by the Contractor at his own cost.	
4.02.05	Shop painting All paints and primers shall be of standard quality and procured from approved manufacturers and shall conform to the provisions of the relevant Indian Standards.	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 31 OF 40
	4.02.12 Galvanizing All galvanizing shall be uniform and of standard quality when tested in accordance with IS: 2633 - Method for testing uniformity of coating on Zinc Coated Articles and 15: 4759 - specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products. 4.03.00 Tolerance The tolerances on the dimensions of individual rolled steel components shall be as specified in IS: 1852 - specification for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures shall be as specified in IS: 721 - Tolerances for Fabrication of Steel Structures. 4.04.00 Acceptance Should any structure or part of a structure be found not to comply with any of the provisions of this specification, the same shall be liable to rejection. No Structure or part of the structure once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check some of the tests at an appropriate laboratory at the contractors cost. When all tests to be performed in the Contractor's shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue acceptance certificate, upon receipt of which, the items will be shop painted, packed and dispatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract. 4.05.00 Delivery of materials 4.05.01 General The Contractor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work. The Owner may prescribe or control the sequence of delivery of materials, at his own discretion.	

	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 32 OF 40
4.05.02	Marking Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection. 4.05.03	Shipping Shipping shall be strictly in accordance with the sequence stipulated in the agreed Programme. Contractor shall dispatch the materials to the e worksite securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All parts shall be adequately braced to prevent damage in transit. Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and such distinct marking (all previous irrelevant markings being carefully obliterated) shall show the following: a) Name and address of the consignee b) Name and address of the consignor c) Gross weight of the package in tonnes and its dimensions d) Identification marks and/or number of the package e) Custom registration number, if required All markings shall be carried out with such materials as would ensure quick drying and indelibility. Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and corresponding piece numbers. Each packing case shall contain in duplicate in English a packing list pasted on to the inside of the cover in a water-proof envelope, quoting especially - a) Name of the Contractor b) Number and date of the Contract c) Name of the office placing the contract d) Nomenclature of stores

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 33 OF 40
	e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawings and the quantity of each. The shipping dimensions of each packing shall not exceed the maximum dimensions permissible for transport over the Indian Railways/Roads. After delivery of the materials at site, all packing materials shall automatically become the property of the Owner. Notwithstanding anything stated hereinbefore, any loss or damage resulting from inadequate packing shall be made good by the Contractor at no additional cost to the Owner. When facilities exist, all shipments shall be covered by approved Insurance Policy for transit at the cost of the Contractor. The contractor shall ship the complete materials or part on board a vessel belonging to an agency approved by the Owner or on rail and/or road transport as directed. The Contractor shall take all reasonable steps to ensure correct appraisal of freight rates, weights and volumes and in no case will the Owner be liable to pay any warehouse, wharfage, demurrage and other charges. If, however, the Owner has to make payment of any of the above-mentioned charges, the amount paid will be deducted from the bills of the Contractor. Necessary advise regarding the shipment with relevant details shall reach the Engineer at least a week in advance. 5.00.00 INFORMATION TO BE SUBMITTED 5.01.00 With Tender The following information is required to be submitted with the Tender: a) Progress Schedule The Contractor shall quote in his Tender a detailed schedule of progress of work and total time of completion, itemizing the time required for each of the following aspects of work. i) Preparation and approval of fabrication drawing ii) Procurement of Materials iii) Fabrication and shipping of all anchor bolts iv) Fabrication and shipping of main steelwork. v) Fabrication and shipping of steelwork for bunkers, tanks and/or silos	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 34 OF 40
	as applicable. vi) Fabrication and shipping of all other remaining steelwork including miscellaneous steelwork. vii) Final date of completion of all shipments. b) Shop Location of the Tenderer's fabrication workshop giving details of equipment, manpower, the total capacity, and the capacity that will be available exclusively for this contract shall be submitted. 5.02.00 After Award After award of the Contract the successful Tenderer is to submit the following: a) Complete fabrication drawings, material lists, cutting lists, rive and bolt lists, field welding schedules based on the approved design drawings prepared by him in accordance with the approved schedule. b) Monthly Progress Report with necessary photographs in six (6) copies to reach the Engineer on or before the 7th day o. each month, giving the up-to-date status of preparation of detailed shop drawings, bill of materials, procurement of materials, actual fabrication done, shipping and all other relevant information. c) Detailed monthly material reconciliation statements relevant to the Work done and reported in the Progress Report, giving the stock at hand of raw steel, work in progress, finished materials. d) Results of any test as and when conducted and as require by the engineer. e) Manufacturer's mill test report in respect of steel materials, rivets, bolts, nuts, and electrodes as may be applicable. 6.00.00 RATES AND MEASUREMENT 6.01.00 Rates 6.01.01 The items of work in the Schedule of items describe the work in brief. The various items of the Schedule of items shall be read in conjunction with these specifications including amendments and additions, general conditions of contract, special conditions of contracts, and other tender documents, if any. For each item of Schedule of Items, the bidder's rates shall include the activities covered in the description of the item as well as all necessary	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 35 OF 40
	operations described in the Specifications. 6.01.02 The bidder's rates shall include cost of all 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. Rates shall also include for taking all safety measures. 6.01.03 The bidder's -rates for all items of schedule of items shall include complete cost towards plant, equipment, erection and dismantling of scaffolding, men, materials and consumables, skilled and unskilled labour, levies, taxes, royalties, duties, transport, storage, repair/rectification/maintenance until handing over, contingencies, overhead and all incidental items not specifically mentioned but reasonably implied and necessary to complete the work. 6.01.04 No claims shall be entertained, if the details shown on the 'Released for Construction' drawings differ from those shown on the bid/tender drawings. 6.01.05 Rates shall be inclusive of all leads and lifts/elevation. 6.01.06 The bidder's rates for Structural Steel shall include for fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, erection scheme, alignment, welding, including preheating and post heating, testing of welders, inspection of welds, visual inspection, non destructive and special testing, rectification and correction of defective welding works, production test plate, inspection and testing, erection scheme, protection against damage in transit, stability of structures, etc. The rates shall also be inclusive of providing and installing temporary structures, transport of Owner issue material from store, return of surplus/waste steel materials including cut pieces/waste steel, provision of additional butt/weld joint to reduce the wastage and all other general, special, such requirements as may be required, for the successful completion of the work. The rates for fabrication are inclusive of all tests on welds and material and no extra shall be payable for quality tests specified for fabrication of structure in shop or at site. Separate BOQ items for test on welds like radiography or Ultrasonic, DPT, magnetic particle tests are kept for tests on material/fabrication not covered under regular fabrication item of BOQ. 6.01.07 The bidder's rates for foundation bolts assembly shall include fabrication, threading, heat treatment, erection, installation, and alignment of complete bolt assembly with nuts, locknuts, anchor plates, stiffener plates, protective tape, etc. This shall also include the cost of all materials not issued by the Owner. Material issued by Owner will be specified in GCC.	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 38 OF 40
	foundation bolt shall be calculated in the same way as that done for the item of fabrication, erection, alignment of structural steel. The weight of the nut / locknut shall be taken as per actual weight supplied by the contractor and accepted by the Engineer. 6.02.02 The measurement for the item of fabrication, erection, alignment, welding, etc. of structural steel work shall be based on the approved weight of steel nearest to a Kg, by applying the unit weight as adopted at the time of issue of structural steel on the measurements worked out as given below. 6.02.03 For ISMB, ISMC, ISA, flats, round bars, square bars and pipes, length shall be taken as per distance between planes normal to the axis of the member passing through the extreme points of the section. 6.02.04 Gussets plates in trusses, and bracings, brackets plates, stiffeners, and skew cuts if any in plates for butt welds, the area shall be assumed as the minimum circumscribed rectangle. However deduction for any notch/skew cut shall be made as mentioned in clause no-6.02.06. 6.02.05 For bunker wall plates, the minimum-circumscribing rectangle of the individual plate/pieces out of which these wall plates are assembled by butt-welding, shall be measured. Care shall be taken to ensure maximum utilization of cut-pieces generated by providing extra butt joints (for which no extra payment shall be made). 6.02.06 For all other plates, where the area of any notch/skew cut in the plate is less than 0.05 sq.m. the area of the plate shall be assumed as that of the minimum circumscribing rectangle for the purpose of measurement and calculation of area for the purpose of payment. However, if the area of any notch/skew cuts in a plate is more than 0.05 sq.m, the area of notch/skew cut shall be deducted from assumed minimum circumscribing rectangular area for the purpose of payment. 6.02.07 No deduction shall be made for the hole in the members, if the area of individual hole is less than 0.05 sq.m. The weight shall be calculated by deducting the area of holes, if area of individual hole is more than 0.05 sq.m. 6.02.08 All cut-pieces and scrap generated due to cutting of holes, skew-cuts of plates, gussets, brackets, stiffeners, etc. shall be stacked separately and handed over to the project stores without being considered for material accounting as the circumscribing rectangle has been considered for payment. 6.02.09 The splice plate shown in the fabrication drawing or approved by the Engineer shall only be measured for payment. 6.02.10 The weight of permanent bolts, washers and nuts and welds shall not be included in the weights of the members. No extra payment shall be made for	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 39 OF 40
	welding/bolting. 6.02.11 The bolts and nuts required for erection purpose shall not be paid for and may be taken away by the Contractor after final welding for members. Erection boltholes left after removal of erection bolts shall be suitably plugged with welds. 6.02.12 The measurement for the item of application of inorganic primer including blast cleaning of steel surfaces shall be based on the weight on which the zinc silicate primer is applied, after blast cleaning in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works. 6.02.13 The measurement for the item of application of finish primer system shall be based on the weight on which the epoxy based finish primer is applied in Metric Tonne, corrected to third place of decimal. The weight shall be the weight as approved, for erection mark/element of the mark painted, for payment of the item of fabrication and erection of structural steel works. 6.02.14 The measurement for the item of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor, and accepted by the Engineer. Nothing extra shall be payable for making cutouts, notches, openings of any profile, trimming profiles etc. in the grating units. 6.02.15 The measurement for the item of hot dipped galvanization of gratings shall be based on the actual weight in Kgs, corrected to second place of decimal of gratings galvanized by the Contractor and accepted by the Engineer. 6.02.16 The measurement for the item of permanent bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules. 6.02.17 The measurement for the item of High Strength Structural bolts with nuts and washers shall be based on the actual weight in Kgs, corrected to second place of decimal, as supplied by the Contractor and accepted by the Engineer, and as per the approved bolts and nuts schedules. 6.02.18 The measurement for the item of the work of dismantling, additions, alterations, reerection etc. shall be as given below 6.02.19 For dismantling, the unmodified weight of the actually dismantled erection marks shall only be measured. 6.02.20 For the work of addition to, alteration in and / or modification of 'erection	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEEL WORK	SPECIFICATION NO. PE-TS-999-600-C017 VOLUME - II B SECTION - D SUBSECTION -D17 REV.NO. 0 DATE 16/03/2016 SHEET 40 OF 40
	marks' either in erected position or in the fabrication yard, measurement of weight for payment purpose shall be calculated as the arithmetic sum of weight of steel cut and removed from the erection mark, weight of steel reutilised out of such cut and removed pieces and weight of additional new steel pieces added to the erection mark. 6.02.21 For re-erection the weight of the modified erection mark shall only be measured. 6.02.22 The weight shall be measured nearest to kg. and shall be arrived in a manner similar to the measurement for the item of fabrication, erection, alignment and welding of structural steel. 6.02.23 The measurement for the item of PTFE bearings shall be based on the load carrying capacity of PTFE in MT, corrected to third place of decimal, supplied by the contractor and as accepted by the Engineer and as per the approved bearing schedule, for the total vertical load carrying capacity, for all bearings. 6.02.24 The measurement for the item of stainless steel hopper shall be based on the actual finished weight of hopper weight in Kgs, corrected to second place of decimal. The hopper weight shall be arrived by multiplying of the inner surface area of the hopper with the unit weight of the hopper plate. 6.02.25 The measurement for the item of flexible open-ended bellows straps of neoprene shall be based in running meter, corrected to second place of decimal. Bellow Straps shall be supplied as per the requirement of the approved drawings. The measurement shall be done for the inner circumference of the bunker on which neoprene has been fixed and for the length supplied by the Contractor 'and as accepted by the Engineer. 6.02.26 The measurement for the item of Stainless Steel Hand Railing shall be based on finished weight of handrail in Kgs corrected to second place of decimal. The weight shall also include the weight of Stainless Steel fasteners, Stainless Steel beading, Stainless Steel cleats etc. The weight shall be the finished weight of Hand Rail, as accepted by the Engineer.	



TITLE:

**TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-999-600-C018

VOLUME - II B

SECTION - D SUBSECTION – D18

REV.NO. 0 DATE 30/11/2015

SHEET 1 OF 17

VOLUME: II B

**SECTION - D
(PART I)**

SUB-SECTION – D 18

ERECTION OF STRUCTURAL STEELWORK



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-999-600-C018

VOLUME - II B

SECTION - D

SUBSECTION – D18

REV.NO. 0

DATE 30/11/2015

SHEET 2

OF 17

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	GENERAL	3
3.00.00	WORKMANSHIP	6
4.00.00	TESTING AND ACCEPTANCE CRITERIA	12
5.00.00	INFORMATION TO BE SUBMITTED	16

	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018	
		VOLUME - II B	
		SECTION - D	SUBSECTION – D18
		REV.NO. 0	DATE 30/11/2015
		SHEET 3	OF 17

SUB-SECTION – D 18

ERECTION OF STRUCTURAL STEELWORK

1.00.00 SCOPE

This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at site, installing the same in position, painting and grouting the stanchion bases all complete as per Drawings, this Specification and other provision of the Contract.

2.00.00 GENERAL

2.01.00 Work to be provided for by the Contractor, unless otherwise specified in the Contract, shall include but not be limited to the following:

- a) The Contractor shall provide all construction and transport equipment, tools, tackle, consumables, materials, labour, and supervision required for erection of the structural steelwork.
- b) Receiving, unloading, checking, and moving to storage yard at Site including prompt attendance to all insurance matters as necessary for all fabricated steel materials arriving at Site. The Contractor shall pay all demurrage and/or wharfage charges etc. on account of default on his part.
- c) Transportation of all fabricated structural steel materials from Site storage yard, handling, rigging, assembling, riveting, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Engineer. If necessary suitable temporary approach roads to be built for transportation of fabricated steel structures.
- d) Checking center lines, levels of all foundation blocks including checking line, level, position and plumb of all bolts and pockets. Any defect observed in the foundation shall be rectified with Engineer's approval. The Contractor shall fully satisfy himself regarding the correctness of the foundations before installing the fabricated steel structures on the foundation blocks.
- e) Aligning, plumbing, leveling, riveting, bolting, welding and securely fixing the fabricated steel structures including floor gratings, chequered plates etc. in accordance with the Drawings or as directed by the Engineer.
- f) Painting of the erected steel structures.
- g) All minor modifications of the fabricated steel structures as directed by the

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 30/11/2015 SHEET 4 OF 17
	Engineer including but not limited to the following: i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling. ii) Cutting, chipping, filling, grinding, etc. if required for preparation and finishing of site connections. iii) Reaming of holes for use of higher size rivet or bolt if required. iv) Refabrication of parts damaged beyond repair during transport and handling or refabrication of parts, which are incorrectly fabricated. v) Fabrication of parts omitted during fabrication by error, or subsequently found necessary. vi) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication. vii) Carry out tests in accordance with this specification. 2.02.00 Work by Others No work under this Specification will be provided for by any agency other than the Contractor unless specifically mentioned elsewhere in the contract. 2.03.00 Codes and Standards All work under this Specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specification and codes of Practice of equivalent: IS: 800 - Code of practice for general construction in steel. IS: 456 - Code of practice for main or reinforced concrete. 2.04.00 Conformity with Designs The Contractor will erect the entire fabricated steel structure, align all the members, complete all field connections and grout the foundations all as per the provisions of this specification and the sequence and the design criteria laid down by the Engineer. All work shall conform to the provisions of this specification and /or instructions of the engineer. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specifications and/or the instructions o the Engineer.	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 30/11/2015 SHEET 5 OF 17
	2.05.00 Material 2.05.01 General All fabricated steel structures and connection materials shall be supplied by the Contractor to the site. The Contractor shall take delivery from railway wagons or trucks at site, and unload the materials and perform all formalities like checking of materials and attend to insurance matters in accordance with Sub-Clause 2.01.00 and as specified hereinbefore. 2.05.02 Materials to conform to Indian standards All materials required to be supplied by the Contractor under this contract shall conform to the relevant Indian Standard specifications. 2.06.00 Storage of Materials 2.06.01 General All material shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use shall be removed immediately from the site, failing which, the engineer shall be at liberty to get the materials removed by agency and the cost incurred thereof shall be realised from the Contractor's dues. 2.06.02 Yard The Contractor will have to establish a suitable yard in an approved location at site for storing the fabricated steel structures and other raw steel materials such as structural sections and plates as required. The yard shall have facilities like drainage, lighting, and suitable access for large cranes, trailers, and other heavy equipments. The yard shall be fenced all around with security arrangement and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved Programme of work. The Tenderer must visit the site prior to submission of his tender to acquaint himself with the availability of land and the development necessary by way of filling, drainage, access roads, fences, sheds etc. all of which shall be carried out by the Contractor at his own cost as directed by the Engineer. 2.06.03 Covered Store All field connection materials, paints, cement etc. shall be stored on well	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 30/11/2015 SHEET 6 OF 17
	designed racks and platforms off the ground in a properly covered store building to be built at the cost of the Contractor. 2.07.00 Quality Control The contractor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Engineer to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the Following items of work : i) Erection: Lines, levels, grades, plumbs, joint characteristics including tightness of bolts. ii) Grouting: Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency, and strength of grout. iii) Painting: Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats. 2.08.00 Taking Delivery The Contractor shall take delivery of fabricated structural steel and necessary connection materials from railhead/trucks as may be necessary and as directed by the Engineer. He shall check, unload; transport the materials to his stores for proper storing at his own cost. The Contractor shall submit claims to insurance or other authorities and pursue the same in case of loss or damage during transit and handling and all loss thereof shall be borne by him. The Contractor shall also take all precautions against damage of the materials in his custody after taking delivery and till the same are erected in place and accepted. The Contractor shall salvage, collect, and deliver all the packing materials to the Owner free of charge. 3.00.00 WORKMANSHIP 3.01.00 Erection 3.01.01 Plant and Equipment The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be thoroughly verified. They shall be efficient, dependable, in good working condition and shall have the approval of the Engineer.	



TITLE:

**TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-999-600-C018

VOLUME - II B

SECTION - D SUBSECTION – D18

REV.NO. 0 DATE 30/11/2015

SHEET 8 OF 17

Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance under this Specification.

No permanent field connections by riveting, bolting or shall be carried out until proper alignment and plumbing has been attained.

3.01.06 Field Riveting

All rivets shall be heated and driven with pneumatic tools. Hand passing or "throwing" of rivets are desirable. Any other method of conveying hot rivets from the furnace to the driving point must be approved by the engineer. No-cold rivets shall be driven. All other requirements of riveting including quality and acceptance criteria shall be in accordance with the relevant portions of the Specification for Fabrication of Structural Steelwork of the Project.

3.01.07 Field Bolting

All relevant Portions in respect of bolted construction of the Specification for Fabrication of Structural Steelwork applicable to the Project shall also be applicable for field bolting in addition to the following:

Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burns, and other, defects that would prevent solid seating of the parts. Contact surfaces within friction type joints shall be free of oil, paint, lacquer, or galvanizing.

All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods.

a) Turn-of-nut Method

When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the Joint are brought into good contact with each other. "Snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench. Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table-I with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation



TITLE:

**TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-999-600-C018

VOLUME - II B

SECTION - D SUBSECTION – D18

REV.NO. 0 DATE 30/11/2015

SHEET 9 OF 17

there shall be no rotation of the part not turned by the wrench.

TABLE-I

Bolts length not exceeding 8 times dia or 200 mm	Bolt length exceeding 8 times dia or 200 mm	Remarks
1/2 turn	2/3 turn	Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation-30° over or under.

Bolts may be installed without hardened washers when tightening is done by the turn -of-nut -method. However, normal washers shall be used.

Bolts tightened by the turn-of-nut method may have the outer face of the match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

b) Torque Wrench Tightening

When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torques specified in TABLE-II (See Note below the Table). Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

TABLE-II

Nominal Bolt Diameter (mm) (Kg.M) of IS:1367	Torque to be applied for bolt class 8.8
20	59.94
22	81.63
24	103.73

Note: The above torque values are approximate for providing tensions of 14.

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 30/11/2015 SHEET 10 OF 17
	7 T for 20 mm dia.; and 21.2 T for 24 mm dia. bolts under moderately lubricated condition. The torque wrench shall be calibrated at least once daily to find out the actual torque required to produce the above required tension in the bolt by placing it in a tension indicating device. These torques shall be applied for tightening the bolts on that day with the particular wrench. In either of the above two methods, if required, for bolt entering and wrench operation clearances, tightening may be done by turning the bolt while the nut is prevented from rotating. Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds. Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications. All other requirements regarding assembly and bolt tightening shall be in accordance with this sub clause. 3.01.08 Field Welding All field assembly and welding shall be carried out in accordance with the requirements of the specification for fabrication work applicable to the project, excepting such provisions therein which manifestly apply to shop conditions only. Where the fabricated structural steel members have been delivered painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints. 3.01.09 Holes, Cutting and Fitting No cutting of sections, flanges, webs, cleats, rivets, bolts, welds etc. shall be done unless specifically approved and /or instructed by the Engineer. The erector shall not cut, drill, or otherwise alter the work of other trades, unless such work is clearly specified in the Contract or directed by the Engineer. Wherever such work is obtain specified the Contractor shall obtain complete information as to size, location and number of alterations prior to carrying out any work. The Contractor shall not be entitled for any payment on account of any such work. 3.02.00 Drifting Correction of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge holes as necessary to make connections. Reaming, that weakens the member	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 30/11/2015 SHEET 11 OF 17
	or makes it impossible to fill the holes properly or to adjust accurately after reaming, shall not be allowed. Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited. 3.03.00 Grouting of stanchion bases and bearings of beams and girders on stone, brick or concrete (Plain or reinforced) Grouting shall be carried out with Ordinary Cement grout as described below: The mix shall be one (1) part cement and one (1) part sand and just enough water to make it workable. The positions to be grouted shall be cleaned thoroughly with compressed air jet and wetted with water and any accumulated water shall be removed. These shall be placed under expert supervision, taking care to avoid air locks. Edges shall be finished properly. If the thickness of grout is 25 mm or more, two (2) parts of 6 mm down graded stone chips may be added to the above noted cement-sand grout mix, if required, by the Engineer or shown on the drawings. No grouting shall be carried out until a sufficient number of bottom lengths of stanchions have been properly lined, leveled, and plumbed and sufficient floor beams are tied in position. Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally levelled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall be thoroughly cleaned. If required by the Engineer, certain admixtures like aluminium powder, “ironite” or equivalent, may be required to be added to the grout to enhance certain desirable properties of the grout. Approved non-shrink pre-mixed grout having required flowability and compressive strength may also be used with Engineer's approval. 3.04.00 Painting after Erection Field painting shall only be done after the structure is erected, levelled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. Normally, final painting shall be done only after the floor slabs are concreted and masonry walls are built. However, touch up painting, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the Contractor free of cost to the Owner. The materials and specification for such painting in the field shall be in accordance with the requirements of the specification for fabrication of structural	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 30/11/2015 SHEET 12 OF 17
	steelwork applicable for the project. Painting shall not be done in frosty or foggy weather or when humidity is such as to cause condensation on the surfaces to be painted. Before painting of steel, which is delivered unpainted, is commenced, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust. All field rivets, bolts, welds, and abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Where specified, surfaces, which will be in contact after site assembling, shall receive a coat of paint (in addition to the shop coat, if any) and shall be brought together while the paint is still wet. Surface, which will be inaccessible after field assembly shall receive the full, specified protective treatment before Bolts and fabricated steel members who are galvanized or otherwise treated and steel members to be encased shall not be painted. The final painting shall be of tow coats of Synthetics Enamel painting or Aluminium paint of approved manufacture as per the approved “Schedule of Painting”. The shades shall also be as per the approved schedule. Synthetic enamel paint shall conform to IS: 2932. 3.05.00 Final cleaning up Upon completion of erection and before final acceptance of the work by the Engineer, the contractor shall remove free of cost all false work, rubbish and all Temporary Works resulting in connection with the performance of his work. 4.00.00 TESTING AND ACCEPTANCE CRITERIA 4.01.00 General Loading tests shall be carried out on erected structures, if required by the Engineer, to check adequacy of fabrication and/or erection. Any structure or a part thereof found to be unsuitable for acceptance as a result of the test shall have to be dismantled and replaced with suitable member as per the Contract and no payment towards the cost of the dismantled portion and any connected work shall be made to the contractor. In course of dismantling, if any damage is done to any other parts of the structure or to any fixtures, the same shall be made good free of cost by the Contractor, to the satisfaction of the Engineer. The Cost of the tests specified hereinafter shall be borne by the Owner; but if the structure fails to pass the tests, the cost of the tests shall be recovered from the Contractor. Any extra claim due to loss of time, idle labour, etc. arising out of these testing operations shall not be entertained, however, only reasonable and appropriate time extensions will be allowed.	

	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 30/11/2015 SHEET 13 OF 17
	The structure or structural member under consideration shall be loaded with its actual dead load for as long a time as possible before testing and the tests shall be conducted as indicated in the following sub-clauses 4.01.01, 4.01.02 and 4.01.03. The method of testing and application of loading shall be as approved by the Engineer. 4.01.01 Stiffness Test In this test, the structure or member shall be subjected, addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limit. If, after removal of the test load, the member or structure does not show a recovery of at least 80 per cent of the maximum strain or deflection shown during 24 hours under load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery after this second test is not less than 90 per cent of the maximum increase in strain or deflection recorded during the second test. 4.01.02 Strength Test The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified superimposed load, and this load shall be maintained for 24 hours. In the case of wind load, a load corresponding to twice the specified wind load shall be applied and maintained for 24 hours, either with or without the vertical test load for more severe condition in the member under consideration or the structure as a whole. Complete tests under both conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part fails and if on the removal of the test load, the structure shows a recovery of at least 20 per cent of the maximum deflection or strain recorded during the 24 hours under load. 4.01.03 Structure of same design Where several structures are built to the same design and it is considered unnecessary to test all of them, one structure, as a prototype, shall be fully tested, as described in previous Sub-clauses, but in addition, during the first application of the test load, particular note shall be taken of the strain or deflection when the test load 1.5 times the specified superimposed load has been maintained for 24 hours. This information is required as a basis of comparison in any check test carried out on samples of the structure.	



TITLE:

**TECHNICAL SPECIFICATION FOR
ERECTION OF STRUCTURAL
STEELWORK**

SPECIFICATION NO. PE-TS-999-600-C018

VOLUME - II B

SECTION - D SUBSECTION - D18

REV.NO. 0 DATE 30/11/2015

SHEET 14 OF 17

When a structure of the same type is selected for a check test, it shall be subjected, in addition to its actual dead load, to a superimposed test load, equal to 1.5 time the specified live load, in a manner and to an extent prescribed by the Engineer. This load shall be maintained for 24 hours, during which time, the maximum deflection shall be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded in the check test does not exceed by more than 20% of the maximum strain or deflection recorded at similar load in the test on the prototype.

4.01.04 Repair for subsequent test and use after strength tests

An actual structure which has passed the "Strength Test" as specified in Sub-clause 4.1.2 hereinbefore and is subsequently to be erected for use, shall be considered satisfactory for use after it has been strengthened by replacing any distorted members and has subsequently satisfied the 'Stiffness Test' as specified in Sub-clause 4.01.01 hereinbefore.

4.02.00 Tolerances

Some variation is to be expected in the finished dimensions of structural steel frames. Unless otherwise specified, such variations are deemed to be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabricating tolerances for the finished parts and the rolling tolerances for the profile dimensions permitted under the Specifications for fabrication of structural steel work applicable to this Project and as specified below: The specified tolerance is mainly for welded erection. In case of bolted erection, no tolerance is desired so that all prefabricated bolt holes are matched on erection.

I. For Buildings Containing Cranes

Component	Description	Variation Allowed
1.	2.	3.
Main columns	a) shifting of column axis at foundation level with respect to building line	
	i) In longitudinal direction	i) ± 3.0 mm
	ii) In lateral direction	ii) ± 3.0 mm
	b) Deviation of both major column axis from vertical between foundation and	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 30/11/2015 SHEET 15 OF 17
	other member connection levels: i) For a column upto and including 10M height ii) For a column greater than 10M but less than 40M height c) For adjacent pairs of columns across the width of the building prior to placing of truss d) For any individual column deviation of any bearing or resting level from levels shown on drawings. e) For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating Trusses least. Trusses Crane Cirders	i) ± 3.5 mm from true vertical ii) ± 3.5 mm from true vertical for any 10 M length measured between connection levels, but not more than ± 7 mm per 30m length. ± 9.0 mm on true span. ± 3.0 mm 3.0 mm 1/1500 of the span or greater than 10mm whichever is the centre of bottom chord. 1/250 of depth of truss or 20 mm which ever is the - least. 2.0 mm. ± 3.0 mm

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	SPECIFICATION NO. PE-TS-999-600-C018 VOLUME - II B SECTION - D SUBSECTION – D18 REV.NO. 0 DATE 30/11/2015 SHEET 16 OF 17
	c) Relative shifting of ends of adjacent crane rail in plan and elevation after thermite welding. 1.0 mm. d) Deviation of crane rail axis from centre line of web. ± 3.5 mm Setting of Expansion gaps At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or below 30°C. The coefficient of expansion or contraction shall be taken as 0.000012 per °C per unit length. iv) For Building without Cranes The maximum tolerances for line and level of the steel work shall be ±3.0 mm on any part of the structure. The structure shall not be Out of Plumb more than 3.5 mm on each lox section of height and not more than 7.0 mm per 30 m section. These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise. 4.03.00 Acceptance Structures and members have passed the tests and conform to all requirements specified in the foregoing Sub-clause 4.01.00, 4.01.01, 4.01.02, 4.01.03 and 4.01.04 and other applicable provisions of this specification and are within the limits of tolerances specified in Sub-clause 4.02.00 and/or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfillment of the provisions of this contract. 5.00.00 INFORMATION TO BE SUBMITTED 5.01.00 Before Tender 5.01.01 Tentative Programme The Tenderer shall submit a tentative programme based on the information available in the Tender Document and visit to site indicating the structure-wise erection schedule proposed to be maintained by the Contractor to complete the job in time in accordance with the Contract.	

	TITLE:	SPECIFICATION NO. PE-TS-999-600-C018	
	TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK	VOLUME - II B	
		SECTION - D	SUBSECTION - D18
		REV.NO. 0	DATE 30/11/2015
		SHEET 17	OF 17
5.01.02	Constructional Plant and Equipment, Tools, Temporary works & manpower A detailed list Of all constructional plant and equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the Tenderer which he will be able to employ on the job to maintain the progress of work in accordance with the Contract shall be submitted along with the Tender. The total number of each category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be indicated.		
5.01.03	Erection Yard A site plan showing the layout and location of the erection yard proposed to be established by the tenderer shall also be attached with the tender indicating the storage space for fabricated steel materials, site-fabrication and repair shop, covered stores, offices, locations of erection equipments and other facilities. The Engineer shall have the right to modify the arrangement and location of the proposed yard to suit site conditions and the Contractor shall comply with the same without any claim whatsoever.		
5.02.00	After award of the Contract After award of the contract, the Contractor shall submit the following:		
5.02.01	Detailed Programme The Contractor shall submit a detailed erection programme within a month of the award of the Contract for completion of the work in time in accordance with the Contract. This will show the target programme, with details of erection proposed to be carried out in each fortnight, details of major equipment required, and an assessment of required strength of various categories of workers in a proforma approved by the Engineer.		
5.02.02	Fortnightly Progress Report The Contractor shall submit fortnightly progress reports in triplicate to the Engineer showing along with necessary photographs, 125 mm x 90 mm size, and all details of actual achievements against the target programme specified in Sub-clause 5.02.01 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the Contractor shall also furnish details of fabricated materials in hand at site and the strength of his workers.		

TITLE:

SPECIFICATION NO. PE-TS-999-600-C018

SECTION - D SUBSECTION – D18

SHEET 17 OF 17

5.01.02 Constructional Plant and Equipment, Tools, Temporary works & manpower A detailed list Of all constructional plant and equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the Tenderer which he will be able to employ on the job to maintain the progress of work in accordance with the Contract shall be submitted along with the Tender. The total number of each category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be indicated.

5.01.03 Erection Yard

5.02.00 After award of the Contract

5.02.01 Detailed Programme

5.02.02 Fortnightly Progress Report



TITLE:

**TECHNICAL SPECIFICATION FOR
ROOF DECKING**

SPECIFICATION NO. PE-TS-999-600-C019

VOLUME - II B

SECTION - D | SUB-SECTION – D19

REV.NO. 00 DATE 30/11/2015

SHEET 1 OF 7

VOLUME: II B

SECTION - D

SUB-SECTION – D19

ROOF DECKING

SPECIFICATION NO. PE-TS-999-600-C019



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
ROOF DECKING**

SPECIFICATION NO. PE-TS-999-600-C019

VOLUME - II B

SECTION - D | SUB-SECTION – D19

REV.NO. 00 DATE 30/11/2015

SHEET 2 OF 7

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	SCOPE	3
2.00.00	MATERIALS	3
3.00.00	INSTALLATION	3
4.00.00	ACCEPTANCE CRITERIA	6
5.00.00	IS CODES	6
6.00.00	RATES AND MEASUREMENTS	7

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-999-600-C019 VOLUME - II B SECTION - D SUB-SECTION – D19 REV.NO. 00 DATE 30/11/2015 SHEET 3 OF 7
<u>ROOF DECKING</u> 1.00.00 Scope This section of the specification covers the supply, fabrication and erection of profiled light gauge Metal Decks (coated and painted) as roof decking to the main plant building and any other area as indicated in the drawings. 2.00.00 Material 2.01.01 Roof of main plant TG and Deareator bay and bunker building consists of permanently colour coated (on exposed face) galvanized MS trough metal sheet decking plate of approved colour over roof purlins for cast-in-situ roof slab as per IS: 14246 and conform to class 3. Thickness of deck plate shall be minimum 0.8mm and minimum trough depth of 44 mm and centre to centre of the valley shall be 130mm with minimum yield strength of 250 Mpa. Silicon modified polyester paint shall be used for permanent coating over galvanized surface with minimum rate of galvanization 150 gm/sqm. DFT of permanent colour coating shall be 20 microns. It shall serve as permanent shuttering for cast-in-situ roof slab. It should have adequate strength to support weight of green concrete and imposed load during construction. The thickness of the deck plate shall however be designed suitably according to the spacing of roof purlins. 3.00.00 INSTALLATION The Contractor shall furnish all labour, equipment and materials as required for the design, fabrication, coating, erection and fixing of the decking over purlins, painting and for the complete performance of the work in accordance with the construction drawings and as described herein. The description, which follows, gives a general indication of the nature and extent of the work but is not necessarily exhaustive and does not purport to cover all the details/operations which will be necessary in order to carry out the work. 3.01.00 Detailed Design of Roof Decking The Contractor, in conjunction with the manufacturer, shall be responsible for the detailing of the profiled decking, fittings and fixtures and shall submit with his tender particulars of the proposed manufacturer and of the particular product proposed for use. The detailing is to be based on typical details furnished by the Engineer. The Contractor shall submit to the Engineer, two copies of the general arrangement and detailed working drawings for the proposed design, together with all calculations necessary to verify the adequacy and completeness of the design & detailing of decking sheets,		

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-999-600-C019 VOLUME - II B SECTION - D SUB-SECTION – D19 REV.NO. 00 DATE 30/11/2015 SHEET 4 OF 7
	fixtures, flashings and trims. After approval he shall supply further eight copies. The Engineer will verify the correct interpretation of his requirements but may not necessarily check the design and details, and the Contractor shall be entirely responsible for the accuracy of the drawings and the correctness of the design and the suitability of the details. Manufacture of roof decking sheets shall not commence until the necessary approval of the Engineer has been obtained. 3.02.00 Erection & Fixing 3.02.01 Sequence of Manufacture/Erection Cutting Schedules, delivery to site and stacking arrangements in store shall ensure that sheets are erected in a sequence which follows that for the manufacture. The decking sheets shall be erected using an arrangement of sheets and joints to conform with the requirements of this specification. Decking erection for each elevation or feature shall commence at one end only and proceed towards the other end, in order to ensure tight fitting laps. 3.02.02 Position and Location of Laps Side and end laps of roof decking sheets shall be located and positioned in such a manner as to provide the maximum weather protection taking into account the direction of the prevailing wind. The lines formed by horizontal laps and fixing shall where possible, be continuous and coincide with the edges of large openings in the roof. 3.02.03 Alignment of Sheets and Fixings All roof decking sheets shall be fixed plumb and level with all fixings evenly spaced and accurately lined. All dirt and grease shall be removed from the surfaces of the sheets as the work proceeds. 3.02.04 Site Cutting Approval must be obtained before the roof decking sheets are cut at site. Generally cutting of sheets to length will not be permitted, only special cutting and trimming for small openings shall allowed. Where possible, site cut edges shall be concealed at laps. 3.02.05 Damaged Sheets Distorted, blemished or water stained sheets and any other fittings shall not be used.	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-999-600-C019 VOLUME - II B SECTION - D SUB-SECTION – D19 REV.NO. 00 DATE 30/11/2015 SHEET 5 OF 7
	3.02.06 Laps End laps and side laps to roof decking sheets shall be sufficiently large to ensure that the decking complies with the weather tightness and other requirements of this specification. The length of each decking sheet shall be adjusted so that the end laps shall bear on the purlins. In no case end laps shall not be less than 150 mm and side laps shall not be less than 53 mm. 3.02.07 End Lap Fixings End lap fixings shall be located at least 25 mm from the end of each sheet. 3.02.08 Side Lap Fixings The spacing of side lap fixings shall ensure compliance with this specification regarding tightness. The spacing of these fixing screws shall not exceed 500mm. The fixing shall be located in the bottom flat of the corrugation. 3.02.09 Holes Holes in MS decking sheets shall be punched. In case holes are drilled holes, it is to be ensured that the holes do not go oversize due to the small thickness of the sheeting. All drilling swarf shall be removed from the surfaces of decking, supporting steel work, purlins etc. 3.02.10 Location and Spacing of Fixings Fixings shall be accurately located in position in the centre of the corrugations to ensure that the heads of bolts, nuts and washers bear squarely down on the surface of the sheeting and are not located at the edge or on the joints in supporting purlins. 3.02.11 Fixings The tenderer shall submit with his tender details of the proposed method for securing the roofing sheets to the metal purlins. The roof decking sheets are to be fixed to the roof purlins with hex washer head white zinc plated heat treated carbon steel self drilling / self tapping screws of minimum thread diameter of 5.6mm. These self drilling screws shall be drilled through the roofing sheets and purlins supporting the roofing sheets. These purlins shall be suitably spaced as per the requirement of roofing sheets and the roofing sheets shall not sag more than span/250 for the loads likely to be imposed during concreting and in future. The self-drilling screws are to be spaced at a maximum distance of 390mm centre to centre along the length of the purlins and top chord of truss. The screws are to be located preferably in the valley only and shall be installed in accordance with the manufacturer's	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-999-600-C019 VOLUME - II B SECTION - D SUB-SECTION – D19 REV.NO. 00 DATE 30/11/2015 SHEET 6 OF 7
	recommendations using tools approved by the manufacturer which do not damage the coating of the decking sheets. 3.03.00 Protection during Construction Precautions shall be taken during the erection of the roof decking to ensure that partially erected decking are protected during inclement weather and damage at all times. 3.04.00 Damage Any damage to coating & primer during transportation is to redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner. 4.00.00 Acceptance Criteria The installation shall present a neat appearance and shall be checked for water tightness. The following shall be checked : a) Side and end laps b) Absence of damage in the sheeting. c) Conformity of fixings with the approved design. 5.00.00 IS Codes 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 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 : 513 - Specification for cold rolled carbon steel sheets. IS : 3618 - Specification for phosphate treatment of iron and steel for protection against corrosion. IS : 4431 - Specification for carbon & carbon manganese free cutting steel. IS : 1573 - Electroplated Coatings of zinc on iron and steel.	

	TITLE: TECHNICAL SPECIFICATION FOR ROOF DECKING	SPECIFICATION NO. PE-TS-999-600-C019 VOLUME - II B SECTION - D SUB-SECTION – D19 REV.NO. 00 DATE 30/11/2015 SHEET 7 OF 7
6.00.0		
RATES AND MEASUREMENTS		
6.01.00		
Rates		
Rates shall be unit rate for complete item described in the Schedule of Items and shall include all wastage.		
6.02.00		
Method of Measurement		
Roofing shall be measured for net area of the work done. Profiled sheeting (coated & painted) shall be measured in plan area of sheets and not girthed. No deduction shall be made for openings measuring up to 0.1 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size.		
No payments shall be made for laps.		



TITLE:

**TECHNICAL SPECIFICATION
FOR FALSE FLOORING**

SPECIFICATION NO. PE-TS-999-600-C020

VOLUME - II B

SECTION - D | SUB-SECTION – D20

REV.NO. 00 DATE 30/11/2015

SHEET 1 OF 6

VOLUME: II B

SECTION - D

SUB-SECTION – D20

FALSE FLOORING

SPECIFICATION NO. PE-TS-999-600-C020



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION
FOR FALSE FLOORING**

SPECIFICATION NO. PE-TS-999-600-C020

VOLUME - II B

SECTION - D | SUB-SECTION – D20

REV.NO. 00 DATE 30/11/2015

SHEET 2 OF 6

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	GENERAL	3
2.00.00	MATERIALS	3
3.00.00	INSTALLATION	4
4.00.00	ACCEPTANCE CRITERIA	5
5.00.00	IS CODES	6
6.00.00	RATES AND MEASUREMENTS	6



TITLE:

TECHNICAL SPECIFICATION FOR FALSE FLOORING

SPECIFICATION NO. PE-TS-999-600-C020

VOLUME - II B

SECTION - D | SUB-SECTION - D20

REV.NO. 00 DATE 30/11/2015

SHEET 3 OF 6

FALSE FLOORING

1.00.00 General

This section of the specification covers the supply, fabrication and installation of false flooring system having PVC top finish particle board, GI supporting system, painting etc. as per schedule of items in the main plant building and any other area as indicated in the drawings.

The scope of contractor covers supply of all materials, fabrication & installation works required to be carried out for completion of false flooring in the area specified in the drawings.

2.00.00 MATERIAL

2.01.00 Supporting structure

Supporting pedestals shall be made of steel and will be of height as required. Supporting pedestal shall be truly vertical and located at distances to conform with size of floor panels and shall be equipped with locking devices to prevent disturbances of finished elevation. Base of pedestal shall have integral load dispersion plate of size 100x100x8mm to transmit the load evenly to the base floor. Adjustment of pedestal shall be provided by threaded vertical rod of 25mm diameter and elevating nut. The pedestal head shall provide positive interlocking of the steel grid channels supporting system and shall prevent lateral shifting.

The grid channels shall be made of galvanised steel of 40mm x 40mm x 3.15mm thick and shall be placed at 610mm centre to centre both ways to support floor panels in uniform levelled elevations. Nominal height of the false flooring system shall be 600 mm unless otherwise indicated. Pedestal head shall be equipped with conducting grounding pad if so desired by the Engineer

2.02.00 Floor Panels

The floor panels shall be made of fire resistant particle board, phenol formaldehyde bonded. Size of each panel shall be 610mm x 610mm with all panel edges finished to a tolerance of ± 0.2 mm. Floor panel shall have 2mm thick non-static PVC on top, 2mm thick hard PVC strip lipping on four edges and 26 G aluminium sheet fixed with araldite at bottom. Minimum thickness of the panel shall be 35mm, unless otherwise noted. All panels shall be completely interchangeable and easily removable with a suction lift tool. Panels shall be square within a tolerance of ± 0.25 mm on the diagonal. The floor panels shall be cut, wherever required for providing suitable outlets for cables and edges shall be lipped with hard PVC sheets.

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FALSE FLOORING	SPECIFICATION NO. PE-TS-999-600-C020 VOLUME - II B SECTION - D SUB-SECTION – D20 REV.NO. 00 DATE 30/11/2015 SHEET 4 OF 6
2.02.01	Strength Each 610mm x 610 mm floor panel must be capable of withstanding the designed service load. The ultimate strength shall provide a safety factor of 3. The false flooring shall be capable of carrying a axial load of 800 kg and uniform load of 2000 kg/sq.m with maximum deflection of 1/350. If required by the Engineer, the samples shall be accepted only after carrying out load tests. The Engineer may relax the test requirements with concentrated load in case cabinets are not handled with castor fitting arrangement. One additional pedestal shall be provided under floor stringer along front panel area of each control board for taking possible additional load that may occur from time to time. 2.02.02 Surface finish All removable panels shall have the top surface finished with 2 mm thick flexible PVC flooring conforming to IS:3462 and shall be fixed to the surface with compatible high-creep resistant adhesive. The PVC floor tile shall be in single piece for each floor panel. Under side of panels shall also be painted with suitable epoxy or oil based paint. 2.02.03 Damaged Floor Panels Distorted, blemished or stained floor panels shall not be used. 2.03.00 Skirting Skirting shall be 150 mm high and 2 mm thick, completely matching with false flooring surface finish materials and shall be fixed to the wall surface as per manufacturer’s installation instructions. 3.00.00 INSTALLATION 3.01.00 Base The system shall be placed over a base of RCC floor slab and beams. Any grouting etc. that is necessary to fix the supporting structure shall be done. The concrete sub floor shall be sealed with two coats of polyurethane paint to prevent moisture from coming in contact with cables and to minimise dust problem. The floor panels and channels shall be completely interchangeable and remain in position without screwing or bolting under working/imposed loadings. Any damage to the sub floor during installation of the false flooring system	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FALSE FLOORING	SPECIFICATION NO. PE-TS-999-600-C020 VOLUME - II B SECTION - D SUB-SECTION – D20 REV.NO. 00 DATE 30/11/2015 SHEET 5 OF 6
	shall be made good by the contractor without any extra cost to the Owner. All steel surfaces are to be protected by two coats of polyurethane paint over a compatible primer and any damage to the paint during installation shall be made good. In case the loads exerted by the weight of machines are above the stated characteristics of floor finish material, the floor shall be protected by overlaying hard board during installation of machine or equipment. All installation work of the false flooring system shall be supervised by the manufacturer's authorised representative. 3.03.00 Painting After fixing the false flooring supporting system the sub floor shall be given a coat of polyurethane paint. 3.04.00 Protection during Construction All precautions shall be taken during the erection of the false flooring to ensure that partially erected flooring are protected and shall not be damaged before handing over to owner. 3.05.00 Damage Any damage of coating to supporting system caused during transportation is to be redone with the similar type of coating as per the manufacturer's specification at no extra cost to the Owner. 4.00.00 ACCEPTANCE CRITERIA The false flooring system shall only be accepted after completion of following checks : - Level - Alignment of joints - Thickness of joints - Surface finish - Colour and texture - Details of edges, junctions etc. - Performance - Criteria specified for strength.	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR FALSE FLOORING	SPECIFICATION NO. PE-TS-999-600-C020 VOLUME - II B SECTION - D SUB-SECTION – D20 REV.NO. 00 DATE 30/11/2015 SHEET 6 OF 6
5.00.00	IS CODES 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 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:5318 Laying of flexible sheet and flooring. IS:3462 Flexible PVC flooring IS:3087 Wood particle boards (medium density) for general purposes.	
6.00.0	RATES AND MEASUREMENTS	
6.01.00	Rates	
	Rates shall be unit rate for complete item described in the Schedule of Items and shall include, but not limited to, supply & installation of floor panels, supporting systems, paintings etc.	
6.02.00	Method of Measurement	
	False flooring shall be measured in Sq.M for net area of the work done. No deduction shall be made for openings measuring up to 0.4 sq.m. in area. No extra shall be paid for extra labour in cutting and for wastage etc. in making opening and cutting to size.	



TITLE:

**TECHNICAL SPECIFICATION FOR
BORED CAST-IN-SITU RCC PILES**

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION – D21

REV.NO. 00 DATE 30/11/2015

SHEET 1 OF 26

VOLUME: II B

SECTION - D

SUB-SECTION – D21

BORED CAST-IN-SITU RCC PILES

SPECIFICATION NO. PE-TS-999-600-C021



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:
**TECHNICAL SPECIFICATION FOR
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SPECIFICATION NO. PE-TS-999-600-C021
VOLUME - II B
SECTION - D | SUB-SECTION – D21
REV.NO. 00 DATE 30/11/2015
SHEET 2 OF 26

CONTENTS

CLAUSE NO.	DESCRIPTION	
1.00.00	SCOPE	3
2.00.00	GENERAL REQUIREMENTS	3
3.00.00	MATERIALS	5
4.00.00	PILE INSTALLATION	6
5.00.0	SAMPLING, TESTING, AND QUALITY ASSURANCE	12
6.00.00	PILE TESTING	15
7.00.00	CODES AND STANDARDS	16
8.00.00	RATES AND MEASUREMENT	17
	ANNEXURE-A	
	ANNEXURE-B	
	ANNEXURE-C	
	ANNEXURE-D	
	TABLE - 1	



TITLE:

**TECHNICAL SPECIFICATION FOR
BORED CAST-IN-SITU RCC PILES**

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION - D21

REV.NO. 00 DATE 30/11/2015

SHEET 3 OF 26

**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 REQUIREMENTS

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.

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 30/11/2015 SHEET 5 OF 26
	3.00.00 MATERIALS 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/M³ 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.	

	TITLE:	SPECIFICATION NO. PE-TS-999-600-C021
	TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	VOLUME - II B
		SECTION - D SUB-SECTION – D21
		REV.NO. 00 DATE 30/11/2015
		SHEET 7 OF 26
4.01.03	The capacity of the rig shall be adequate so as to reach the specified founding level.	
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.	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION - D21 REV.NO. 00 DATE 30/11/2015 SHEET 8 OF 26
	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. 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.	

	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021	
		VOLUME - II B	
		SECTION - D	SUB-SECTION – D21
		REV.NO. 00	DATE 30/11/2015
		SHEET 9	OF 26
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.		
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).		

	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021	
		VOLUME - II B	
		SECTION - D	SUB-SECTION - D21
		REV.NO. 00	DATE 30/11/2015
		SHEET 10	OF 26
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.		
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.		

	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021	
		VOLUME - II B	
		SECTION - D	SUB-SECTION – D21
		REV.NO. 00	DATE 30/11/2015
		SHEET 11	OF 26
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		
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.		

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 30/11/2015 SHEET 12 OF 26
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	
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,	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 30/11/2015 SHEET 13 OF 26
	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 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.	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 30/11/2015 SHEET 14 OF 26
	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 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 Pile 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	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021
		VOLUME - II B
		SECTION - D SUB-SECTION – D21
		REV.NO. 00 DATE 30/11/2015
		SHEET 15 OF 26
	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: - 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. - 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. - 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 its length these will set up secondary reflections, which will be added to the return signal. - 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. - 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. - More than one recording of signals shall be done until repeatability of signals is achieved on the same pile. - 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	

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 30/11/2015 SHEET 16 OF 26
	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 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 foundations - Bored cast-in-situ concrete piles. IS: 2911 - Code of practice for design and construction of pile 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.	

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021 VOLUME - II B SECTION - D SUB-SECTION – D21 REV.NO. 00 DATE 30/11/2015 SHEET 17 OF 26
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, 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,	

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	SPECIFICATION NO. PE-TS-999-600-C021
		VOLUME - II B
		SECTION - D SUB-SECTION – D21
		REV.NO. 00 DATE 30/11/2015
		SHEET 18 OF 26
	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. 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.	



TITLE:

**TECHNICAL SPECIFICATION FOR
BORED CAST-IN-SITU RCC PILES**

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION - D21

REV.NO. 00 DATE 30/11/2015

SHEET 20 OF 26

ANNEXURE-A

Specific Requirements for Bored Cast-in-situ RCC Piles

A1.0 Minimum cement concrete grade M-25

Minimum cement content 400 Kg/M³

A1.1 Safe load

Diameter of Pile

Diameter of Pile (mm)	Vertical/ Compression (MT)	Horizontal/ Lateral (MX)	Pull out/Tension (MT)
*	*	*	*
*	*	*	*

A2. Installation criteria

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

A2.1 In Soil/weathered Rock

a) Minimum length of the pile shall be _____* m below COL.

b) The pile shall be terminated after penetrating through the strata having SPT penetration less than ____* cm for ____* blows, for a minimum length of _____* times the diameter of the pile.

A2.2 In Rock

a) Piles shall be installed and socketed into the rocks for a length (socketing length) equal to ____* times the pile diameter subject to a minimum of _____* meter below the socketing horizon.

b) Socketing horizon shall consist of rock strata having minimum uniaxial compressive strength of _____* kg/sq.cm.

A3. Average cut-off level for tender design and initial load test can be assumed as _____* m below ground level.

A4. A protocol shall be signed between BHEL site and contractor regarding,

Strata at the founding depth

Installation criteria



TITLE:

**TECHNICAL SPECIFICATION FOR
BORED CAST-IN-SITU RCC PILES**

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION - D21

REV.NO. 00 DATE 30/11/2015

SHEET 21 OF 26

Socketing depth

Density of bentonite before concreting

Slump of concrete.

Time interval between end of boring and start of concreting,

* Values shall be indicated separately depending upon subsoil strata of the site.



TITLE:
**TECHNICAL SPECIFICATION FOR
BORED CAST-IN-SITU RCC PILES**

SPECIFICATION NO. PE-TS-999-600-C021
VOLUME - II B
SECTION - D | SUB-SECTION - D21
REV.NO. 00 DATE 30/11/2015
SHEET 22 OF 26

ANNEXURE-B

List of Equipments

SI.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.



TITLE:

**TECHNICAL SPECIFICATION FOR
BORED CAST-IN-SITU RCC PILES**

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION - D21

REV.NO. 00 DATE 30/11/2015

SHEET 23 OF 26

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.



TITLE:

**TECHNICAL SPECIFICATION FOR
BORED CAST-IN-SITU RCC PILES**

SPECIFICATION NO. PE-TS-999-600-C021

VOLUME - II B

SECTION - D | SUB-SECTION - D21

REV.NO. 00 DATE 30/11/2015

SHEET 24 OF 26

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 -

	TITLE:	SPECIFICATION NO. PE-TS-999-600-C021	
	TECHNICAL SPECIFICATION FOR BORED CAST-IN-SITU RCC PILES	VOLUME - II B	
		SECTION - D	SUB-SECTION - D21
		REV.NO. 00	DATE 30/11/2015
	SHEET 25	OF 26	

14. SPT* N values in soil (from the nearest bore hole).
+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.

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	



TITLE:

**TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 30/11/2015

SHEET 1 OF 16

VOLUME: II B

SECTION - D

SUB-SECTION – D22

SITE LEVELLING & GRADING WORKS

SPECIFICATION NO. PE-TS-999-600-C022



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 30/11/2015

SHEET 2 OF 16

C O N T E N T

CLAUSE NO.	DESCRIPTION	SHEET NO.
1.00.00	GENERAL	3
2.00.00	SCOPE	3
3.00.00	MATERIALS	4
4.00.00	QUALITY CONTROL	6
5.00.00	EXECUTION	6
6.00.00	RATES AND MEASUREMENTS	15

	TITLE: TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS	SPECIFICATION NO. PE-TS-999-600-C022 VOLUME - II B SECTION - D SUB-SECTION – D22 REV.NO. 00 DATE 30/11/2015 SHEET 3 OF 16
GENERAL TECHNICAL SPECIFICATION FOR SITE LEVELLING AND GRADING 1.00 GENERAL This specification cover the works to be carried out for “Site Levelling and Grading Works including Slope Protection” etc for the entire plant and associated areas. The specified formation level(s) shall be achieved either by excavation or by raising with controlled fill with excavated/borrowed earth as the case may be. 2.00 SCOPE 2.01 The scope include all works involved in levelling the site to the lines, grades, cross sections and dimensions as shown on the approved drawings and/or as directed by the engineer including site clearance, setting out, earth work in excavation, stacking, loading, transportation, unloading, dewatering, drainage, filling, watering, compaction, turfing on slopes (if required), lighting, disposal of residual/surplus earth etc. It also include supplying and providing all labour, materials, supervision, services, equipments, tools and plants, testing and all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work etc. 2.02 All tools and plants, equipments and machineries to be used in this work shall be of standard quality and manufactured by reputed concerns conforming to Indian Standard (IS) codes or equivalent thereof. 2.03 Work to be provided by the Contractor The works to be provided by the contractor unless specified otherwise shall include but not be limited to the following. a) Supplying and providing all labour, supervision, services including as required under statutory labour regulations, materials, equipments, tools and plants, approaches, transportation etc required for the completion of the work. b) Preparation and submission of detailed scheme of all operations required for executing the work (material handling, placement, services, approaches etc) to the engineer for approval. c) Carrying out sampling and testing on fill materials/fills to assess the quality/moisture content/degree of compaction and submission of the test results whenever required by the engineer. d) Design, construction and maintenance of Magazine of proper capacity for storage of explosives for blasting work and removal of the same after completion of the work etc.		

 BHEL Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS	SPECIFICATION NO. PE-TS-999-600-C022 VOLUME - II B SECTION - D SUB-SECTION – D22 REV.NO. 00 DATE 30/11/2015 SHEET 4 OF 16
2.04	Work to be provided by others No work under this specification will be provided for by any agency other than the contractor unless specifically mentioned elsewhere in the contract. 2.05 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. IS: 1200 Methods of measurement of building and civil engineering works, Part-1: Earthwork IS: 2720 Method of test for soils (Relevant parts) IS: 3764 Excavation work- Code of safety IS: 4081 Safety code for blasting and related drilling operations IS: 4701 Code of practice for earthwork on canals IS: 6922 Criteria for safety and design of structures subject to underground Blasts In case of conflict between this specification and those (IS codes) referred to herein, the former shall prevail. In case any particular aspect of work is not covered specifically by the specification or/and by the IS codes, any other standard practice as may be specified by the engineer shall be followed. 2.06 Conformity with Designs The contractor shall carry out the work as per the approved drawings, specification and as directed by the engineer. 3.00 MATERIALS All materials required for the work shall be of best variety and approved by the engineer. 3.01 Materials for Excavation For the purpose of identifying the various strata met during the course of excavation, the following classification is to be followed.	



TITLE:

**TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 30/11/2015

SHEET 5 OF 16

a) Soil

It include all type of soil including laterite, moorum etc with/without any percentage of kankars which can be excavated by normal means such as shovel, pick axe, crow bar, spade etc and those which do not fall under **clause 3.01 (b) and (c)** etc.

b) Soft Rock

It include the rocks (including weathered rock) which are removable by splitting with the help of crow bar, pick axe, wedges, pavement breakers, pneumatic tools, hammers or such implements etc and not requiring blasting (for excavation) in the opinion of the engineer.

c) Hard Rock

It includes the rocks, which require blasting for excavation in the opinion of the engineer. Where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other method as approved by the engineer. The mere fact that the contractor resorts to blasting shall not classify the soft rock under hard rock.

However, the engineer's decision on the type of strata encountered during excavation shall be the final and binding on the contractor.

3.02

Materials for Filling

Any coarse grained or fine grained low plastic soil free from vegetation, roots, shingle, salts, organic matters, sod and any other harmful chemicals shall be used for filling. The contractor shall test the fill material to establish its suitability and submit the results to the engineer for approval. Fill material shall be got approved by the engineer. The following type of materials shall not be used for filling.

- a)Materials from swamps, marshes and bogs
- b)Expansive clays
- c)Peat, logs, sod and perishable materials
- d)Materials susceptible to combustion
- e)Any material or industrial and domestic produce which will adversely affect other materials of work
- f)Materials from prohibited areas

The earth available by cutting the high grounds within the project site and the materials (if) available from the road excavation or any other excavation under the same contract shall be used for filling depending upon its suitability as fill material. Filling with excavated rock (in the project site) shall be done only with



TITLE:

TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION – D22

REV.NO. 00 DATE 30/11/2015

SHEET 6 OF 16

the written permission of the engineer in the following manner. The boulders shall be broken into pieces not exceeding 150mm size in any direction and mixed with fine materials consisting of decomposed rock, moorum or any approved earth to fill the voids as far as possible and the mixture shall then be used for filling. In case the earth required for filling is over and above the earth available from the compulsory excavations within the project area, then borrow areas for obtaining suitable fill material shall be arranged by the contractor himself from outside the plant boundary limits and all expenses including royalties, taxes, duties etc shall be borne by him. He shall obtain and submit the necessary clearances/permissions from the concerned authorities to the engineer for the borrow areas/materials acquired.

4.00

QUALITY CONTROL

All works shall conform to the lines, levels, grades, cross sections and dimensions shown on the approved drawings and/or as directed by the engineer. The contractor shall establish and maintain quality control for the various aspects of the work, method of construction, materials and equipments used etc. The quality control operation shall include but not be limited to the following.

Sl. No.	Activity	Check
1	Lines, levels & grades	a) By periodic surveys b) By establishing markers, boards etc
2	Filling	(a) On quality of fill material (b) On moisture content of fill material (c) On degree of compaction achieved

5.00

EXECUTION

The contractor shall prepare and submit the detailed drawings/schemes for excavation and filling works as proposed to be executed by him showing the dimensions as per the construction drawings and specification adding his proposal of approaches, dewatering (if any), drainage and compaction etc within 15 days of award of the contract to the engineer for approval.

5.01

Site Clearance

Before the commencement of earthwork, the entire area of cutting and filling shall be cleared of all trees, stumps, bushes, grasses, vegetation etc with their roots, fences, logs, rubbish, water, slush etc. It is not necessary to remove all the soil containing fine hair like roots but only the rather heavy mats are to be removed. Cutting of trees shall include trees having girth of any size and removing roots upto a depth of 600mm below the existing ground level or 300mm below the formation level whichever is deeper. After the removal of roots of trees, the pot holes formed shall be filled with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The trees shall be cut in to suitable pieces as instructed by the engineer. Before earthwork is started, all the spoils, unserviceable materials and



TITLE:

TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 30/11/2015

SHEET 7 OF 16

rubbish shall be burnt or removed and disposed off to the approved disposal area(s) as specified by the engineer. Useful materials, saleable timbers, fire woods etc shall be the property of owner and shall be stacked properly at the worksite in a manner as directed by the engineer.

5.02

Setting Out

On receiving the approval from the engineer with modifications and corrections if any, the contractor shall set out the work from the control points furnished by the engineer and fix permanent points and markers for the ease of periodic checking as the work proceeds. These permanent points and markers shall be fixed at the interval as prescribed by the engineer and shall be got checked and certified by the engineer after whom the contractor shall proceed with the work. It should be noted that this checking by the engineer prior to the start of the work will in no way relieve the contractor of his responsibility of carrying out the work to true lines, levels and grades as per the drawings and specification. If any errors are noticed in the contractor's work at any stage, the contractor at his own risk and cost shall rectify the same. The contractor shall take spot levels of the area (with respect to the bench mark/ available source as provided by the engineer) to be excavated or to be filled at an interval of not more than 10m or as directed by the engineer before starting any earth work and shall be submitted to the engineer for prior approval.

5.03

Excavation

Levelling by excavation shall be carried out where the existing ground levels are higher than the specified formation level. Excavation shall include removal of all materials whatever nature as may be and whether wet or dry shall be carried out exactly in accordance with the line, levels, grades and curves shown on the approved drawings and/or as directed by the engineer. All excavations shall be done to the minimum dimensions as required. The contractor shall obtain prior approval of the engineer for the method he proposes to adopt for excavation in different types of strata including dimensions, side slopes and dewatering if any, stacking or disposal etc. This approval however shall not in any way make the engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to any other activities in the area. **Prior to starting the excavation, the ground level at the location shall be checked jointly with the engineer.**

The rough excavation may be carried up to a maximum depth of 150mm above the final formation level. The balance shall be excavated with special care and the final surface shall be compacted by rolling with 6 passes of 8 to 10 tonne roller. If directed by the engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer. The contractor shall be paid for the extra excavation and filling at the appropriate items of work.

	TITLE: TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS	SPECIFICATION NO. PE-TS-999-600-C022 VOLUME - II B SECTION - D SUB-SECTION – D22 REV.NO. 00 DATE 30/11/2015 SHEET 8 OF 16
	If the excavation is done to a depth greater than that shown on the drawing or as directed by the engineer due to the contractor's fault, the excess depth shall be filled up to the required level with good earth in 250mm layers (loose thickness) and compacted unless otherwise directed by the engineer at the own risk and cost of the contractor. Suitable slope in cutting as per the requirements and as directed by the engineer shall be adopted to withhold the face of earth. The contractor shall be held responsible for any damage to any part of the work caused by the collapse of the side of excavations. 5.03.01 Excavation in Hard Rock Excavation in hard rock shall normally be done with blasting. In case where blasting is prohibited for any reasons, the excavation shall be carried out by chiselling or any other approved method as directed by the engineer. Personnel deployed for rock excavation shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. 5.03.02 Blasting a) General Storage, handing and use of explosives shall be governed by the current explosive rules/regulations laid down by the Central and the State Governments. The contractor shall ensure that these rules/regulations are strictly adhere to. The following instructions are also to be strictly followed and the instructions wherever found in variance with the above said rules/regulations, the former (instructions) shall be superseded with the later (above said rules/regulations). No child under the age of 16 and no person who is in a state of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives. The contractor shall obtain licence from the District Authorities for undertaking the blasting work as well as for obtaining and storing the explosives as per Explosives Rules, 1940 corrected upto date. The contractor shall purchase the explosives, fuses, detonators etc only from a licensed dealer and shall be responsible for the safe custody and proper accounting of the explosive materials. The engineer or his authorized representative shall have the access to check the contractor's store of explosives and his accounts at any time. It is the full responsibility of the contractor to transport the explosives as and when required for the work in a safe manner to the work spot. Further, the engineer may issue modifications, alterations and new instructions to the contractor from time to time. The contractor shall comply with the same without these being made a cause for any extra claim.	



TITLE:

TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 30/11/2015

SHEET 9 OF 16

b) Materials

All materials such as explosives, detonators, fuses, tamping materials etc proposed to be used in the blasting operation shall have the prior approval of the engineer. Only explosives of approved make and strength are to be used. The fuses known as instantaneous fuse must not be used. The issue of fuse with only one protective coat is prohibited. The fuse shall be sufficiently water resistant as to be unaffected when immersed in water for 30 minutes. The rate of burning of the fuse shall be uniform and shall be not less than 4 seconds per inch of length with 10% tolerance on either side. Before use, the fuse shall be inspected. Moist, damaged or broken ones shall be discarded. When the fuses are in stock for long, the rate of burning of fuses shall be tested before use. The detonators shall be capable of giving an effective blasting of the explosives. Moist and damaged detonators shall be discarded.

c) Storage of Explosives

The current Explosive Rules shall govern the storage of explosives. Explosives shall be stored in a clean, dry and well-ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400m of the actual work site or any source of fire. The space surrounding the magazine shall be fenced and the ground inside shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be through a single gate only and no person shall be allowed without the permission of the officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The magazine shall be well drained. Two lightning conductors, one at each end shall be provided to the magazine. The lightning conductors shall be tested once in every year.

Explosives, fuses and detonators shall each be separately stored. Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides. Special care shall be taken to keep the floor free from any grains of explosives. Cases containing explosives shall not be opened inside the magazine and the explosives in open cases shall not be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine but must be removed without delay to a safe distance and be destroyed.

Artificial light, matches, inflammable materials, oily cotton, rag waste and articles liable to spontaneous ignition shall not be allowed inside the magazine.

Illumination shall be obtained from an electric storage battery lantern. No smoking shall be allowed within 100m distance from any magazine. Magazine shoes without nails shall be used while entering the magazine. The persons entering the magazine must put on the magazine shoes which shall be provided at the magazine for this purpose and should be careful

* not to put their feet on the clean floor unless the magazine shoes on.

**TITLE:****TECHNICAL SPECIFICATION FOR
SITE LEVELLING & GRADING
WORKS**

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 30/11/2015

SHEET 10 OF 16

* not to touch the magazine shoes on ground outside the clean floor.

* not to allow any dirt or grit to fall on the clean floor.

Persons with bare feet shall dip their feet in water before entering the magazine and then step directly from the tub to the clean floor. No person having article of steel or iron with/on him shall be allowed to enter the magazine. Workmen shall be examined before entering the magazine to check none of the prohibited articles are with them. A brush broom shall be kept in the lobby of the magazine for cleaning the magazine. Cleaning shall be done immediately after each occasion whenever the magazine is opened for receipt, delivery or inspection of the explosives.

The mallets, levers, wedges etc for opening the barrels or cases shall be of wood. The cases of explosives are to be carried by hand and shall not be rolled or dragged inside the magazine. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been stored long in the store are to be issued first. Neither the magazine shall be opened nor any person shall be allowed in the vicinity of the magazine during any dust storm or thunderstorm. All magazines shall be officially inspected at definite intervals and a record of such inspections shall be kept.

d) Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from direct rays of the sun, artificial lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each case or package shall be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on the vehicle conveying explosives. No explosive shall be transported in a carriage or vessel unless all iron or steel therein the carriage or vessel which are likely to contact the package containing explosives are effectually covered with lead, leather, wood, cloth or any other suitable material. No light shall be carried on the vehicle carrying explosives and no operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

e) Use of Explosives

The contractor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The contractor shall satisfy himself that the person so appointed is fully acquainted with his responsibilities. Holes for charging the explosives shall be drilled with pneumatic drills and the drilling pattern shall be so planned that the rock pieces after blasting will be suitable for handling. The hole diameter shall be of such a size that the cartridges can easily pass down through them and any undue force is not required during charging. Charging operation shall be carried out by or under the personal supervision of the shot firer. Wrappings shall never be removed



TITLE:

TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 30/11/2015

SHEET 11 OF 16

from the explosive cartridges. Only one cartridge at a time shall be inserted in a hole and wooden rods shall only be used for loading and stemming the shot holes. Only such quantities of explosives as are required for a particular work shall be brought to the work site. Should any surplus remain when all the holes have been charged shall be carefully removed to a point at least 300m away from the firing point.

The authorized shot firer himself shall make all the connections. The shot firing cable shall not be dragged along the ground to avoid any damage to the insulation. The shot firing cable shall be tested each time for its continuity and possible short circuiting. The shot firer shall always carry the exploder handle with him until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits. Before any blasting is carried out it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300m radius from the firing point or as required by the statutory regulations at least 10 minutes before the time of firing by sounding a warning siren and the area shall be encircled by red flags.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges, the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current etc and keep the lead wires short circuited until it is ready to fire. Any kink in the detonator leading wire shall be avoided. For simultaneous firing of a large number of shot holes, use of cordtex may be done. An electric detonator attached to its side with adhesive tape shall initiate cordtex connecting wire or string. Blasting shall only be carried out at certain specified times to be agreed jointly by the contractor and the engineer.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations, the authorized shot firer shall return to the blast area and inspect carefully the work and satisfy himself that all the charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole at a distance of not less than 600mm from the misfired hole and by exploding a new charge. The authorized shot firer shall be

present during the removal of debris as it may contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

Where blasting is to be carried out in proximity of other structures, controlled blasting by drilling shallow shot holes and proper muffling arrangements with steel plates loaded with sand bags etc shall be used on top of the blast holes to prevent the rock fragments from causing any damage to the adjacent structures and other properties. Adequate safety precautions as per building byelaws, safety codes, statutory regulations etc shall be taken during blasting operations.

	TITLE: TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS	SPECIFICATION NO. PE-TS-999-600-C022 VOLUME - II B SECTION - D SUB-SECTION – D22 REV.NO. 00 DATE 30/11/2015 SHEET 12 OF 16
5.03.04	Restrictions on Blasting a) Blasting which may disturb or endanger the stability, safety or quality of the adjacent structures/foundations shall not be permitted. b) Blasting within 200m of a permanent structure or construction work in progress shall not be permitted. c) Progressive blasting shall be limited to two third of the total remaining depth of excavation. d) No large scale blasting operations will be resorted to when the excavation reaches the last one metre and only small charge preferably black powder may be allowed so as not to shatter the parent rock. e) The last blast shall not be more than 0.50 m in depth. f) In rocky formations, at locations where specifically indicated or ordered in writing by the engineer, the use of explosives shall be discontinued and excavation shall be completed by chiselling or any other suitable method as approved by the engineer.	
5.04	Sorting of Excavated Materials The excavated material shall be carefully sorted for use in filling the areas in the project site by removing roots, grasses, organic matters and other objectionable materials and be sorted out into different types of materials for use and as directed by the engineer. The excavated material which is not considered fit for filling purpose shall be immediately removed and disposed at such a place and in such a manner as will be directed by the engineer. The material found unusable should be got approved by the engineer before actually disposing it off. The useful materials that cannot be used directly shall be heaped in separate area as stock piles. Stockpiles shall be of regular size as for as possible for ease of measurement. The materials heaped shall be utilised as and when required and as directed by the engineer. The cost of complete item of earthwork includes the cost of rehandling of the materials and temporarily heaped and reused.	
5.05	Disposal of Surplus/ Waste Materials Surplus and other waste materials shall be removed and disposed of from the construction site to the area demarcated by the engineer. No material shall be wasted unless approved by the engineer.	
5.06	Earth Work in Filling Levelling by raising with controlled fill of approved excavated/borrowed earth shall be carried out where the existing ground levels are lower than the specified formation level. After clearing site as per clause 5.01, the original ground shall be compacted by rolling subject to a minimum 6 passes of 8 to 10 tonne roller. The approved earth/fill material shall then be spread in horizontal layers not exceeding 300mm in compacted thickness. Each layer shall be watered and thoroughly compacted with proper moisture content and such equipments as may be required to obtain a minimum of 95% of its maximum dry density as	



TITLE:

TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS

SPECIFICATION NO. PE-TS-999-600-C022

VOLUME - II B

SECTION - D | SUB-SECTION - D22

REV.NO. 00 DATE 30/11/2015

SHEET 13 OF 16

determined by standard Proctor's test as per IS: 2720 part-VII or 85% of relative density as per IS:2720 part-XIV as specified. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The fill material shall be tested for its optimum moisture content and maximum dry density as per IS: 2720, part-VII. Moisture content shall be checked at the source of supply in accordance with IS:2720 part- II and if found less than that required for proper compaction, the same shall be made good either at the source or after spreading the soil in loose thickness for compaction. In the latter case, water shall be sprinkled directly from the hose line or from the truck-mounted water tank etc making due allowance for evaporation losses and the fill material be thoroughly mixed by means of harrows, rotary mixers or by any other suitable approved method until the layer is uniformly wet. **Flooding shall not be permitted for watering purpose under any circumstances.** If the material delivered is too wet, it shall then be dried by aeration and exposure to the sun till the moisture content is suitable for compaction. Should circumstances arise owing to wet weather the moisture content cannot be reduced to the required amount by the above procedure, the work on compaction shall be suspended. Clods or hard lumps of earth shall be broken to have a maximum size of 150mm when being placed in the layers before compaction. For each of the above tests on the fill material, one sample for every 10,000cu.m shall be tested. Additional samples shall be tested whenever there is a change of source or type of material.

Before start of filling, the contractor shall submit the engineer his proposal for the methodology to be adopted for compaction. The compaction equipments as approved by the engineer shall only be employed to compact the different type materials encountered during construction. If directed by the engineer, the contractor shall demonstrate the efficacy of the plant he intends to use by carrying out compaction trials. Moisture content of the fill material shall be controlled near optimum moisture content during compaction.

The compacted layer shall be tested for its dry density as per IS:2720, part-XXVIII or XXIX as directed by the engineer. Samples shall be taken at the rate of one sample for every 10,000sq.m area of each compacted layer. In addition random checks shall be carried out in compacted layers by means of Proctor needle penetration test. Contractor shall submit all the test results to the engineer immediately after completion of the tests. A sample shall be deemed to have passed the test when the dry density of the compacted fill is equal to or more than 95% of its maximum dry density. When field density measurements reveal any soft areas in the fills, further compaction shall be carried out as directed by the engineer. If in spite of that, the specified compaction is not achieved, the material in the soft areas shall be replaced with approved material compacted to the density requirements and satisfaction of the engineer.

Subsequent layers shall be placed only after the finished layer has been tested and accepted by the engineer.

Where the filling is to be done across low swampy ground that will not support the weight of trucks or other hauling equipments, the lower part of the fill shall be constructed by dumping successive loads in a uniformly distributed

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS	SPECIFICATION NO. PE-TS-999-600-C022 VOLUME - II B SECTION - D SUB-SECTION – D22 REV.NO. 00 DATE 30/11/2015 SHEET 14 OF 16
	layer of a thickness not greater than that necessary to support the hauling equipment while placing subsequent layers. 5.07 Dewatering and Drainage It shall be ensured that the area to be excavated/filled shall be free from water. The contractor shall remove the water (if any) by pumping or by any other means as approved by the engineer. At all times, the surface of cutting/filling during execution shall be maintained at such a cross fall as will shed water and prevent ponding. All existing drains/channels (if any) in the work area shall be suitably diverted by the contractor before taking up any excavation or filling. These diversions shall be such that it shall ensure effective disposal of water without any accumulation or flooding within the project site and in adjoining areas. 5.08 Finishing Operations Finishing operation shall include the work of shaping and dressing the excavated/filled ground to the required grades, levels, lines, side slopes, crosssections and dimensions as shown on the approved drawings or as directed by the engineer. 5.09 Turfing Turfing shall be provided at the slopes and other locations as shown on the drawings or as directed by the engineer. The turf shall be of approved quality of grass. The sod shall consist of dense, well rooted growth of permanent and desirable grasses indigenous to the locality where it is to be used and shall be practically free from weeds or other undesirable matter. The grass on the sod shall have a length of approximately 50mm and the sod shall be free of any debris. Thickness of the sod shall be as uniform as possible with 50 to 80mm of soil covering the grass roots depending on the nature of the sod so that all the dense root system of the grasses are retained in the sod strip. The sods shall be cut in rectangular strips of uniform width not less than about 300mm x 250mm size but not so large so that it is convenient to handle and transport without damage. The area to be sodded shall be previously constructed to the required slope and cross section. Prior to placing the sods, the slopes shall be roughened and wetted in order to have a satisfactory bond. The strips of sod shall be laid in close contact with each other and be tamped firmly in place so as to fill and close the joints between them. The turfing so laid shall be well watered and protected until final acceptance.	

	TITLE: TECHNICAL SPECIFICATION FOR SITE LEVELLING & GRADING WORKS	SPECIFICATION NO. PE-TS-999-600-C022 VOLUME - II B SECTION - D SUB-SECTION – D22 REV.NO. 00 DATE 30/11/2015 SHEET 16 OF 16
	c) Where soft rock and hard rock are mixed, the measurement shall be done as follows. The two types of rock shall be stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in the stacks. If the sum of net quantity of the two types of rock so arrived exceeds the total quantity of excavation then the quantity of each type of rock shall be worked out from the total quantity (from excavation) in the ratio of net quantities in stack measurements of the two types of rock. If stacking is not feasible, the method as suggested by the engineer shall be followed. d) Where soil, soft rock and hard rock are mixed, the measurement shall be done as follows. The soft and hard rock shall be removed from the excavated material and stacked separately and measured in stacks. The net quantity of each type of rock shall be so arrived by applying a deduction of 50% for looseness/voids in stacks. The difference between the entire excavation and the sum of the quantities of soft and hard rocks so arrived shall be taken as soil. e) For earth work in filling, the actual measurements of fill shall be calculated by taking levels of the original ground before start of the work but after site clearance and after compaction of fills. The quantity of earth work in filling shall be computed from these levels in cubic meter. f) For turfing, the measurement shall be made on the finished work in square meter.	



TITLE:

**TECHNICAL SPECIFICATION
FOR ANTI-TERMITE
TREATMENT**

SPECIFICATION NO. PE-TS-999-600-C023

VOLUME - II B

SECTION - D | SUB-SECTION – D23

REV.NO. 00 DATE 30/11/2015

SHEET 1 OF 5

VOLUME – II B

SECTION – D

SUB SECTION – D23

ANTI-TERMITE TREATMENT

SPECIFICATION NO. PE-TS-999-600-C023



Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A,
Noida (U.P.)-201301



TITLE:

**TECHNICAL SPECIFICATION
FOR ANTI-TERMITE
TREATMENT**

SPECIFICATION NO. PE-TS-999-600-C023

VOLUME - II B

SECTION - D | SUB-SECTION - D23

REV.NO. 00 DATE 30/11/2015

SHEET 2 OF 5

TABLE OF CONTENTS

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	SCOPE	3
2.00.00	EXECUTION	3
3.00.00	ACCEPTANCE CRITERIA	4
4.00.00	RATES	4
5.00.00	METHOD OF MEASUREMENT	4
6.00.00	I.S. CODES	5

 Maharatna Company	TITLE: TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT	SPECIFICATION NO. PE-TS-999-600-C023											
		VOLUME - II B											
		SECTION - D		SUB-SECTION – D23									
		REV.NO.	00	DATE	30/11/2015								
		SHEET	3	OF	5								
TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT													
1.00.00	SCOPE The scope of work is to set up a chemical barrier against attack by subterranean termites while the building is under construction.												
2.00.00	EXECUTION												
2.01.00	General All work shall in general be executed as specified in IS: 6313 Part II-1981 and as per approved specification of the agency having special know-how for the job. All necessary work to ensure uniform distribution and proper penetration of treatment of treating solution shall be done according to the instruction of the Engineer. Soil treatment shall not be done when it is raining or when the soil is wet with rain or subsoil water. Once formed, the treated soil barrier shall not be disturbed.												
2.02.00	Chemicals and Rate of Application Any of the following chemicals (conforming to relevant Indian Standards) in water emulsion shall be applied by pressure pumps, uniformly over the area treated. <table><tr><td>Chemicals</td><td>Concentration by Weight, Percentage</td></tr><tr><td>Chlorpyrifos Emulsifiable (IS 8944 - 1978)</td><td>: 1.0</td></tr><tr><td>Heptachlor Emulsifiable Concentrate (IS: 6439 - 1978)</td><td>: 0.5</td></tr><tr><td>Chlordane Emulsifiable Concentrate (IS: 2682 - 1984)</td><td>: 1.0</td></tr></table>					Chemicals	Concentration by Weight, Percentage	Chlorpyrifos Emulsifiable (IS 8944 - 1978)	: 1.0	Heptachlor Emulsifiable Concentrate (IS: 6439 - 1978)	: 0.5	Chlordane Emulsifiable Concentrate (IS: 2682 - 1984)	: 1.0
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Chlordane Emulsifiable Concentrate (IS: 2682 - 1984)	: 1.0												
2.02.01	Treatment of Column Pits, Wall Trenches and Basement Excavations Foundations, basements etc. may either be fully enveloped by the chemical barrier or the treatment may start 500 mm below ground level. The bottom surface and sides of excavation (upto a height of about 300 mm) for column pits, walls trenches and basements shall be treated with chemicals at the rate of 5 litres / M ² of surface area. Backfills around columns, walls etc. shall be treated at the rate of 7.5 litres / M ² of the vertical surface. Chemical treatment shall be done in stages following the compaction of earth in layers. The treatment shall be carried out after the ramming operation is done by												

 BHEL Bharat Heavy Electricals Limited	TITLE: TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT	SPECIFICATION NO. PE-TS-999-600-C023 VOLUME - II B SECTION - D SUB-SECTION – D23 REV.NO. 00 DATE 30/11/2015 SHEET 4 OF 5
	rodding the earth at 150 mm centres close to the wall surface and spraying the chemicals in the specified dose. 2.02.02 Treatment of Top Surface of Plinth Filling Holes 50 mm to 75 mm deep at 150 mm centres both ways shall be made with crowbars on the surface of compacted plinth fill. Chemical emulsion at the rate of 5 litres / M² of surface shall be applied prior to laying soling or sub-grade. Special care shall be taken to maintain continuity of the chemical barrier at the junction of vertical and horizontal surfaces. 2.02.03 Treatment of Soil Surrounding Pipes, Wastes and Conduits Special care shall be taken at the points where pipes and conduits enter the building and the soil shall be treated for a distance of 150 mm and a depth of 75 mm at the point where they enter the building. 2.02.04 Treatment of Expansion Joints These shall receive special attention and shall be treated in a manner approved by the Engineer. 2.02.05 Treatment at Junction of the Wall and the Floor Special care shall be taken to establish continuity of the vertical chemical barrier on inner wall surfaces from ground level up to the level of the filled earth surface. A small channel 30 x 30 mm shall be made at all the junctions of wall and columns with the floor. Rod holes made in the channel up to the ground level 150 mm apart and the chemical emulsion poured along the channel at the rate of 7.5 litres per square meter of the vertical wall or column surface. The soil should be tamped back into place after this operation. 3.00.00 ACCEPTANCE CRITERIA The Contractor shall give a 10-year service guarantee in writing supplemented by a separate and unilateral guarantee from the specialised agency for the job to keep the building free of termites for the specified period. 4.00.00 RATES Rates shall be of complete work per unit area as stated in the Schedule. 5.00.00 METHOD OF MEASUREMENT Complete work of anti-termite treatment shall be measured for plinth area treated.	

	TITLE: TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT	SPECIFICATION NO. PE-TS-999-600-C023 VOLUME - II B SECTION - D SUB-SECTION – D23 REV.NO. 00 DATE 30/11/2015 SHEET 5 OF 5
6.00.00	This includes treatment, to foundations, walls, trenches, basements, plinth, burried pipes, conduits etc. The extended portions of foundation and like beyond plinth limit shall be the part of complete work. I.S. CODE Relevant code applicable for this Specification. IS: 6313 (Part-II) 1981 : Code of Practice of Anti-Termite Measures in Buildings Pre-constructional chemical treatment measures.	

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**UTTAR PRADESH RAJYA VIDYUT UTPADAN
NIGAM LIMITED**
[UPRVUNL]



PANKI THERMAL POWER STATION
[1 x 660 MW]

Customer's Consultant



Geotechnical Investigation Report Part-2
Rev.03

NTPC DOCUMENT NO. 9962-001-PE-301-PVC-W-130A

BHEL DOCUMENT NO. PE-DC-426-602-C002



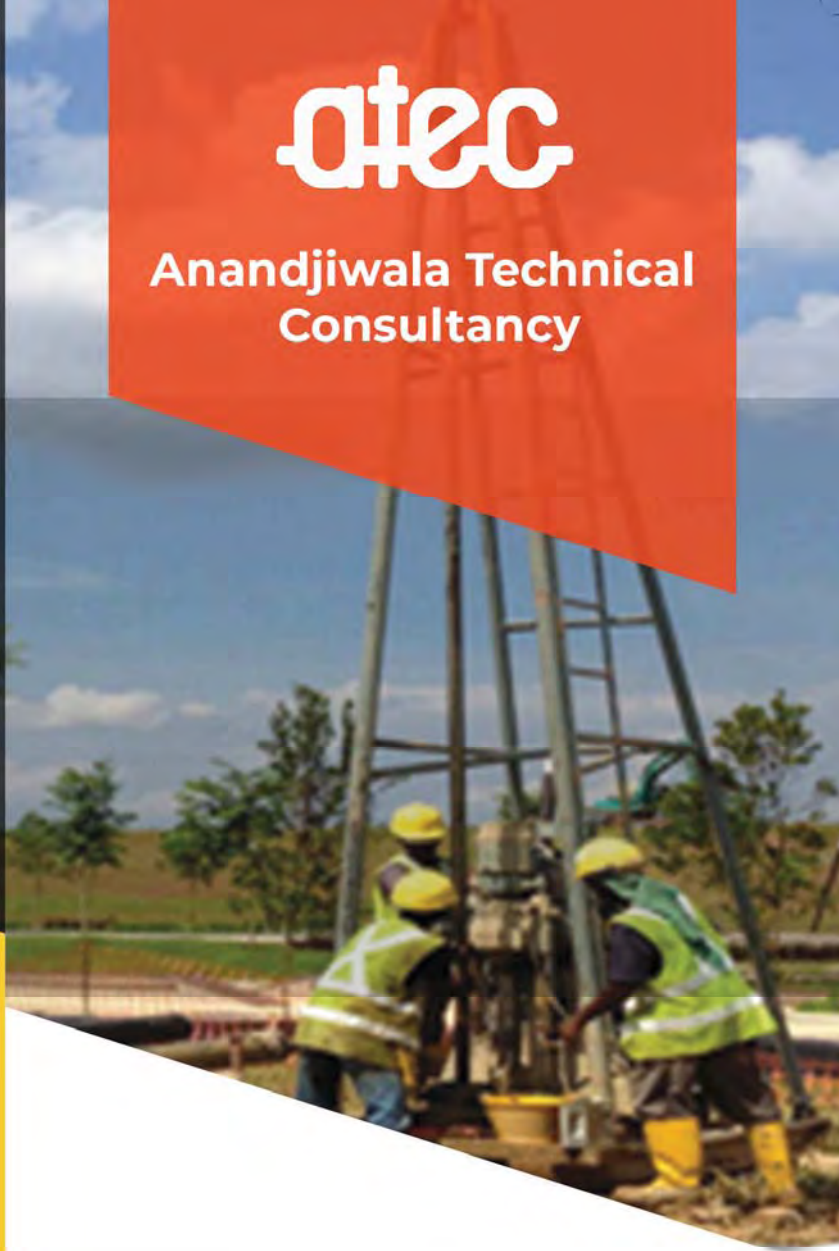
Bharat Heavy Electricals Limited
Project Engineering Management
PPEI Building, Power Sector,
Plot No. 25, Sector 16A, Noida (U.P.)-201301

Geo Technical Investigation Report

Part-2

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NAME OF PROJECT: GEOTECHNICAL
INVESTIGATION FOR 1X660 MW PANKI
THERMAL POWER STATION AT
KANPUR, U.P.

CLIENT: BHARAT HEAVY ELECTRICALS
LIMITED (POWER SECTOR)

OWNER: UTTAR PRADESH RAJYA
VIDYUT UTPADAN NIGAM LIMITED

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GEOTECHNICAL INVESTIGATION REPORT

PART-2 BALANCE OF PLANT (BOP) AREA

CLIENT



**BHARAT HEAVY ELECTRICALS LIMITED
(POWER SECTOR)**

OWNER

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED

BY



**ANANDJIWALA TECHNICAL CONSULTANCY
NAGPUR
(AUGUST 2018)**

REPORT NO.:	675-Part-2/ATEC-06/18-19
REVISION NO.:	
CHANGE :	
PREPARED BY :	Darshan Chhatbar
CHECKED BY :	Prakash Khabya
AUTHORISED BY :	Mrugesh Anandjiwala
DATE OF SUBMISSION	15/09/2018

INDEX

SR. NO.	DESCRIPTION	PAGE NO
1	GENERAL	1
2	SITE LOCATION	1
3	OBJECT OF INVESTIGATION	1
4	SCOPE OF WORK	1
5	FIELD INVESTIGATIONS	2
6	TEST PROCEDURES FOR FIELD TESTS	2
7	LABORATORY INVESTIGATION	3
8	SUB SOIL STRATIFICATION	4-16
9	BOREHOLE DETAILS	16-17
10	GENERAL DESIGN PROFILE	18
11	SAMPLE CALCULATION FOR PILE CAPACITY & OPEN FOUNDATION	19-36
12	SUMMARY & CONCLUSION	38-39
13	NOTATIONS	40
14	REFERENCES	41
15	ANNEXURES	
15.1	ANNEXURE-1 BORE LOGS	42-131
15.2	ANNEXURE-2 SUMMARY OF LAB TEST RESULTS	132-216
15.3	ANNEXURE-3 GRAINSIZE & CONSOLIDATION GRAPHS	217-266
15.4	ANNEXURE-4 FIELD TEST RESULTS	267-368
15.5	ANNEXURE-5 SOIL CHEMICAL TEST RESULTS	369-370
15.6	ANNEXURE-6 WATER CHEMICAL TEST RESULTS	371-372
15.7	ANNEXURE-7 SOIL PROFILE	373-374
15.8	ANNEXURE-8 LOCAL GEOLOGY	375-376

GENERAL :

Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

The Geotechnical Investigation work was entrusted to **Anandjiwala Technical Consultancy, Ahmedabad** vide LOA no. BHEL/NR/SCT/PANKI/GEOTECH INV/1078(1085) dated 18/04/2018.

SITE LOCATION :

At Panki Thermal Power Station at Kanpur, U.P.

OBJECT OF INVESTIGATION :

The object of investigation is to determine the sub surface conditions at the site and to provide information that would assist the Structural Engineer in the design of foundation. The study includes identification of suitable foundations system and assessment of safe bearing capacity of the sub strata in according with standard engineering practice and IS Codes.

SCOPE OF WORK :

The scope of work at the project site comprised of the following :

- ◆ Mobilizing required no. of boring/ drilling rigs with all necessary equipment's and personnel.
- ◆ Making forty two number of borehole with rotary drilling through all types of soil.
- ◆ Conducting SPT at regular depth intervals along with standard field & laboratory test.
- ◆ Collecting disturbed and undisturbed soil samples along with standard field & laboratory test.
- ◆ Submitting report with field and laboratory test results and recommendations for foundations.

FIELD INVESTIGATION :

FIELD BORING & SAMPLING :

42 No. of 150 mm. dia bores were drilled down up to the depth of 40.00 m at proposed site of construction by our skilled and experienced site personnel by using rotary drilling in May—August 2018 as suggested by client.

TEST PROCEDURES FOR FIELD TESTS :

STANDARD PENETRATION TEST :

The standard penetration tests were carried out by split spoon sampler confirming to IS 2131-1981. The split spoon sampler assembly is divided in three parts. One is cutting shoe of 38 mm inside dia and 51 mm out side diameter with 75 mm length. The second is split body of same diameter and 508 mm in length. The third is driving head with ball of same dia meters and 180 mm in length. The drive weight assembly consist of 63.5 kg. weight hammer and 750 mm free fall guide rod.

Before conducting the Standard Penetration Test we had cleaned the bore by shell then lowered the S.P.T. sampler with 'A' rod and conducted the Standard Penetration Test in accordance with IS 2131-1981.

UNDISTURBED SAMPLE :

The undisturbed soil samples were collected in thin walled sampling tubes. The thin wall sampling tubes confirming to IS 2132-1981 consist of cutting shoe sampling tube and driving head with ball.

The tests were conducted in accordance with IS 2132- 1981.

DISTURBED SAMPLES :

Disturbed samples were collected during boring and from the split spoon sampler.

The samples recovered were labeled and sent to Laboratory for testing.

The borehole was terminated when adequate depth of drilling was completed in consultation with the Site-in-charge as per technical specification.

LABORATORY TESTING :

DISTURBED SAMPLE / SPT SAMPLE:

The following laboratory tests were carried out on disturb and undisturbed samples.

- 1) Grain Size Analysis
- 2) Atterberg Limit

UNDISTURBED SAMPLE :

- 1) Grain Size Analysis
- 2) Atterberg Limit
- 3) Specific Gravity
- 4) Field Density & Moisture Content
- 5) Direct Shear Test
- 6) Consolidation Test
- 7) Free Swell Index
- 8) Swell Pressure
- 9) Shrinkage Limit
- 10) Unconfined Compressive Strength (UCS)

- 1) Grain Size Analysis : These tests were carried out in accordance with IS 2720(Part IV)-1992.
- 2) Atterberg limit : The apparatus are (1) Casagrand and (2) Cone Penetrometer in accordance with IS 9259-1979 and 11196-1985 respectively. We had carried out these tests by using both equipments with respect to the soil behavior and as per the IS- 2720 (Part-V)-1991.
- 3) Specific Gravity: These tests were carried out in accordance with IS-2720 (Part- 3/Sec-1) -1980 for fine grain soil and IS 2720 (Part-3/ Sec-2)-1980 for medium and coarse grain soil.
- 4) Field density and moisture content : These tests were carried out in accordance with IS 2720 (Part-2)-1973.
- 5) Direct Shear Test : These tests were carried out by small size box shear test in accordance with IS- 2720 (Part-13)-1986 and apparatus confirming to IS-11229-1985.
- 6) Consolidation Test: These tests were carried out in accordance with IS- 2720 (Part-15)-1986.
- 7) Free Swell Index : These tests were carried out in accordance with IS-2720 (Part- XL)-1977.
- 8) Swell Pressure : These tests were carried out in accordance with IS- 2720 (Part-41)-1977.
- 9) Shrinkage Limit : These tests were carried out in accordance with IS- 2720 (Part-6)-1972.
- 10) Unconfined Compressive Strength (UCS): These tests were carried out in accordance with IS- 2720 (Part-10)-1986.

SUB SOIL STRATIFICATION :

LOCATION :

The bore log data reveals the soil formation as under.

Customer Site Office

BH-78

The first layer from 0.00m to 2.00m consists of filling material.

The layer from 2.00m to 6.00m consists of brownish silty soil.

The layer from 6.00m to 9.00m consists of brownish silty sandy soil.

The layer from 9.00m to 14.50m consists of brownish silty clay soil.

The layer from 14.50m to 19.00m consists of brownish silty sandy soil.

The layer from 19.00m to 23.50m consists of brownish silty clay soil.

The layer from 23.50m to 30.00m consists of brownish silty soil.

The water table was encountered at 4.10m in the borehole during the investigation in June 2018.

LOCATION :

Ammonia Unloading & Storage Area

BH-67

The first layer from 0.00m to 2.00m consists of filling material.

The layer from 2.00m to 30.00m consists of brownish silty clay soil.

The layer from 30.00m to 33.00m consists of brownish silty soil.

The layer from 33.00m to 40.00m consists of brownish silty clay soil.

The water table was encountered at 4.00m in the borehole during the investigation in June 2018.

LOCATION :

H2 Regeneration Area

BH-85

The first layer from 0.00m to 4.0m consists of blackish ash.

The layer from 4.00m to 19.00m consists of brownish silty clay soil.

The layer from 19.00m to 30.00m consists of brownish silty sandy soil.

The water table was encountered at 6.90m in the borehole during the investigation in July 2018.

LOCATION :

BHEL Site Office

BH-72

The first layer from 0.00m to 5.00m consists of brownish silty clay soil.

The layer from 5.00m to 7.00m consists of brownish silty soil.

The layer from 7.00m to 11.50m consists of brownish silty clay soil.

The layer from 11.50m to 15.00m consists of brownish silty soil.

The layer from 15.00m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 5.00m in the borehole during the investigation in July 2018.

LOCATION :

Warehouse / Store

BH-73

The first layer from 0.00m to 3.00m consists of blackish ash.

The layer from 3.00m to 7.00m consists of brownish silty soil.

The layer from 7.00m to 17.50m consists of brownish silty clay soil.

The layer from 17.50m to 29.00m consists of brownish silty sandy soil.

The layer from 29.00m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 5.00m in the borehole during the investigation in July 2018.

LOCATION :

Canteen

BH-74

The first layer from 0.00m to 1.00m consists of blackish ash.

The layer from 1.00m to 5.00m consists of brownish silty soil.

The layer from 5.00m to 20.50m consists of brownish silty clay soil.

The layer from 20.50m to 28.50m consists of brownish silty soil.

The layer from 28.50m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 5.00m in the borehole during the investigation in July 2018.

LOCATION :

Fire Station Building

BH-75

The first layer from 0.00m to 1.00m consists of blackish ash.

LOCATION :

The layer from 1.00m to 15.00m consists of brownish silty clay soil.

The layer from 15.00m to 30.00m consists of brownish silty sandy soil.

The water table was encountered at 5.00m in the borehole during the investigation in July 2018.

Security Complex

BH-76

The first layer from 0.00m to 1.00m consists of blackish ash.

The layer from 1.00m to 9.00m consists of brownish silty clay soil.

The layer from 9.00m to 14.00m consists of brownish silty soil.

The layer from 14.00m to 28.00m consists of brownish fine sandy soil.

The layer from 28.00m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 5.50m in the borehole during the investigation in July 2018.

Boundary Wall

BH-1

The first layer from 0.00m to 1.00m consists of brownish silty soil.

The layer from 1.00m to 3.00m consists of brownish silty clay soil.

The layer from 3.00m to 9.00m consists of brownish silty soil.

The layer from 9.00m to 26.50m consists of brownish silty clay soil.

The layer from 26.50m to 30.00m consists of brownish fine sandy soil.

The water table was encountered at 4.40m in the borehole during the investigation in July 2018.

BH-9

The first layer from 0.00m to 17.50m consists of brownish silty soil.

The layer from 17.50m to 20.50m consists of brownish silty sandy soil.

The layer from 20.50m to 23.50m consists of brownish fine sandy soil.

The layer from 23.50m to 28.00m consists of brownish silty sandy soil.

The layer from 28.00m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 4.30m in the borehole during the investigation in July 2018.

BH-11

The first layer from 0.00m to 26.50m consists of brownish silty soil.

The layer from 26.50m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 5.60m in the borehole during the investigation in July 2018.

BH-19

The first layer from 0.00m to 1.00m consists of blackish ash.

The layer from 1.00m to 3.00m consists of brownish silty clay soil.

The layer from 3.00m to 5.00m consists of brownish silty soil.

The layer from 5.00m to 17.50m consists of brownish silty clay soil.

The layer from 17.50m to 30.00m consists of brownish silty sandy soil.

The water table was encountered at 4.50m in the borehole during the investigation in July 2018.

BH-59

The first layer from 0.00m to 9.00m consists of brownish silty clay soil.

The layer from 9.00m to 11.50m consists of brownish silty soil.

The layer from 11.50m to 20.50m consists of brownish silty sandy soil.

The layer from 20.50m to 23.50m consists of brownish silty clay soil.

The layer from 23.50m to 30.00m consists of brownish fine sandy soil.

The water table was encountered at 4.60m in the borehole during the investigation in July 2018.

LOCATION :

Administrative Building

BH-77

The first layer from 0.00m to 7.00m consists of brownish silty soil.

The layer from 7.00m to 9.00m consists of brownish silty sandy soil.

The layer from 9.00m to 15.00m consists of brownish silty clay soil.

The layer from 15.00m to 20.50m consists of brownish fine sandy soil.

The layer from 20.50m to 25.00m consists of brownish silty clay soil.

The layer from 25.00m to 30.00m consists of brownish silty soil.

LOCATION :

The water table was encountered at 4.30m in the borehole during the investigation in June 2018.

BH-86

The first layer from 0.00m to 2.00m consists of brownish silty soil.

The layer from 2.00m to 10.00m consists of brownish silty clay soil.

The layer from 10.00m to 13.00m consists of brownish silty soil.

The layer from 13.00m to 20.50m consists of brownish silty clay soil.

The layer from 20.50m to 23.50m consists of brownish silty soil.

The layer from 23.50m to 26.50m consists of brownish silty clay soil.

The layer from 26.50m to 30.00m consists of brownish silty sandy soil.

The water table was encountered at 4.60m in the borehole during the investigation in July 2018.

Construction Yard

BH-13

The first layer from 0.00m to 5.00m consists of brownish silty soil.

The layer from 5.00m to 7.00m consists of brownish silty sandy soil.

The layer from 7.00m to 9.00m consists of brownish silty clay soil.

The layer from 9.00m to 11.50m consists of brownish silty sandy soil.

The layer from 11.50m to 13.00m consists of brownish silty clay soil.

The layer from 13.00m to 15.00m consists of brownish silty sandy soil.

The layer from 15.00m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 4.90m in the borehole during the investigation in July—August 2018.

LOCATION :

**CW Pump House
BH-20**

The first layer from 0.00m to 9.00m consists of brownish silty clay soil.

The layer from 9.00m to 11.50m consists of brownish silty soil.

The layer from 11.50m to 22.00m consists of brownish silty clay soil.

The layer from 22.00m to 30.00m consists of brownish fine sandy soil.

The water table was encountered at 4.60m in the borehole during the investigation in July 2018.

BH-21

The first layer from 0.00m to 1.00m consists of brownish silty sandy soil.

The layer from 1.00m to 9.00m consists of brownish silty clay soil.

The layer from 9.00m to 11.50m consists of brownish silty sandy soil.

The layer from 11.50m to 23.50m consists of brownish silty clay soil.

The layer from 23.50m to 30.00m consists of brownish fine sandy soil.

The water table was encountered at 4.60m in the borehole during the investigation in July 2018.

BH-23

The first layer from 0.00m to 20.50m consists of brownish silty soil.

The layer from 20.50m to 30.00m consists of brownish silty sandy soil.

The water table was encountered at 4.80m in the borehole during the investigation in July 2018.

LOCATION :

**DM Plant
BH-56**

The first layer from 0.00m to 1.00m consists of brownish silty soil.

The layer from 1.00m to 5.00m consists of brownish silty clay soil.

The layer from 5.00m to 7.00m consists of brownish silty soil.

The layer from 7.00m to 15.00m consists of brownish silty clay soil.

The layer from 15.00m to 30.00m consists of brownish silty sandy soil.

The water table was encountered at 3.60m in the borehole during the investigation in June 2018.

LOCATION :

BH-57

The first layer from 0.00m to 2.00m consists of brownish silty soil.

The layer from 2.00m to 6.00m consists of brownish silty clay soil.

The layer from 6.00m to 8.00m consists of brownish silty soil.

The layer from 8.00m to 13.00m consists of brownish silty clay soil.

The layer from 13.00m to 27.00m consists of brownish silty sandy soil.

The layer from 27.00m to 30.00m consists of brownish fine sandy soil.

The water table was encountered at 3.80m in the borehole during the investigation in July 2018.

**ETP Area
BH-58**

The first layer from 0.00m to 5.00m consists of brownish silty soil.

The layer from 5.00m to 7.00m consists of brownish silty clay soil.

The layer from 7.00m to 11.50m consists of brownish silty sandy soil.

The layer from 11.50m to 20.50m consists of brownish silty clay soil.

The layer from 20.50m to 22.00m consists of brownish silty soil.

The layer from 22.00m to 28.50m consists of brownish silty sandy soil.

The layer from 28.50m to 30.00m consists of brownish silty soil.

The water table was encountered at 3.90m in the borehole during the investigation in June 2018.

LOCATION :

**Fire Water Booster
BH-34**

The first layer from 0.00m to 1.00m consists of filling material.

The layer from 1.00m to 5.00m consists of brownish silty soil.

The layer from 5.00m to 7.00m consists of brownish silty clay soil.

The layer from 7.00m to 20.50m consists of brownish silty soil.

The layer from 20.50m to 28.00m consists of brownish fine sandy soil.

The layer from 28.00m to 35.50m consists of brownish silty clay soil.

LOCATION :

The layer from 35.50m to 40.00m consists of brownish silty soil.

The water table was encountered at 4.30m in the borehole during the investigation in June 2018.

HFO LDO DYKA Area

BH-33

The first layer from 0.00m to 3.00m consists of brownish silty soil.

The layer from 3.00m to 7.00m consists of brownish silty clay soil.

The layer from 7.00m to 30.00m consists of brownish silty sandy soil.

The water table was encountered at 4.30m in the borehole during the investigation in July 2018.

BH-71

The first layer from 0.00m to 40.00m consists of brownish silty clay soil.

The water table was encountered at 5.00m in the borehole during the investigation in July 2018.

LOCATION :

HFO LDO Pump House

BH-12

The first layer from 0.00m to 9.00m consists of brownish silty clay soil.

The layer from 9.00m to 11.50m consists of brownish silty sandy soil.

The layer from 11.50m to 40.00m consists of brownish silty clay soil.

The water table was encountered at 5.30m in the borehole during the investigation in July—August 2018.

LOCATION :

LHP Storage Shed

BH-84

The first layer from 0.00m to 1.50m consists of filling material.

The layer from 1.50m to 11.50m consists of brownish fine sandy soil.

The layer from 11.50m to 15.00m consists of brownish silty clay soil.

The layer from 15.00m to 20.50m consists of brownish silty soil.

The layer from 20.50m to 27.00m consists of brownish silty sandy soil.

The layer from 27.00m to 30.00m consists of brownish fine sandy soil.

The water table was encountered at 4.00m in the borehole during the investigation in June 2018.

LOCATION :

Plant Gate

BH-60

The first layer from 0.00m to 5.00m consists of brownish silty soil.

The layer from 5.00m to 11.50m consists of brownish fine sandy soil.

The layer from 11.50m to 16.00m consists of brownish silty clay soil.

The layer from 16.00m to 25.00m consists of brownish fine sandy soil.

The layer from 25.00m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 3.90m in the borehole during the investigation in June 2018.

LOCATION :

PT Plant

BH-16

The first layer from 0.00m to 5.00m consists of brownish silty clay soil.

The layer from 5.00m to 30.00m consists of brownish silty sand.

WATER TABLE :

The water table was encountered at 4.20m in the borehole during the investigation in July 2018.

BH-17

The first layer from 0.00m to 16.00m consists of brownish silty soil.

The layer from 16.00m to 20.50m consists of brownish silty clay soil.

The layer from 20.50m to 28.00m consists of brownish silty soil.

The layer from 28.00m to 40.00m consists of brownish silty clay soil.

WATER TABLE :

The water table was encountered at 4.40m in the borehole during the investigation in July 2018.

BH-18

The first layer from 0.00m to 13.00m consists of brownish silty clay soil.

The layer from 13.00m to 16.00m consists of brownish silty sand.

The layer from 16.00m to 30.00m consists of brownish silty clay soil.

WATER TABLE :

The water table was encountered at 4.40m in the borehole during the investigation in July 2018.

WATER TABLE :

LOCATION :

BH-24

The first layer from 0.00m to 10.00m consists of brownish silty clay soil.

The layer from 10.00m to 17.50m consists of brownish silty sand.

The layer from 17.50m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 4.20m in the borehole during the investigation in July 2018.

**Rain Water Reservoir Pond
BH-10**

The first layer from 0.00m to 5.00m consists of brownish silty clay soil.

The layer from 5.00m to 11.50m consists of brownish silty soil.

The layer from 11.50m to 17.50m consists of brownish silty clay soil.

The layer from 17.50m to 27.00m consists of brownish silty sandy soil.

The layer from 27.00m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 4.80m in the borehole during the investigation in July 2018.

LOCATION :

**Raw Water Reservoir
BH-2**

The first layer from 0.00m to 5.00m consists of brownish silty clay soil.

The layer from 5.00m to 17.50m consists of brownish silty soil.

The layer from 17.50m to 23.50m consists of brownish silty clay soil.

The layer from 23.50m to 25.00m consists of brownish silty soil.

The layer from 25.00m to 28.00m consists of brownish fine sandy soil.

The layer from 28.00m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 4.10m in the borehole during the investigation in July 2018.

BH-3

The first layer from 0.00m to 7.00m consists of brownish silty clay soil.

The layer from 7.00m to 20.50m consists of brownish silty soil.

The layer from 20.50m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 4.10m in the borehole during the investigation in May 2018.

BH-5

The first layer from 0.00m to 17.50m consists of brownish silty clay soil.

The layer from 17.50m to 26.50m consists of brownish silty soil.

The layer from 26.50m to 30.00m consists of brownish silty sandy soil.

The water table was encountered at 4.20m in the borehole during the investigation in May 2018.

BH-6

The first layer from 0.00m to 5.00m consists of brownish silty clay soil.

The layer from 5.00m to 19.00m consists of brownish silty soil.

The layer from 19.00m to 23.50m consists of brownish silty clay soil.

The layer from 23.50m to 30.00m consists of brownish fine sandy soil.

The water table was encountered at 4.10m in the borehole during the investigation in May 2018.

BH-7

The first layer from 0.00m to 5.00m consists of brownish silty clay soil.

The layer from 5.00m to 9.00m consists of brownish silty soil.

The layer from 9.00m to 11.50m consists of brownish silty clay soil.

The layer from 11.50m to 17.50m consists of brownish silty soil.

The layer from 17.50m to 22.00m consists of brownish silty clay soil.

The layer from 22.00m to 25.00m consists of brownish fine sandy soil.

The layer from 25.00m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 4.10m in the borehole during the investigation in July 2018.

LOCATION :

Township

BH-8

The first layer from 0.00m to 1.00m consists of brownish silty soil.

The layer from 1.00m to 7.00m consists of brownish silty clay soil.

The layer from 7.00m to 17.50m consists of brownish silty sandy soil.

The layer from 17.50m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 4.20m in the borehole during the investigation in July 2018.

LOCATION :

Training Center

BH-4

The first layer from 0.00m to 1.00m consists of brownish silty soil.

The layer from 1.00m to 3.00m consists of brownish silty clay soil.

The layer from 3.00m to 5.00m consists of brownish silty soil.

The layer from 5.00m to 7.00m consists of brownish silty clay soil.

The layer from 7.00m to 9.00m consists of brownish silty soil.

The layer from 9.00m to 26.50m consists of brownish silty clay soil.

The layer from 26.50m to 29.00m consists of brownish fine sandy soil.

The layer from 29.00m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 4.50m in the borehole during the investigation in July 2018.

LOCATION :

Workshop

BH-28

The first layer from 0.00m to 4.00m consists of brownish silty soil.

The layer from 4.00m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 5.00m in the borehole during the investigation in July 2018.

BH-29

The first layer from 0.00m to 11.50m consists of brownish silty clay soil.

The layer from 11.50m to 15.00m consists of brownish silty sandy soil.

The layer from 15.00m to 30.00m consists of brownish silty clay soil.

The water table was encountered at 5.10m in the borehole during the investigation in August 2018.

SUMMARY OF BOREHOLES

Sr. No	Borehole No.	Location	RL of GL (m)	Easting	Northing	Water Table RL (m)	Water Table Depth BGL (m)
1	BH-78	Customer Site Office	+126.3	556	-271	+122.2	4.10
2	BH-67	Ammonia unloading & storage area	+126.3	280	-271	+122.3	4.00
3	BH-85	H2 Regeneration Area	+129.0	343	-910	+122.1	6.90
4	BH-72	BHEL Site Office	+127.2	377	-221	+122.2	5.00
5	BH-73	Warehouse / Store	+127.2	438	-219	+122.2	5.00
6	BH-74	Canteen	+127.2	497	-221	+122.2	5.00
7	BH-75	Fire Station Building	+127.2	555	-211	+122.2	5.00
8	BH-76	Security Complex	+127.7	605	-213	+122.2	5.50
9	BH-1	Boundary wall	+126.8	-1158	99	+122.4	4.40
10	BH-9	Boundary wall	+126.7	-418	-495	+122.4	4.30
11	BH-11	Boundary wall	+128.0	-60	143	+122.4	5.60
12	BH-19	Boundary wall	+126.9	-600	-711	+122.4	4.50
13	BH-59	Boundary wall	+127.0	606	-573	+122.4	4.60
14	BH-77	Administrative Building	+126.7	656	-244	+122.4	4.30
15	BH-86	Boundary wall	+127.0	480	116	+122.4	4.60
16	BH-13	construction yard	+127.1	-52	-180	+122.2	4.90
17	BH-20	CW Pump House	+126.8	48	-587	+122.2	4.60
18	BH-21	CW Pump House	+126.8	42	-544	+122.2	4.60
19	BH-23	CW Pump House	+127.0	41	-453	+122.2	4.80
20	BH-56	DM Plant	+125.9	355	-519	+122.3	3.60
21	BH-57	DM Plant	+126.1	396	-534	+122.3	3.80
22	BH-58	ETP Area	+126.2	480	-523	+122.3	3.90
23	BH-34	Fire water booster	+126.6	241	-302	+122.3	4.30
24	BH-33	HFO LDO DYKA Area	+126.7	241	-198	+122.4	4.30
25	BH-71	HFO LDO DYKA Area	+127.4	276	-226	+122.4	5.00

Sr. No	Borehole No.	Location	RL of GL (m)	Easting	Northing	Water Table RL (m)	Water Table Depth BGL (m)
26	BH-12	HFO LDO pump house	+127.4	-6	39	+122.1	5.30
27	BH-84	LHP Storage Shed	+126.1	480	-446	+122.1	4.00
28	BH-60	Plant Gate	+126.0	599	-451	+122.1	3.90
29	BH-16	PT Plant	+126.6	-69	-429	+122.4	4.20
30	BH-17	PT Plant	+126.8	-69	-476	+122.4	4.40
31	BH-18	PT Plant	+126.6	-28	-525	+122.4	4.20
32	BH-24	PT Plant	+126.6	-2	-448	+122.4	4.20
33	BH-10	Rain water Reservoir	+126.9	-240	-360	+122.1	4.80
34	BH-2	Raw water reservoir	+126.3	-1140	-157	+122.2	4.10
35	BH-3	Raw water reservoir	+126.3	-1140	-274	+122.2	4.10
36	BH-5	Raw water reservoir	+126.4	-900	-180	+122.2	4.20
37	BH-6	Raw water reservoir	+126.3	-960	-272	+122.2	4.10
38	BH-7	Raw water reservoir	+126.3	-896	-406	+122.2	4.10
39	BH-8	Town ship	+127.0	-636	159	+122.2	4.80
40	BH-4	Training center	+126.7	-979	37	+122.2	4.50
41	BH-28	Workshop	+127.1	51	-221	+122.1	5.00
42	BH-29	Workshop	+127.2	114	-223	+122.1	5.10

GENERAL DESIGN PROFILE

Calculation Parameters Taken for Calculation of Pile load Carrying Capacity

layer No.	layer Thick.	Φ	Type of soil	Strata Type	C_i (t/m ²)	Density of Sub-merged soil γ_{Sub} (t/m ³)	K_i
1	3.00	0.00	CL	Silty clay	8.00	1.00	0
2	5.00	0.00	CL	Silty clay	10.00	1.00	0
3	2.00	30.00	ML	Sandy silt	0.00	1.00	1
4	8.00	0.00	CL	Silty clay	18.00	1.00	0
5	5.00	33.00	ML	Sandy silt	0.00	1.00	1.15
6	17.00	0.00	CL	Silty clay	25.00	1.00	0

Note:

1. Φ Values are taken from graph of relationship between Φ and N-values from IS 6403:1981 in absence of UDS samples.
2. The values of C_u taken from the equation given in Karl Terzaghi & Peck as UDS samples could not be found

****Sample Calculation for Bored Cast In-Situ RCC Pile As Per IS:2911 (2010) PART 1 / SEC 2)****

A. Calculation for overall Vertical load on pile for BOP Area

Data

1:-	Pile Dia	0.600 m.
2:-	Existing Ground level	0.00 m.
3:-	Existing GWT level.....	4.20 m.
4:-	Total length of Pile From E.G.L.....	31.00 m.
5:-	Pile Cut-Off level	3.00 m.
6:-	Pile Termination level from cut off	28.00 m.
7:-	Factor Of Safty	2.50

B. Pile Load Calculation Equations As Per IS :2911-2010 (PART-1/SEC-2)

A	PILES IN GRANULAR SOILS:	$^{**}Q_u = A_p * (0.5 * D * \gamma * N_r + P_D * N_q) + \sum_{i=1}^n K_i * P_{Di} * \tan \delta_i * A_{si}^{**}$
B	PILES IN COHESIVE SOILS:	$^{**}Q_u = A_p * N_c * C_p + \sum_{i=1}^n \alpha_i * c_i * A_i^{**}$
Where,		
Q_u = THE ULTIMATE LOAD CARRING CAPACITY OF PILE IN TONNES		

C. *Ultimate End Bearing Capacity*****

C₁	For Granular Soils: $Q_{eg} = A_p * (0.5 * D * \gamma * N_r + P_D * N_q)$
Where,	
Q_{eg}:- Ultimate end bearing capacity for granular soil, in tonnes.	
A_p :- Cross sectional Area of pile tip.	0.283 m ²
D :- Diameter of pile shaft.	0.600 m
γ :- Effective unit weight of the soil at pile tip.	2.000 t/m ³
N_r :- Bearing Capacity factors depending upon the angle of internal friction, at pile tip.	0.00
N_q :- Bearing Capacity factors depending upon the angle of internal friction, at pile tip.	0.00
P_D :- Effective overburden pressure at pile tip.	12.00 t/m ²
Q_{eg}:- Ultimate End Bearing Capacity For Granular Soil, in Tonnes	
0.0 t/m²	

D. Over Burden Effective Pressure (P_D) Calculation

Calculation table				
Layer	Thickness of layer (m)	Thickness in submerged zone(m)	Density of Saturated soil γ_{Sub} (t/m ³)	P _D (t/m ²)
1	3.00	3.00	1.00	3.00
2	5.00	5.00	1.00	5.00
3	2.00	2.00	1.00	2.00
4	2.00	2.00	1.00	2.00
5	0.00	0.00	1.00	0.00
6	0.00	0.00	1.00	0.00
Total effective overburden pressure up to P _D level from EGL, in t/m ²				12.00

C_2	For Cohesive Soils: $Q_{ec} = A_p * N_c * C_p$
Where,	
Q_{ec} :- Ultimate skin friction capacity for granular soil,in tonnes.	
A_p :-Cross sectional Area of pile tip , in (m^2).	0.2826
N_c :- Bearing capacity factor, may be taken as.	9.00
C_p :-Average cohesion at pile tip, in (t/m^2)	25.00
Q_{ec} :- Ultimate End Bearing Capacity For Cohesive soil, in tonnes	
63.585	

E.

****Ultimate Skin Friction Capacity****

E_1	For Granular Soils: $Q_{sg} = \sum_{i=1}^n K_i * P_{Di} * \tan \delta_i * A_{si}$					
Where,						
Q_{sg} :- Ultimate skin friction capacity for granular soil, in tonnes						
K_i :- Coefficient of earth presure for the ith layer -: (Note 3) IS 2911 (Part 1/ Sec 2) 2010.						
P_{Di} :- Effective overburden pressure for the ith layer, in (t/m ²).						
$\tan \delta_i$:- Angle of wall friction between pile and soil for the ith layer:(Note 4) IS 2911 (Part 1/Sec 2) 2010.						
A_{si} :- Surface area of pile shaft in the ith layer, in (m ²).						
Calculation table						
Layer	K_i	P_{Di} (t/m ²)	$\tan \delta_i$	A_{si} (m ²)	Q_{sg} (t)	Allowable Q_{sg} (t)
1	0.00	1.50	0.00	5.65	0.00	0.00
2	0.00	5.50	0.00	9.42	0.00	0.00
3	1.00	9.00	0.58	3.77	19.58	19.58
4	0.00	11.00	0.00	15.07	0.00	0.00
5	1.15	12.00	0.65	9.42	84.42	84.42
6	0.00	12.00	0.00	15.07	0.00	0.00
Q_{sg} :- Ultimate Skin Friction Capacity for Granular Soil, in Tonnes						104.00

E_2	For Cohesive Soils: $Q_{sc} = \sum_{i=1}^n \alpha_i * c_i * A_{si}$				
Where,					
Q_{sc} :- Ultimate skin friction capacity for cohesive soil, in tonnes.					
α_i :- Adhesion factor for the ith layer depending on the consistency of soil.					
C_i :- Average cohesion for the ith layer, in (t/m ²).					
A_{si} :- Surface area of pile shaft in the ith layer,in (m ²).					
Calculation table					
Layer	α_i	C_i (t/m ²)	A_{si} (m ²)	Q_{sc}(t)	$Allowable\ Q_{sc}$ (t)
1	0.45	8.0	5.65	20.35	0
2	0.45	10.0	9.42	42.39	42.39
3	1.00	0.0	3.77	0.00	0
4	0.30	18.0	15.07	81.39	81.3888
5	1.00	0.0	9.42	0.00	0
6	0.27	25.0	15.07	100.61	100.6056
Q_{sc} :- Ultimate skin friction capacity for cohesive soil in tonnes					224.38

F.

****Results****

* Total Ultimate End Bearing Capacity $Q_{ue} = Q_{eg} + Q_{ec}$, In tonnes. *	63.6
* Total Ultimate skin friction Capacity $Q_{us} = Q_{sg} + Q_{sc}$, In tonnes. *	328.4
*Total Ultimate Pile Capacity $Q_u = Q_{us} + Q_{ue}$, In tonnes. *	392.0
* Safe Pile Capacity Q_u/FOS , In tonnes. *	156.79

******Design Parameter******

Calculation Parameters Taken for Calculation of Pile load Carrying Capacity							
layer No.	layer Thick.	ϕ	Type of soil	Strata Type	C_1 (t/m^2)	Density of Submerged soil γ_{Sub} (t/m^3)	K_1
1	3.00	0.00	CL	Silty clay	8.00	1.00	0
2	5.00	0.00	CL	Silty clay	10.00	1.00	0
3	2.00	30.00	ML	Sandy silt	0.00	1.00	1
4	8.00	0.00	CL	Silty clay	18.00	1.00	0
5	5.00	33.00	ML	Sandy silt	0.00	1.00	1.15
6	17.00	0.00	CL	Silty clay	25.00	1.00	0

Note:
 1. ϕ Values are taken from graph of relationship between ϕ and N-values from IS 6403:1981 in absence of UDS samples.
 2. The values of C_u taken from the equation given in Karl Terzaghi & Peck in absence of UDS samples for calculation of pile capacity.

****Sample Calculation for Bored Cast In-Situ RCC Pile As Per IS:2911 (2010) PART 1 / SEC 2)****

A. Calculation for overall Vertical load on pile for BOP Area

Data

1:-	Pile Dia	0.760 m.
2:-	Existing Ground level	0.00 m.
3:-	Existing GWT level.....	4.20 m.
4:-	Total length of Pile From E.G.L.....	36.00 m.
5:-	Pile Cut-Off level	3.00 m.
6:-	Pile Termination level from cut off	33.00 m.
7:-	Factor Of Safty	2.50

B. Pile Load Calculation Equations As Per IS :2911-2010 (PART-1/SEC-2)

A	PILES IN GRANULAR SOILS:	$^{**}Q_u = A_p * (0.5 * D * \gamma * N_r + P_D * N_q) + \sum_{i=1}^n K_i * P_{Di} * \tan \delta_i * A_{si}^{**}$
B	PILES IN COHESIVE SOILS:	$^{**}Q_u = A_p * N_c * C_p + \sum_{i=1}^n \alpha_i * c_i * A_i^{**}$
Where,		
Q_u = THE ULTIMATE LOAD CARRING CAPACITY OF PILE IN TONNES		

C. **Ultimate End Bearing Capacity**

C₁	For Granular Soils: Qeg = A_p * (0.5 * D * γ * N_r + P_D* N_q)
Where,	
Qeg:- Ultimate end bearing capacity for granular soil, in tonnes.	
A_p :- Cross sectional Area of pile tip.	0.453 m ²
D :- Diameter of pile shaft.	0.760 m
γ :- Effective unit weight of the soil at pile tip.	2.000 t/m ³
N_r :- Bearing Capacity factors depending upon the angle of internal friction, at pile tip.	0.00
N_q :- Bearing Capacity factors depending upon the angle of internal friction, at pile tip.	0.00
P_D :- Effective overburden pressure at pile tip.	15.20 t/m ²
Qeg:- Ultimate End Bearing Capacity For Granular Soil, in Tonnes	
0.0 t/m²	

D. Over Burden Effective Pressure (P_D) Calculation

Calculation table				
Layer	Thickness of layer (m)	Thickness in submerged zone(m)	Density of Saturated soil γ _{Sub} (t/m ³)	P _D (t/m ²)
1	3.00	3.00	1.00	3.00
2	5.00	5.00	1.00	5.00
3	2.00	2.00	1.00	2.00
4	5.20	5.20	1.00	5.20
5	0.00	0.00	1.00	0.00
6	0.00	0.00	1.00	0.00
Total effective overburden pressure up to P _D level from EGL, in t/m ²				15.20

C_2	For Cohesive Soils: $Q_{ec} = A_p * N_c * C_p$
Where,	
Q_{ec} :- Ultimate skin friction capacity for granular soil,in tonnes.	
A_p :-Cross sectional Area of pile tip , in (m^2).	0.4534
N_c :- Bearing capacity factor, may be taken as.	9.00
C_p :-Average cohesion at pile tip, in (t/m^2)	25.00
Q_{ec} :- Ultimate End Bearing Capacity For Cohesive soil, in tonnes	
102.019	

E.

****Ultimate Skin Friction Capacity****

E_1	For Granular Soils: $Q_{sg} = \sum_{i=1}^n K_i * P_{Di} * \tan \delta_i * A_{si}$					
Where,						
Q_{sg} :-Ultimate skin friction capacity for granular soil, in tonnes						
K_i :- Coefficient of earth presure for the ith layer -: (Note 3) IS 2911 (Part 1/ Sec 2) 2010.						
P_{Di} :- Effective overburden pressure for the ith layer, in (t/m ²).						
$\tan \delta_i$:- Angle of wall friction between pile and soil for the ith layer:(Note 4) IS 2911 (Part 1/Sec 2) 2010.						
A_{si} :- Surface area of pile shaft in the ith layer, in (m ²).						
Calculation table						
Layer	K_i	P_{Di} (t/m ²)	$\tan \delta_i$	A_{si} (m ²)	Q_{sg} (t)	Allowable Q_{sg} (t)
1	0.00	1.50	0.00	7.16	0.00	0.00
2	0.00	5.50	0.00	11.93	0.00	0.00
3	1.00	9.00	0.58	4.77	24.80	24.80
4	0.00	12.60	0.00	19.09	0.00	0.00
5	1.15	15.20	0.65	11.93	135.45	135.45
6	0.00	15.20	0.00	31.02	0.00	0.00
Q_{sg} :- Ultimate Skin Friction Capacity for Granular Soil, in Tonnes						160.25

E_2	For Cohesive Soils: $Q_{sc} = \sum_{i=1}^n \alpha_i * c_i * A_{si}$				
Where,					
Q_{sc} :- Ultimate skin friction capacity for cohesive soil, in tonnes.					
α_i :- Adhesion factor for the ith layer depending on the consistency of soil.					
C_i :- Average cohesion for the ith layer, in (t/m ²).					
A_{si} :- Surface area of pile shaft in the ith layer,in (m ²).					
Calculation table					
Layer	α_i	C_i (t/m ²)	A_{si} (m ²)	Q_{sc}(t)	$Allowable\ Q_{sc}$ (t)
1	0.45	8.0	7.16	25.77	0
2	0.45	10.0	11.93	53.69	53.694
3	1.00	0.0	4.77	0.00	0
4	0.30	18.0	19.09	103.09	103.09248
5	1.00	0.0	11.93	0.00	0
6	0.27	25.0	31.02	207.08	207.07986
Q_{sc} :- Ultimate skin friction capacity for cohesive soil in tonnes					363.87

F.

****Results****

* Total Ultimate End Bearing Capacity $Q_{ue} = Q_{eg} + Q_{ec}$, In tonnes. *	102.0
* Total Ultimate skin friction Capacity $Q_{us} = Q_{sg} + Q_{sc}$, In tonnes. *	524.1
*Total Ultimate Pile Capacity $Q_u = Q_{us} + Q_{ue}$, In tonnes. *	626.1
* Safe Pile Capacity Q_u/FOS , In tonnes. *	250.45

******Design Parameter******

Calculation Parameters Taken for Calculation of Pile load Carrying Capacity							
layer No.	layer Thick.	Φ	Type of soil	Strata Type	C_1 (t/m ²)	Density of Submerged soil γ_{Sub} (t/m ³)	K_1
1	3.00	0.00	CL	Silty clay	8.00	1.00	0
2	5.00	0.00	CL	Silty clay	10.00	1.00	0
3	2.00	30.00	ML	Sandy silt	0.00	1.00	1
4	8.00	0.00	CL	Silty clay	18.00	1.00	0
5	5.00	33.00	ML	Sandy silt	0.00	1.00	1.15
6	17.00	0.00	CL	Silty clay	25.00	1.00	0
Note: 1. ϕ Values are taken from graph of relationship between ϕ and N-values from IS 6403:1981 in absence of UDS samples. 2. The values of C_u taken from the equation given in Karl Terzaghi & Peck in absence of UDS samples for calculation of pile capacity.							

SAMPLE CALCULATIONS OF PULL-OUT CAPACITY OF PILES

(As Per IS 2911 Part 1 / Sec 2, 2010)

Project: Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

1) Design Stipulations

a. Pile diameter in present calculations B = D in m =	0.60
b. Total length of pile below E.G.L in m	31.00
c. Pile cutoff level below E.G.L in m	3.00
d. Effective length of pile below cut - off in m	28.00
e. Characteristic strength of concrete fck in N/mm ² =	30.00
f. Unit weight of concrete in t/m ³ =	1.50
g. Ultimate skin friction capacity of pile in t from pile bearing capacity calculations	328.40

2) Calculations of pull-out capacity of pile

$$\begin{aligned}\text{Volume of pile} &= \pi * D * D * L / 4 \\ &= \pi * 0.6 * 0.6 * 28 / 4 \\ &= 7.92 \text{ m}^3\end{aligned}$$

$$\begin{aligned}\text{Dead weight of pile} &= \text{Volume of pile} * \text{unit weight of concrete} \\ &= 7.92 * 1.5 \\ &= 11.88 \text{ t}\end{aligned}$$

$$\begin{aligned}\text{Safe pull-out capacity of pile} &= (\text{Total skin friction capacity of pile} / \text{F.O.S}) + \text{dead weight of pile} \\ &= 328.4 * 0.67 / 2.5 + 11.88 \\ &= 99.89 \text{ t}\end{aligned}$$

SAMPLE CALCULATIONS OF PULL-OUT CAPACITY OF PILES

(As Per IS 2911 Part 1 / Sec 2, 2010)

Project: Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

1) Design Stipulations

a. Pile diameter in present calculations B = D in m =	0.76
b. Total length of pile below E.G.L in m	36.00
c. Pile cutoff level below E.G.L in m	3.00
d. Effective length of pile below cut - off in m	33.00
e. Characteristic strength of concrete fck in N/mm ² =	30.00
f. Unit weight of concrete in t/m ³ =	1.50
g. Ultimate skin friction capacity of pile in t from pile bearing capacity calculations	524.10

2) Calculations of pull-out capacity of pile

$$\begin{aligned}\text{Volume of pile} &= \pi * D * D * L / 4 \\ &= \pi * 0.76 * 0.76 * 33 / 4 \\ &= 14.97 \text{ m}^3\end{aligned}$$

$$\begin{aligned}\text{Dead weight of pile} &= \text{Volume of pile} * \text{unit weight of concrete} \\ &= 14.97 * 1.5 \\ &= 22.46 \text{ t}\end{aligned}$$

$$\begin{aligned}\text{Safe pull-out capacity of pile} &= (\text{Total skin friction capacity of pile} / \text{F.O.S}) + \text{dead weight of pile} \\ &= 524.1 * 0.67 / 2.5 + 22.46 \\ &= 162.91 \text{ t}\end{aligned}$$

SAMPLE CALCULATIONS OF Laterally Loaded PILES

(As Per IS 2911 Part 1 / Sec 2, 2010)

Project: Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

1) Design Stipulations

a. Pile diameter in present calculations B = D in m	0.60
b. Effective length of pile below cut - off in m	28.00
c. Characteristic strength of concrete f_{ck} in N/mm^2 =	30.00
d. Corrected Standard penetration number N' =	18.00
e. Condition of soil =	Submerged
f. Cantilever length above ground/bed to the point of load application e in m =	0.00
g. Young's modulus of pile material $E = 5000 * \sqrt{f_{ck}}$ in N/mm^2 =	27386.13
h. Moment of inertia of pile cross section $I = \pi * D^4 / 64$ in m^4 =	0.01
i. Modulus of subgrade reaction η_h in MN/m^2 (Ref. Table 3 of IS 2911 part-1/sec-2) =	2.55
j. Type of pile behaviour (Ref. Table-5 of IS 2911 part-1/sec-2)=	Long Pile

2) Calculations of lateral capacity of pile

a) Stiffness factor

For pile in sand and normally loaded clays

$$\begin{aligned} \text{Stiffness factor } T, \text{ in m} &= \sqrt[5]{\frac{EI}{\eta h}} \\ &= \left(\frac{27386.13 * 0.0064}{2.552} \right)^{1/5} \\ &= 2.33 \end{aligned}$$

b) Type of pile behaviour

here,

Embedded length of pile $L=28 \geq 4T$

So, Long Pile

c) Lateral load capacity of long elastic pile

$$\text{Deflection of pile head } y = \frac{H(e+Zf)^3}{3EI} * 1000$$

for free head
pile

$$\text{Deflection of pile head } y = \frac{H(e+Zf)^3}{12EI} * 1000$$

for fixed
head pile

Where,

H= lateral load in kN

y= deflection of pile head in mm

E= Young's modulus of pile material in kN/m²

I= Moment of inertia of the pile cross section in m⁴

Zf = depth to point of fixity in m = 1.9 * 2.33= 4.42
= 2.16 * 2.33= 5.03

for free head pile
for fixed head pile

(Ref. fig-4 of IS 2911 part 1/sec2)

e= Cantilever length above ground/bed to the point of load application in m

so,

$$H = \frac{3EI * y}{1000 * (e + Zf)^3}$$

for free head
pile

$$= \left(\frac{3 * 5 * 27386.13 * 1000 * 0.0064}{1000 * 10 * (0+4.42)^3} \right)$$

$$= 3.03 \text{ Tonne}$$

$$H = \frac{12EI * y}{1000 * (e + Zf)^3}$$

for fixed
head pile

$$= \left(\frac{12 * 5 * 27386.13 * 1000 * 0.0064}{1000 * 10 * (0+5.03)^3} \right)$$

$$= 8.21 \text{ Tonne}$$

SAMPLE CALCULATIONS OF Laterally LOADED PILES

(As Per IS 2911 Part 1 / Sec 2, 2010)

Project: Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

1) Design Stipulations

a. Pile diameter in present calculations B = D in m	0.76
b. Effective length of pile below cut - off in m	33.00
c. Characteristic strength of concrete f_{ck} in N/mm^2 =	30.00
d. Corrected Standard penetration number N' =	18.00
e. Condition of soil =	Submerged
f. Cantilever length above ground/bed to the point of load application e in m =	0.00
g. Young's modulus of pile material $E = 5000 * \sqrt{f_{ck}}$ in N/mm^2 =	27386.13
h. Moment of inertia of pile cross section $I = \pi * D^4 / 64$ in m^4 =	0.02
i. Modulus of subgrade reaction η_h in MN/m^2 (Ref. Table 3 of IS 2911 part-1/sec-2) =	2.55
j. Type of pile behaviour (Ref. Table-5 of IS 2911 part-1/sec-2)=	Long Pile

2) Calculations of lateral capacity of pile

a) Stiffness factor

For pile in sand and normally loaded clays

$$\begin{aligned} \text{Stiffness factor } T, \text{ in m} &= \sqrt[5]{\frac{EI}{\eta h}} \\ &= \left(\frac{27386.13 * 0.0164}{2.552} \right)^{1/5} \\ &= 2.81 \end{aligned}$$

b) Type of pile behaviour

here,

Embedded length of pile $L=33 \geq 4T$

So, Long Pile

c) Lateral load capacity of long elastic pile

$$\text{Deflection of pile head } y = \frac{H(e+Zf)^3}{3EI} * 1000$$

for free head
pile

$$\text{Deflection of pile head } y = \frac{H(e+Zf)^3}{12EI} * 1000$$

for fixed
head pile

Where,

H= lateral load in kN

y= deflection of pile head in mm

E= Young's modulus of pile material in kN/m²

I= Moment of inertia of the pile cross section in m⁴

Zf = depth to point of fixity in m = 1.9 * 2.81= 5.34

$$= 2.16 * 2.81= 6.07$$

for free head pile

for fixed head pile

(Ref. fig-4 of IS 2911 part 1/sec2)

e= Cantilever length above ground/bed to the point of load application in m

so,

$$H = \frac{3EI * y}{1000 * (e + Zf)^3}$$

for free head
pile

$$= \left(\frac{3 * 5 * 27386.13 * 1000 * 0.0164}{1000 * 10 * (0+5.34)^3} \right)$$

$$= 4.42 \text{ Tonne}$$

$$H = \frac{12EI * y}{1000 * (e + Zf)^3}$$

for fixed
head pile

$$= \left(\frac{12 * 5 * 27386.13 * 1000 * 0.0164}{1000 * 10 * (0+6.07)^3} \right)$$

$$= 12.03 \text{ Tonne}$$

SAMPLE CALCULATION FOR SAFE BEARING CAPACITY				
Name of project	Geotechnical Investigation for 1 x660 MW PANKI Thermal Power Station at Kanpur , U.P.			
Location	BOP Area			
Design as per	IS :6403-1981 CLAUSE NO 5.2			
VOID RATIO:- Void ratio of a soil mass is defined as the ratio of volume of voids to the volume of solids.				
e ₀	VOID RATIO =	((G * Y _w)/Y _d) - 1	0.69	
In Case of General shear failure	Qd = C*Nc*sc*dc*ic + q*(Nq-1)*sq*dq*iq + 0.5*B*Y*Nr*sr*dr*ir*W'			
Where,				
Q _d =	ULTIMATE BEARING CAPACITY IN (t/ m ²)			
Type of footing				Rectangle
C =	Cohesion in (t / m ²)			10
Ø =	Angle of internal friction of soil in (degree)			0.00
D _f =	Depth of foundation in (m)			3.00
q =	Effective Surcharge =(Y *df) in absence of external surcharge.df refers to depth of footing in (t/m ²)			3.00
Y =	Unit Weight of soil in (t/m ³)=			1
B =	Width/daimeter of footing in (m)			3
L -	Length of footing in (m)			6
N _c =	Bearing capacity factors			5.14
N _q =	Bearing capacity factors			1.00
N _r =	Bearing capacity factors			0.00
s _c =	Shape factor			1.10
s _q =	Shape factor			1.10
s _r =	Shape factor			0.80
DEPTH FACTORS CALCULATION				
√NQ =	√tan ² (π/4+Ø/2) =	tan(45 + Ø/2) =	tan(45 + Ø/2) =	1.0000
d _c =	(1+ (0.2)*(Df/B)*(√ NØ)			1.2000
d _q =	d _r =	1	FOR Ø < 10 ⁰	1
d _q =	d _r =	1+ (0.1*D _f /B)*√ NØ	FOR Ø > 10 ⁰	1.0000
i _c =	i _q =	(1- α/90) ²		1
i _r =		(1- α/Ø) ²		1
W' =	Water table effect			0.5
Qd = C*N _c *s _c *d _c *i _c + q*(N _q -1)*s _q *d _q *i _q + 0.5*B*Y*N _r *s _r *d _r *i _r *W'				67.8480
considering factor of safety (FOS)			2.5	
Safe Bearing Capacity (t/m ²) =			27.14	
ANANDJIWALA TECHNICAL CONSULTANCY, AHMEDABAD. Tel : 079- 26762598, E mail : atc_abad@yahoo.co.in				

SAMPLE CALCULATION FOR SAFE BEARING CAPACITY				
Name of project	Geotechnical Investigation for 1 x660 MW PANKI Thermal Power Station at Kanpur , U.P.			
Location	BOP Area			
Design as per	IS :6403-1981 CLAUSE NO 5.2			
VOID RATIO:- Void ratio of a soil mass is defined as the ratio of volume of voids to the volume of solids.				
e ₀	VOID RATIO =	((G * Y _w)/Y _d) - 1	0.69	
In Case of Local shear failure	q'd = 2/3*C*N'C*sC*dC*iC + q*(N'q-1)*sq*dq*iq + 0.5*B*Y*N'r*sr*dr*ir*W'			
Where,				
q' _d =	ULTIMATE BEARING CAPACITY IN (t/ m ²)			
Type of footing				Rectangle
C =	Cohesion in (t / m ²)			10
Ø =	Angle of internal friction of soil in (degree)			0.00
D _f =	Depth of foundation in (m)			3.00
q =	Effective Surcharge =(Y *df) in absence of external surcharge.df refers to depth of footing in (t/m ²)			3
Y =	Unit Weight of subsoil in (t/m ³)			1
B =	Width/daimeter of footing in (m)			3
L -	Length of footing in (m)			6
N' _C =	Bearing capacity factors			5.14
N' _q =	Bearing capacity factors			1.00
N' _r =	Bearing capacity factors			0.00
s _c =	Shape factor			1.10
s _q =	Shape factor			1.10
s _r =	Shape factor			0.80
DEPTH FACTORS CALCULATION				
√NQ =	√tan ² (π/4+Ø'/2) =	tan(45 + Ø'/2) =	tan(45 + Ø'/2) =	1.0000
d _c =	(1+ (0.2)*(Df/B)*(√ NØ)			1.2000
d _q =	d _r =	1	FOR Ø < 10 ⁰	1
d _q =	d _r =	1+ (0.1*D _f /B)*√ NØ	FOR Ø > 10 ⁰	1.1000
i _c =	i _q =	(1- α/90) ²		1
i _r =		(1- α/Ø) ²		1
W' =	Water table effect			0.5
q'd = 2/3*C*N'C*sC*dC*iC + q*(N'q-1)*sq*dq*iq + 0.5*B*Y*N'r*sr*dr*ir*W'				45.2320
considering factor of safety (FOS)			2.5	
Safe Bearing Capacity (t/m ²) =			18.09	
Safe Bearing Capacity based on Shear Criteria (t/m ²) =			20.81	
ANANDJIWALA TECHNICAL CONSULTANCY, AHMEDABAD. Tel : 079- 26762598, E mail : atc_abad@yahoo.co.in				

SAMPLE CALCULATION FOR SAFE BEARING CAPACITY AS PER IS 8009-1 CLOUSE No. 9.0	
LOCATION : BOP Area	
1) TYPE OF FOOTING	Rectangular
2) LENGTH OF FOOTING = L (m)	6.00
3) WIDTH OF FOOTING = B (m)	3.00
4) DEPTH OF FOOTING BELOW GROUND LEVEL = D (m)	3.00
5) DENSITY OF SOIL AT FOUNDATION γ_b in t/m^3	2.00
6) $q = \gamma \cdot D$ = OVER BURDEN SURCHARGE (t/m^2)	6.00
7) WATER TABLE EFFECT = W' =	0.50
SAY $Q_{safe} = (t/m^2)$	10.80
DATA	
8) COEFFICIENT OF VOLUME CHANGE = m_v (cm^2/kg)	0.0225
9) INCREASE OF PRESSURE AT MID DEPTH = Δp (t/m^2)	5.13
10) POISSON'S RATION = μ =	0.35
11) MODULUS OF ELASTICITY = E (t/m^2)	1000.00
12) INFLUENCE FACTOR = I	0.30
CALCULATION :	
$S_i = (p \cdot B \cdot (1 - \mu^2) \cdot I) / E$ in mm	8.53
$S_e = \Delta p \cdot m_v \cdot H_o$	
where, H = Depth of compresible layer below foundation in cm	500.00
So, $S_e =$ cm	5.77
$S_e =$ mm	57.69
Correction of Rigidity Factor & Depth Factor =	
Rigidity factor	1.00
Depth factor	0.76
λ = A factor related to pore water pressure	0.70
Final Settlement = $S_f =$	
$S_f = S \cdot \text{Rigidity factor} \cdot \text{Depth factor} \cdot \text{Pore water pressure factor}$	36.85
36.85 mm which is less than 40 hence, ok	
Recommended Safe Bearing Capacity Based on Settlement Criteria is = t/m^2	10.80
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in	

SUMMARY & CONCLUSIONS:

- 1) In case of pile foundation, safe load carrying capacity for vertical compression, lateral, pullout for different diameters and length as shown in table-1.
- 2) In case of open foundation, allowable bearing capacity for different size of footing and depth as shown in table-2 to table-7.

SAFE LOAD CARRYING CAPACITY OF BORED CAST IN-SITU PILE**Table-1**

Pile Diameter (m)	Cutoff level from FGL* (m)	Length of Pile below cut-off (m)	Recommended Vertical Pile Capacity (Tonnes)	Pull-Out Pile Capacity (Tonnes)	Lateral Pile Capacity for Fixed Head (Tonnes)
0.45	3.00	22.00	83.50	51.64	5.20
0.50		23.00	101.45	62.90	5.65
0.60		28.00	156.75	99.85	7.50
0.76		33.00	250.45	162.90	12.00
0.45	4.00	22.00	84.76	51.64	5.20
0.50		23.00	102.80	62.90	5.65
0.60		28.00	158.40	99.85	7.50
0.76		33.00	252.50	162.90	12.00

*Finished Ground Level is RL (+) 126.000m

NET ALLOWABLE BEARING PRESSURE (T/m²)

For Construction yard, CW pump house, ETP area, HFO LDO DYKE area, Plant gate, PT plant, Raw water reservoir, Town ship, Training Centre, and Workshop Boundary wall, Canteen, Administrative Building structures.

Table-2

Please include present layout in the investigation report.

Founding Level RL (m)	Isolated / Strip / Combined Footings				Raft (=6m width)
	1 to 2m width for 40mm settlement	3m width for 40mm settlement	4m width for 40mm settlement	5m width for 40mm settlement	for 40mm Settlement
125.000	10.00	8.00	-	-	-
124.000	13.00	9.50	7.00	6.00	6.50
123.000	15.00	10.50	8.00	6.50	7.00

NET ALLOWABLE BEARING PRESSURE (T/m²)

H₂ Regeneration area

Table-3

Founding Level RL (m)	Isolated / Strip / Combined Footings				Raft (=6m width)
	1 to 2m width for 40mm settlement	3m width for 40mm settlement	4m width for 40mm settlement	5m width for 40mm settlement	for 40mm Settlement
124.000	10.00	8.00	-	-	-
123.000	13.00	9.50	7.00	6.00	6.50
122.000	15.00	10.50	8.00	6.50	7.00

NET ALLOWABLE BEARING PRESSURE (T/m²)

LHP storage shed

Table-4

Founding Level RL (m)	Isolated / Strip / Combined Footings				Raft (=6m width)
	1 to 2m width for 40mm settlement	3m width for 40mm settlement	4m width for 40mm settlement	5m width for 40mm settlement	for 40mm Settlement
123.600	10.00	8.00	-	-	-
122.600	13.00	9.50	7.00	6.00	6.50
121.600	15.00	10.50	8.00	6.50	7.00

NET ALLOWABLE BEARING PRESSURE (T/m²)

Ammonia unloading & storage area, ware house/store and customer site office

Table-5

Founding Level RL (m)	Isolated / Strip / Combined Footings				Raft (=6m width)
	1 to 2m width for 40mm settlement	3m width for 40mm settlement	4m width for 40mm settlement	5m width for 40mm settlement	for 40mm Settlement
123.200	10.00	8.00	-	-	-
122.200	13.00	9.50	7.00	6.00	6.50
121.200	15.00	10.50	8.00	6.50	7.00

**NET ALLOWABLE BEARING PRESSURE (T/m²)
FOR FIRE WATER BOOSTER PUMP HOUSE
Table-6**

Founding Level RL (m)	Isolated / Strip / Combined Footings				Raft (=6m width)
	1 to 2m width for 40mm settlement	3m width for 40mm settlement	4m width for 40mm settlement	5m width for 40mm settlement	for 40mm Settlement
124.600	10.00	8.00	-	-	-
123.600	13.00	9.50	7.00	6.00	6.50
122.600	15.00	10.50	8.00	6.50	7.00

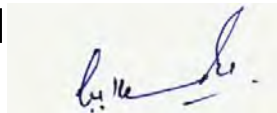
**NET ALLOWABLE BEARING PRESSURE (T/m²)
FOR DM PLANT
Table-7**

Founding Level RL (m)	Isolated / Strip / Combined Footings	
	1 to 2m width for 25 mm settlement	3m width for 25 mm settlement
125.000	7.00	-
124.000	8.00	5.50
123.000	9.00	6.30

- 3) Considering the soil strata, bored cast in-situ RCC pile foundation is suggested.
- 4) The sub-soil characterized by stiff to very stiff clay / clayey silt followed by very stiff clayey silt to hard silty clay / clayey silt.
- 5) In case of any loose material is encountered at the foundation depth same should be completely removed and replaced by PCC.
- 6) Considering Seismic Zone-3 and sub soil characteristics, the project site is not prone to liquefaction.
- 7) The ground water and sub soil does not contain any harmful chemicals, so no special steel or cement is required to use for construction of foundations.
- 8) Considering the local geology and experience, there is no specific geotechnical problem is envisage.
- 9) For Electrical Resistivity test results, Annexure-4.1 can be referred.
- 10) For Field CBR test results, Annexure-4.2 can be referred.
- 11) For DCPT test results, Annexure-4.3 can be referred.
- 12) For Plate Load test results, Annexure-4.4 can be referred.
- 13) For SCPT test results, Annexure-4.5 can be referred.
- 14) For Field Percolation test results, Annexure-4.6 can be referred.

- 15) For Field Permeability test results, Annexure-4.7 can be referred.
- 16) For Trial Pit logs, lab soaked / Unsoaked CBR, Heavy / Light Proctor test results, Annexure-4.8 can be referred.
- 17) For Soil Chemical test results, Annexure-5 can be referred.
- 18) For Water Chemical test results, Annexure-6 can be referred.
- 19) For Soil Profile, Annexure-7 can be referred.
- 20) For Local Geology, Annexure-8 can be referred.
- 21) Based on trial pit samples proctor test and CBR test, existing soil at site can be used as filling / back filling.
- 22) Based on the test results CBR values in soaked condition are in between 3.8% to 5.0%. Accordingly CBR value in soaked condition can be considered as 4.4% for design of sub grade for roads.
- 23) Wherever roads are to be constructed in fill, the CBR value in soaked condition shall be determined from the fill material in laboratory during execution.
- 24) Modulus of sub grade reaction (k) can be considered as 2.45 kg/cm²/cm.
- 25) The comments given in the report and suggestions given are based on ground conditions encountered during investigations. If during executing the foundation work, any variation in stratification of foundation, location is noticed, please inform us about that.
- 26) The above founding levels have been fixed considering the present layout. In case of any change in layout of the structures, the founding level shall be changed accordingly.

Please include present layout in the investigation report.



For, Anandjiwala Technical Consultancy

1X660 MW PANKI TPS EXTENSION PROJECT

S. No.	Bore Hole No.	Location	NGL (m)	FGL (m)	Depth of fill with respect to NGL (m)	Depth of fill/cut with respect to FGL (m)	Remarks	Type of foundation
GEOTECHNICAL INVESTIGATION REPORT PART-2								
1	BH-78	Customer Site Office	+126.3	+126.0	2.0	1.7		open foundation with min. 2 m founding depth from FGL
2	BH-67	Ammonia unloading and storage area	+126.3	+126.0	2.0	1.7		open foundation with min. 2 m founding depth from FGL
3	BH-85	H2 Regeneration area	+129.0	+126.0	4.0	1.0		open with min. 2 m founding depth from FGL
4	BH-72	BHEL site office	+127.2	+126.0	-	-		
5	BH-73	Ware house/store	+127.2	+126.0	3.0	1.8		open foundation with min. 2 m founding depth from FGL
6	BH-74	Canteen	+127.2	+126.0	1.0	-0.2	Depth of Cut	
7	BH-75	Fire station building	+127.2	+126.0	1.0	-0.2	Depth of Cut	
8	BH-76	Security complex	+127.7	+126.0	1.0	-0.7	Depth of Cut	
9	BH-1	Boundary wall	+126.8	+126.0	-	-		
10	BH-9	Boundary wall	+126.7	+126.0	-	-		
11	BH-11	Boundary wall	+128.0	+126.0	-	-		
12	BH-19	Boundary wall	+126.9	+126.0	1.0	0.1		
13	BH-59	Boundary wall	+127.0	+126.0	-	-		
14	BH-77	Admin building	+126.7	+126.0	-	-		
15	BH-86	Boundary wall	+127.0	+126.0	-	-		
16	BH-13	Construction yard	+127.1	+126.0	-	-		
17	BH-20	CW Pump house	+126.8	+126.0	-	-		
18	BH-21	CW Pump house	+126.8	+126.0	-	-		
19	BH-23	CW Pump house	+127.0	+126.0	-	-		
20	BH-56	DM plant	+125.9	+126.0	-	-		
21	BH-57	DM plant	+126.1	+126.0	-	-		
22	BH-58	ETP area	+126.2	+126.0	-	-		
23	BH-34	Fire water , booster pump house	+126.6	+126.0	1.0	0.4		
24	BH-33	HFO, LDO Dyke area	+126.7	+126.0	-	-		
25	BH-71	HFO, LDO Dyke area	+127.4	+126.0	-	-		
26	BH-12	HFO, LDO Pump House	+127.4	+126.0	-	-		
27	BH-84	LHP Storage shed	+126.1	+126.0	1.5	1.4		open foundation with min. 2 m founding depth from FGL
28	BH-60	Plant gate	+126.0	+126.0	-	-		
29	BH-16	PT Plant	+126.6	+126.0	-	-		
30	BH-17	PT Plant	+126.8	+126.0	-	-		
31	BH-18	PT Plant	+126.6	+126.0	-	-		
32	BH-24	PT Plant	+126.6	+126.0	-	-		
33	BH-10	Raw water reservoir	+126.9	+126.0	-	-		
34	BH-2	Raw water reservoir	+126.3	+126.0	-	-		
35	BH-3	Raw water reservoir	+126.3	+126.0	-	-		
36	BH-5	Raw water reservoir	+126.4	+126.0	-	-		
37	BH-6	Raw water reservoir	+126.3	+126.0	-	-		
38	BH-7	Raw water reservoir	+126.3	+126.0	-	-		
39	BH-8	Township	+127.0	+126.0	-	-		
40	BH-4	Training Centre	+126.7	+126.0	-	-		
41	BH-28	Workshop	+127.1	+126.0	-	-		
42	BH-29	Workshop	+127.2	+126.0	-	-		

FGL = RL (+) 126.0 M

PANKI TPS (1x660 MW)

Minutes of meeting held between NTPC and BHEL on 31.10.2018 at NTPC EOC

Detailed geotechnical investigation has been carried out by M/s BHEL for the project site wherein geotechnical report was submitted to NTPC. NTPC reviewed the geotechnical report and submitted their observations on investigation report. The comments on geotechnical report was discussed and based upon the discussion following net safe bearing capacity is finalised.

Founding Level	Net Allowable Bearing Pressure T/m ²				
	Isolated / Strip /combined footings				Raft (6m width) for 40mm settlement
	2m width for 40mm settlement	3m width for 40mm settlement	4m width for 40mm settlement	5m width for 40mm settlement	
1 m below NGL	10	8	-	-	-
2 m below NGL	13	9.5	7	6	6.5
3 m below NGL	15	10.5	8	6.5	7
4 m below NGL	17	11.5	8.5	7	7.5

Mohit
NTPC 31.10.18
Anu
31/10/18

Vivek Varshney
(Dy. Manager)
PEM-CIVIL
BHEL

NOTATIONS

BH	Bore Hole
N	SPT Value
DS	Disturbed Sample
UDS	Undisturbed sample
DU	Direct Shear Undrained Test
TU	Triaxial Shear Undrained Test
LL	Liquid Limit
PL	Plastic Limit
PI	Plasticity Index
NP	Non Plastic
SC	Clayey Sand
SM	Silty sand
SW	Well graded sand
SP	Poorly graded sand
CH	Clay of high plasticity
CI	Clay of Intermediate plasticity
CL	Clay of Low plasticity
MH	Inorganic silt of high plasticity
MI	Inorganic silt of Intermediate plasticity
ML	Inorganic silt of low plasticity
GC	Clayey Gravels
ϕ	Angle of internal friction
qd	Net ultimate bearing capacity
Cc	Compression Index
C	Cohesion
γ_b	Bulk density
MC	Moisture Content
B	Width of Footing in mt.
Nc, Nq & N _y	Bearing Capacity Factors
Sc, Sq & S _y	Shape Factors.
dc, dq & d _y	Depth Factors
ic, iq & i _y	Inclination Factors.
w	Correction factor for water table.

GENERAL REFERENCES

Indian Standards

IS 2720 Part -II, Part -III, Part -IV, Part -V, Part -XIII Part -XXXI, Part -XXVII, Part -XXXI, Part -XXV

IS - 1948, IS - 6403, IS - 1904, IS:6409-1981

IS : 6403-1971 IS 456-2000

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IS 9259-1979 & 11196-1985

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Alam Singh

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Design Aids in Soil Mechanics and Foundation Engineering.

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Murthy V. N. S.

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Karl Terzaghi & Peck

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ANNEXURE-1

BORE LOG

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-78

Page : 1/2

METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +126.3m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.2m (4.1m)

LOCATION: Customer Site Office
CO ORDINATES : Easting : 556
Northing : -271
DATE : 24-06-2018 TO 25-06-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
2.00	1	filling material			2.00	0.00	DS	1	-	-						-
						1.00	UDS	1	-	-						-
6.00	3	brown silty soil			4.00	2.00	SPT	1	4,7,10	17						-
						3.00	UDS	2	-	-						-
						4.00	SPT	2	7,11,14	25						-
	5					5.00	UDS	3	-	-						-
						6.00	SPT	3	7,13,20	33						-
9.00	7	brownish silty sandy soil			3.00	7.00	UDS	4	-	-						-
						8.00	SPT	4	7,9,14	23						-
						9.00	SPT	5	10,14,19	33						-
	9					10.00	SPT	6	17,23,30	53						-
14.50	11	brown silty clay soil			5.50	11.50	SPT	7	9,12,28	40						-
						13.00	SPT	8	10,16,24	40						-
	13					14.50	SPT	9	12,18,29	38						-
	15															-
		brownish silty sandy soil			0.50											

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E mail : nagpur_atc@yahoo.in

RECORD OF BORING

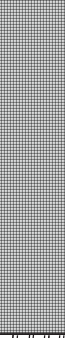
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-78

Page : 2/2

METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +126.3m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.2m (4.1m)

LOCATION: Customer Site Office
CO ORDINATES : Easting : 556
Northing : -271
DATE : 24-06-2018 TO 25-06-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
	16	brownish silty sandy soil			4.00	16.00	SPT	10	14,22,35	57						-
	18					17.50	SPT	11	15,28,32	60						-
19.00						19.00	SPT	12	16,20,38	58						-
	20	brown silty clay soil			4.50	20.50	SPT	13	18,27,40	67						-
	22					22.00	SPT	14	16,22,31	53						-
23.50						23.50	SPT	15	20,28,39	23						-
	24	brown silty soil			6.50	25.00	SPT	16	16,19,29	48						-
	26					26.50	SPT	17	14,19,28	47						-
	28					28.00	SPT	18	21,28,40	68						-
30.00						29.50	SPT	19	22,30,38	68						-
	30					30.00	SPT	20	25,32,52(50m)	>100						-

Bore terminated

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E mail : nagpur_atc@yahoo.in

RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-67																
Page : 1/3																
METHOD OF DRILLING : Rotary																
LOCATION: Ammonia Unloading & Storage Area																
BORE DIA : 150 mm																
CO ORDINATES : Easting : 280																
RL OF GL : +126.3m																
Northing : -271																
DEPTH OF BORING : 40.00m																
DATE : 19-06-2018 TO 22-06-2018																
WATER TABLE :@ +122.3m (4.0m)																
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
2.00	1	filling material			2.00	0.00	DS	1	-	-						-
					1.00	UDS	1	-	-						-	
3 																

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-67

Page : 2/3

Bh-67 Page : 2/3

METHOD OF DRILLING : Rotary

METHOD OF DRILLING : Rotary LOCATION: Ammonia Unloading & Storage Area

CO ORDINATES : Easting : 280

CO ORDINATES : Easting : 280

RL OF GL : +126.3m

RL OF GL : +126.3m

DEPTH OF BORING : 40.00m

DEPTH OF BORING : 40.00m

WATER TABLE : @ +122.3m (4.0m)

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS		
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N								
					15.00													
	16	brown silty clay soil				16.00	SPT	7	20,31,45	>100							-	
	18					17.50	UDS	8	-	-								-
						19.00	SPT	8	15,27,52 (1cm)	>100								-
	20					20.50	SPT	9	16,30,52 (4cm)	>100								-
	22					22.00	SPT	10	18,32,52 (1cm)	>100								-
	24					23.50	SPT	11	20,24,36	90								-
	26					25.00	SPT	12	18,40,50	90								-
	28					26.50	SPT	13	17,27,46	73								-
						28.00	SPT	14	18,27,42	69								-
30.00	30					29.50	SPT	15	15,22,40	62								-

ANANDJIWALA TECHNICAL CONSULTANCY, AHMEDABAD. Tel : 079- 26762598,
E mail : atc_abad@yahoo.co.in

RECORD OF BORING																		
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																		
Bh-67																		
Page : 3/3																		
METHOD OF DRILLING : Rotary																		
BORE DIA : 150 mm																		
RL OF GL : +126.3m																		
DEPTH OF BORING : 40.00m																		
WATER TABLE :@ +122.3m (4.0m)																		
LOCATION: Ammonia Unloading & Storage Area																		
CO ORDINATES : Easting : 280																		
Northing : -271																		
DATE : 19-06-2018 TO 22-06-2018																		
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS		
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N								
					3.00													
	31	brown silty soil				31.00	SPT	16	32,40,51	91						-		
33.00	33					32.50	SPT	17	42,55(7cm)	>100								-
		brown silty clay soil			7.00													
	35					34.00	SPT	18	33,42,50 (5cm)	>100								-
						35.50	SPT	19	36,52(4cm)	>100								-
	37					37.00	SPT	20	40,57(3cm)	>100								-
	39					38.50	SPT	21	43,51(7cm)	>100								-
40.00																		
		Bore terminated				40.00	SPT	22	42,54(1cm)	>100						-		
	41																	
	43																	
	45																	
ANANDJIWALA TECHNICAL CONSULTANCY , AHMEDABAD . Tel : 079- 26762598, E mail : atc_abad@yahoo.co.in																		

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-85

Page : 1/2

METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +129.0m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.1m (6.9m)

LOCATION: H2 Regeneration Area
CO ORDINATES : Easting : 343
Northing : -910
DATE : 09-07-2018 TO 09-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
	1	blackish ash			4.00	0.00	DS	1	-	-						-
						1.00	SPT	1	2,3,4	7						-
						2.00	UDS	1	-	-						-
	3					3.00	SPT	2	4,4,6	10						-
4.00		brown silty clay soil				4.00	UDS	2	-	-						-
	5				11.00	5.00	SPT	3	7,7,9	16						-
						6.00	UDS	3	-	-						-
	7					7.00	SPT	4	7,8,9	17						-
						8.00	UDS	4	-	-						-
	9					9.00	SPT	5	7,8,11	19						-
						10.00	UDS	5	-	-						-
	11					11.50	SPT	6	8,9,12	21						-
						13.00	UDS	6	-	-						-
	13															
						14.50	SPT	7	10,10,13	23						-
	15															

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RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-85

Page : 2/2

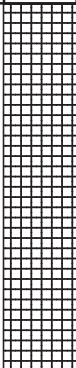
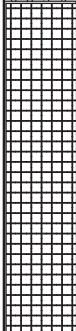
METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +129.0m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.1m (6.9m)

LOCATION: H2 Regeneration Area
CO ORDINATES : Easting : 343
Northing : -910
DATE : 09-07-2018 TO 09-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
19.00	16	brown silty clay soil			1.00											
						16.00	SPT	8	12,13,17	30						UDS Empty
	18				14.00											
						17.50	SPT	9	8,13,18	31						-
						19.00	SPT	10	9,11,14	25						UDS Empty
	20															
						20.50	SPT	11	10,14,17	31						-
	22															
						22.00	SPT	12	11,14,18	32						UDS Empty
	24					23.50	SPT	13	13,14,19	33						-
	26					25.00	SPT	14	17,22,30	52						UDS Empty
	28					26.50	SPT	15	19,22,32	54						-
						28.00	SPT	16	20,25,31	56						UDS Empty
30.00	30					29.50	SPT	17	24,28,35	63						-

Bore terminated

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RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-72																
Page : 1/2																
METHOD OF DRILLING : Rotary					LOCATION: BHEL site office											
BORE DIA : 150 mm					CO ORDINATES : Easting : 377											
RL OF GL : +127.2m					Northing : -221											
DEPTH OF BORING : 30.00m					DATE : 21-07-2018 TO 21-07-2018											
WATER TABLE :@ +122.2m (5.0m)																
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
5.00	1	brown silty clay soil			5.00	0.00	DS	1	-	-						-
	1.00					SPT	1	4,7,9	16						-	
	2.00					UDS	1	-	-						-	
	3.00					SPT	2	8,11,13	24						-	
	4.00					UDS	2	-	-						-	
5.00	5	brown silty soil			2.00	5.00	SPT	3	8,10,13	23						-
	6.00					UDS	3	-	-						-	
7.00	7					7.00	SPT	4	10,13,18	31						-
11.50	9	brown silty clay soil			4.50	8.00	UDS	4	-	-						-
	9.00					SPT	5	12,18,21	39						-	
	10.00					UDS	5	-	-						-	
	11.50					SPT	6	13,20,25	45						-	
15.00	13	brown silty soil			3.50	13.00	UDS	6	-	-						-
	14.50					SPT	7	15,22,27	49						-	
	15.00					15										
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RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-72																
Page : 2/2																
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL OF GL : +127.2m DEPTH OF BORING : 30.00m WATER TABLE : @ +122.2m (5.0m)								LOCATION: BHEL site office CO ORDINATES : Easting : 377 Northing : -221 DATE : 21-07-2018 TO 21-07-2018								
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
					15.00											
	16					16.00	UDS	7	-	-						-
	18					17.50	SPT	8	19,23,28	51						-
						19.00	UDS	8	-	-						-
	20					20.50	SPT	9	17,25,31	56						-
	22					22.00	UDS	9	-	-						-
		brown silty clay soil				23.50	SPT	10	22,29,30	59						-
	24					25.00	SPT	11	23,30,35	65						UDS Empty
	26					26.50	SPT	12	25,31,36	67						-
	28					28.00	SPT	13	26,34,38	72						UDS Empty
						29.50	SPT	14	26,32,41	73						-
30.00	30					30.00	SPT	15	28,37,43	80						-
Bore terminated																
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-73																
Page : 1/2																
METHOD OF DRILLING : Rotary																
LOCATION: Warehouse / Store																
BORE DIA : 150 mm																
CO ORDINATES : Easting : 438																
RL OF GL : +127.2m																
Northing : -219																
DEPTH OF BORING : 30.00m																
DATE : 21-07-2018 TO 21-07-2018																
WATER TABLE :@ +122.2m (5.0m)																
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
3.00	1	blackish ash			3.00	0.00	DS	1	-	-						-
	1.00				SPT	1	3,4,6	10						-		
	2.00				UDS	1	-	-						-		
5.00	3	brown silty soil			3.00	3.00	SPT	2	4,7,9	16						-
	4.00				UDS	2	-	-						-		
	5.00				SPT	3	5,8,10	18						-		
7.00	5	brown silty soil			6.00	6.00	UDS	3	-	-						-
	7.00				SPT	4	8,10,13	23						-		
	8.00				UDS	4	-	-						-		
9.00	7	brown silty clay soil			9.00	9.00	SPT	5	9,11,14	25						-
	10.00				UDS	5	-	-						-		
	11.50				SPT	6	8,12,14	26						-		
13.00	9	brown silty clay soil			13.00	13.00	UDS	6	-	-						-
	14.50				SPT	7	10,18,19	37						-		
	15.00															
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-73

Page : 2/2

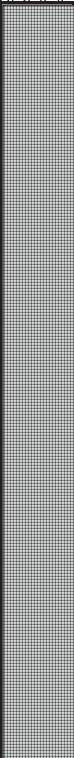
METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +127.2m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.2m (5.0m)

LOCATION: Warehouse / Store
CO ORDINATES : Easting : 438
Northing : -219
DATE : 21-07-2018 TO 21-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS			
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N									
	16	brown silty clay soil			2.50	16.00	UDS	7	-	-						-			
17.50																			
	18	brownish silty sandy soil			11.50	17.50	SPT	8	14,19,23	42						-			
								19.00	SPT	9	16,21,26	47						UDS Empty	
	20							20.50	SPT	10	12,22,28	50						-	
								22.00	SPT	11	18,26,30	56						UDS Empty	
	22							23.50	SPT	12	19,27,31	58						-	
								25.00	SPT	13	20,29,36	65						UDS Empty	
	24							26.50	SPT	14	21,28,33	61						-	
								28.00	SPT	15	22,30,41	71						UDS Empty	
29.00																			
					brown silty clay soil			1.00	29.50	SPT	16	26,30,42	72						-
30.00	30																		
Bore terminated						30.00	SPT	17	27,36,48	84						-			

Bore terminated

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RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-74																
Page : 1/2																
METHOD OF DRILLING : Rotary																
LOCATION: Canteen																
BORE DIA : 150 mm																
CO ORDINATES : Easting : 497																
RL OF GL : +127.2m																
Northing : -221																
DEPTH OF BORING : 30.00m																
DATE : 20-07-2018 TO 20-07-2018																
WATER TABLE :@ +122.2m (5.0m)																
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N	20	40	60	80	100	
1.00	1	blackish ash			1.00	0.00	DS	1	-	-						-
		brown silty soil			4.00	1.00	SPT	1	5,9,11	20						-
						2.00	UDS	1	-	-						-
	3					3.00	SPT	2	6,9,14	23						-
						4.00	UDS	2	-	-						-
	5	brown silty clay soil			10.00	5.00	SPT	3	5,9,14	23						-
						6.00	UDS	3	-	-						-
	7					7.00	SPT	4	5,8,15	23						-
						8.00	UDS	4	-	-						-
	9					9.00	SPT	5	6,9,16	25						-
						10.00	UDS	5	-	-						-
	11					11.50	SPT	6	7,8,18	26						-
						13.00	UDS	6	-	-						-
	13					14.50	SPT	7	8,14,21	35						-
	15															
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

RECORD OF BORING

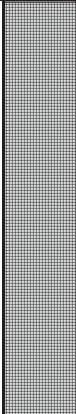
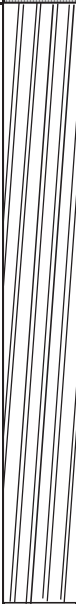
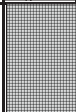
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-74

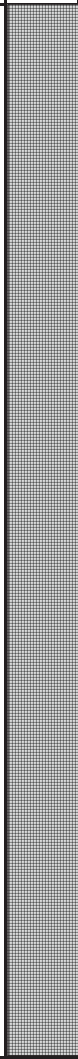
Page : 2/2

METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +127.2m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.2m (5.0m)

LOCATION: Canteen
CO ORDINATES : Easting : 497
Northing : -221
DATE : 20-07-2018 TO 20-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
20.50	16	brown silty clay soil			5.50	16.00	UDS	7	-	-						-
	18				17.50	SPT	8	11,18,24	42						-	
	20				19.00	UDS	8	-	-						-	
					20.50	SPT	9	18,21,32	53						-	
28.50	22	brown silty soil			8.00	22.00	SPT	10	10,18,26	44						UDS Empty
	24				23.50	SPT	11	12,17,24	41						-	
	26				25.00	SPT	12	15,22,23	45						UDS Empty	
	28				26.50	SPT	13	16,26,37	63						-	
					28.00	SPT	14	19,28,39	67						UDS Empty	
30.00	30	brown silty clay soil			1.50	29.50	SPT	15	17,23,35	58						-
Bore terminated						30.00	SPT	16	18,21,36	57						-

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RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-75																
Page : 1/2																
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL OF GL : +127.2m DEPTH OF BORING : 30.00m WATER TABLE :@ +122.2m (5.0m)										LOCATION: Fire Station Building CO ORDINATES : Easting : 555 Northing : -211 DATE : 20-07-2018 TO 20-07-2018						
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
1.00	1	blackish ash			1.00	0.00	DS	1	-	-						-
		brown silty clay soil			14.00	1.00	SPT	1	3,4,6	10						-
					2.00	UDS	1	-	-					-		
	3				3.00	SPT	2	4,6,8	14					-		
					4.00	UDS	2	-	-					-		
	5				5.00	SPT	3	5,7,9	16					-		
					6.00	UDS	3	-	-					-		
	7				7.00	SPT	4	6,8,11	19					-		
					8.00	UDS	4	-	-					-		
	9				9.00	SPT	5	7,9,12	21					-		
					10.00	UDS	5	-	-					-		
	11				11.50	SPT	6	8,10,13	23					-		
					13.00	UDS	6	-	-					-		
	15.00				15	14.50	SPT	7	10,13,16	29					-	
	ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in															

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-75

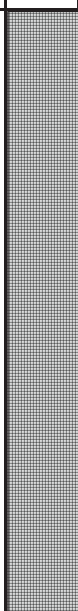
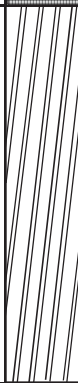
Page : 2/2

METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +127.2m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.2m (5.0m)

LOCATION: Fire Station Building
CO ORDINATES : Easting : 555
Northing : -211
DATE : 20-07-2018 TO 20-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS			
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N									
		brownish silty sandy soil			15.00														
	16				16.00	UDS	7	-	-										-
	18				17.50	SPT	8	13,17,21	38										-
					19.00	UDS	8	-	-										-
	20				20.50	SPT	9	16,20,24	44										-
	22				22.00	UDS	9	-	-										-
					23.50	SPT	10	15,21,28	49										-
	24				25.00	SPT	11	19,20,29	49										UDS Empty
	26				26.50	SPT	12	16,22,31	53										-
	28				28.00	SPT	13	17,23,33	56										UDS Empty
30.00	30				29.50	SPT	14	19,29,39	68										-
					30.00	SPT	15	21,26,41	67										-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02,
E mail : nagpur_atc@yahoo.in

RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-76 Page : 1/2																
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL OF GL : +127.7m DEPTH OF BORING : 30.00m WATER TABLE : @ +122.2m (5.5m)					LOCATION: Security Complex CO ORDINATES : Easting : 605 Northing : -213 DATE : 20-07-2018 TO 20-07-2018											
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
1.00	1	blackish ash			1.00	0.00	DS	1	-	-						-
		brown silty clay soil			8.00	1.00	SPT	1	7,11,12	23						-
					2.00	UDS	1	-	-						-	
	3				3.00	SPT	2	8,9,12	21						-	
					4.00	UDS	2	-	-						-	
	5				5.00	SPT	3	9,13,15	28						-	
					6.00	UDS	3	-	-						-	
	7				7.00	SPT	4	11,14,16	30						-	
					8.00	UDS	4	-	-						-	
9.00	9				9.00	SPT	5	11,17,19	36						-	
		brown silty soil			5.00	10.00	UDS	5	-	-						-
					11.50	SPT	6	13,19,21	40						-	
	13				13.00	UDS	6	-	-						-	
	14.00														-	
	15	brownish fine sandy soil			1.00	14.50	SPT	7	13,19,22	41						-
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

RECORD OF BORING

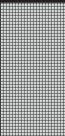
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-76

Page : 2/2

METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +127.7m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.2m (5.5m)

LOCATION: Security Complex
CO ORDINATES : Easting : 605
Northing : -213
DATE : 20-07-2018 TO 20-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
	16	brownish fine sandy soil			13.00	16.00	SPT	8	14,23,28	51						UDS Empty
	18			17.50	SPT	9	16,24,29	53							-	
	20			19.00	SPT	10	17,26,30	56							UDS Empty	
	22			20.50	SPT	11	20,28,32	60							-	
	24			22.00	SPT	12	20,28,32	60							UDS Empty	
	26			23.50	SPT	13	23,35,39	74							-	
	28			25.00	SPT	14	21,34,38	72							UDS Empty	
	30			26.50	SPT	15	24,37,40	77							-	
28.00	28	brown silty clay soil			2.00	28.00	SPT	16	25,38,41	79						UDS Empty
				29.50	SPT	17	25,32,38	70							-	
30.00	30			30.00	SPT	18	27,35,39	74							-	
Bore terminated																

Bore terminated

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RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-1

Page : 1/2

Bh-1

Page : 1/2

METHOD OF DRILLING: Rotary LOCATION: Boundary Wall

BORE DIA : 150 mm

RL OF GL : +126.8m

DEPTH OF BORING : 30.00m DATE : 03-07-2018 TO 03-07-2018

WATER TABLE :@ +122.4m (4.4m)

METHOD OF DRILLING: Rotary LOCATION: Boundary Wall

BORE DIA : 150 mm

RL OF GL : +126.8m

DEPTH OF BORING : 30.00m

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N	20	40	60	80	100	
1.00	1	brown silty soil			1.00	0.00	DS	1	-	-						-
					2.00	1.00	SPT	1	9,6,7	13						-
3.00	3	brown silty clay soil				2.00	UDS	1	-	-						-
						3.00	SPT	2	5,7,9	16						-
						4.00	UDS	2	-	-						-
	5					5.00	SPT	3	6,8,11	19						-
		brown silty soil				6.00	UDS	3	-	-						-
	7					7.00	SPT	4	7,10,13	23						-
						8.00	UDS	4	-	-						-
9.00	9					9.00	SPT	5	11,19,17	36						-
						10.00	SPT	6	12,13,16	29						UDS Empty
	11	brown silty clay soil				11.50	SPT	7	13,15,17	32						-
	13					13.00	SPT	8	14,16,18	34						UDS Empty
	15					14.50	SPT	9	15,18,20	38						-

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RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-1

Page : 2/2

Bh-1

Page : 2/2

METHOD OF DRILLING : Rotary	LOCATION: Boundary Wall

BORE DIA : 150 mm

RL OF GL : +126.8m Northing : 99

DEPTH OF BORING : 30.00m

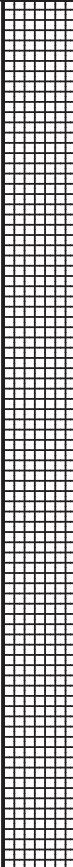
WATER TABLE : @ +122.4m (4.4m)

METHOD OF DRILLING : Rotary	LOCATION: Boundary Wall

BORE DIA : 150 mm

RL OF GL : +126.8m Northing : 99

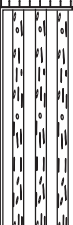
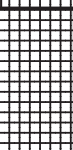
DEPTH OF BORING : 30.00m

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS			
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N									
		brown silty clay soil			11.50														
	16				16.00	SPT	10	16,19,22	41										UDS Empty
	18				17.50	SPT	11	13,19,21	40										-
					19.00	SPT	12	18,20,23	43										UDS Empty
	20				20.50	SPT	13	18,21,29	50										-
	22				22.00	SPT	14	15,21,26	47										UDS Empty
	24				23.50	SPT	15	20,23,28	51										-
		25.00	SPT	16	21,29,33	62										UDS Empty			
26.50	26					26.50	SPT	17	21,27,36	63							-		
	28	brownish fine sandy soil			3.50														
					28.00	SPT	18	25,30,39	69										-
30.00	30				29.50	SPT	19	22,29,32	61										-
		Bore terminated				30.00	SPT	20	25,34,38	72							-		

30.00	SPT	20	25,34,38	72	-

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RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-9																
Page : 1/2																
METHOD OF DRILLING : Rotary																
BORE DIA : 150 mm																
RL OF GL : +126.7m																
DEPTH OF BORING : 30.00m																
WATER TABLE : @ +122.4m (4.3m)																
LOCATION: Boundary Wall																
CO ORDINATES : Easting : -418																
Northing : -495																
DATE : 05-07-2018 TO 06-07-2018																
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N	20	40	60	80	100	
	1	brown silty soil			15.00	0.00	DS	1	-	-						-
					1.00	SPT	1	9,11,15	26							-
					2.00	UDS	1	-	-							-
	3				3.00	SPT	2	12,16,18	34							-
					4.00	UDS	2	-	-							-
	5				5.00	SPT	3	14,17,20	37							-
					6.00	UDS	3	-	-							-
	7				7.00	SPT	4	15,20,29	49							-
					8.00	UDS	4	-	-							-
	9				9.00	SPT	5	17,24,26	50							-
					10.00	UDS	5	-	-							-
	11				11.50	SPT	6	12,18,24	42							-
					13	13.00	SPT	7	16,22,25	47						-
	15				14.50	UDS	6	-	-							-
	ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in															

RECORD OF BORING																		
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																		
Bh-9																		
Page : 2/2																		
METHOD OF DRILLING : Rotary																		
BORE DIA : 150 mm																		
RL OF GL : +126.7m																		
DEPTH OF BORING : 30.00m																		
WATER TABLE : @ +122.4m (4.3m)																		
LOCATION: Boundary Wall																		
CO ORDINATES : Easting : -418																		
Northing : -495																		
DATE : 05-07-2018 TO 06-07-2018																		
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS		
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N								
	16	brown silty soil			2.50	16.00	SPT	8	16,25,30	55						-		
17.50																		
	18	brownish silty sandy soil			3.00	17.50	SPT	9	22,26,31	57						UDS Empty		
						19.00	SPT	10	19,23,29	52								-
20.50	20																	
		brownish fine sandy soil			3.00	20.50	SPT	11	26,32,37	69						UDS Empty		
	22					22.00	SPT	12	25,34,40	74							-	
23.50																		
	24	brownish silty sandy soil			4.50	23.50	SPT	13	20,29,36	65						UDS Empty		
						25.00	SPT	14	28,34,41	79							-	
	26					26.50	SPT	15	30,37,41	78							UDS Empty	
28.00	28																	-
		brown silty clay soil			2.00	28.00	SPT	16	23,38,44	82								
30.00	30																	UDS Empty
Bore terminated						30.00	SPT	18	20,28,35	63						-		
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																		

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-11																	
Page : 1/2																	
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL OF GL : +128.0m DEPTH OF BORING : 30.00m WATER TABLE : @ +122.4m (5.6m)										LOCATION: Boundary Wall CO ORDINATES : Easting : -60 Northing : 143 DATE : 07-07-2018 TO 07-07-2018							
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
					15.00	0.00	DS	1	-	-							-
	1					1.00	SPT	1	4,6,10	16							-
						2.00	UDS	1	-	-							-
	3					3.00	SPT	2	5,7,10	17							-
						4.00	UDS	2	-	-							-
	5					5.00	SPT	3	7,11,13	24							-
						6.00	UDS	3	-	-							-
	7					7.00	SPT	4	9,11,17	28							-
						8.00	UDS	4	-	-							-
	9					9.00	SPT	5	15,19,26	45							-
						10.00	UDS	5	-	-							-
	11					11.50	SPT	6	18,21,32	53							-
						13.00	UDS	6	-	-							-
	13																
						14.50	SPT	7	21,29,39	68							-
	15																
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-11 Page : 2/2																	
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL OF GL : +128.0m DEPTH OF BORING : 30.00m WATER TABLE :@ +122.4m (5.6m)										LOCATION: Boundary Wall CO ORDINATES : Easting : -60 Northing : 143 DATE : 07-07-2018 TO 07-07-2018							
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
					11.50												
	16	brown silty soil				16.00	UDS	7	-	-						-	
	18					17.50	SPT	8	17,25,35	60							-
						19.00	SPT	9	15,23,35	57							UDS Empty
	20					20.50	SPT	10	18,24,36	60							-
	22					22.00	SPT	11	19,27,39	66							UDS Empty
	24					23.50	SPT	12	21,29,49	78							-
						25.00	SPT	13	29,38,48	86							UDS Empty
26.50	26					26.50	SPT	14	38,39,45	84						-	
	28	brown silty clay soil			3.50												
						28.00	SPT	15	36,39,39	78							UDS Empty
	30					29.50	SPT	16	39,39,49	88							-
		Bore terminated				30.00	SPT	17	41,49,55	>100						-	
(13cm)																	
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RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-19

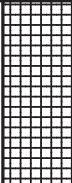
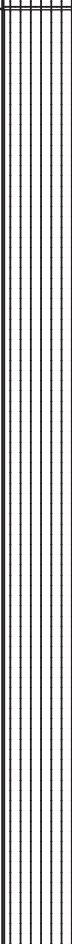
Page : 1/2

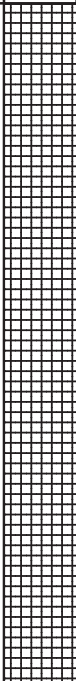
METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +126.9m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.4m (4.5m)

LOCATION: Boundary Wall
CO ORDINATES : Easting : -600
Northing : -711
DATE : 01-07-2018 TO 01-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N	20	40	60	80	100	
1.00	1	blackish ash			1.00	0.00	DS	1	-	-						-
					2.00	1.00	SPT	1	7,11,22	33						-
						2.00	UDS	1	-	-						-
3.00	3	brown silty clay soil				3.00	SPT	2	10,12,15	27						-
					2.00	4.00	UDS	2	-	-						-
5.00	5	brown silty soil				5.00	SPT	3	13,16,18	34						-
					10.00	6.00	UDS	3	-	-						-
	7					7.00	SPT	4	15,20,22	42						-
						8.00	SPT	5	15,21,25	46						UDS Empty
	9	brown silty clay soil				9.00	SPT	6	16,23,26	49						-
						10.00	SPT	7	18,24,25	49						UDS Empty
	11					11.50	SPT	8	17,20,26	46						-
						13.00	SPT	9	18,22,27	49						UDS Empty
	13					14.50	SPT	10	20,25,28	53						-
	15															

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E mail : nagpur_atc@yahoo.in

RECORD OF BORING																			
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																			
Bh-19																			
Page : 2/2																			
METHOD OF DRILLING : Rotary																			
LOCATION: Boundary Wall																			
BORE DIA : 150 mm																			
CO ORDINATES : Easting : -600																			
RL OF GL : +126.9m																			
Northing : -711																			
DEPTH OF BORING : 30.00m																			
DATE : 01-07-2018 TO 01-07-2018																			
WATER TABLE :@ +122.4m (4.5m)																			
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS			
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N									
	16	brown silty clay soil			2.50	16.00	SPT	11	17,25,30	55						UDS Empty			
17.50																			
	18	brownish silty sandy soil			12.50	17.50	SPT	12	17,22,32	54						-			
						19.00	SPT	13	19,26,33	59								UDS Empty	
	20					20.50	SPT	14	14,28,34	62								-	
						22.00	SPT	15	17,29,35	64								UDS Empty	
	22					23.50	SPT	16	20,27,35	62								-	
						25.00	SPT	17	21,35,36	70								UDS Empty	
	24					26.50	SPT	18	17,22,37	59								-	
						28.00	SPT	19	19,25,37	62								UDS Empty	
	26					29.50	SPT	20	21,27,32	59								-	
30.00	30																		
Bore terminated																			
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																			

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-59																	
Page : 1/2																	
METHOD OF DRILLING : Rotary																	
BORE DIA : 150 mm																	
RL OF GL : +127.0m																	
DEPTH OF BORING : 30.00m																	
WATER TABLE :@ +122.4m (4.6m)																	
LOCATION: Boundary Wall																	
CO ORDINATES : Easting : 606																	
Northing : -573																	
DATE : 08-07-2018 TO 09-07-2018																	
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
		brown silty clay soil			9.00	0.00	DS	1	-	-							-
	1				1.00	SPT	1	8,10,10	20							-	
					2.00	UDS	1	-	-							-	
	3				3.00	SPT	2	10,13,16	29							-	
					4.00	UDS	2	-	-							-	
	5				5.00	SPT	3	8,12,13	25							-	
					6.00	UDS	3	-	-							-	
	7				7.00	SPT	4	13,15,18	33							-	
					8.00	UDS	4	-	-							-	
9.00	9				9.00	SPT	5	13,18,23	41					-			
		brown silty soil			2.50	10.00	UDS	5	-	-						-	
	11				11.50	SPT	6	11,15,21	36							-	
		brownish silty sandy soil			3.50												
	13				13.00	UDS	6	-	-							-	
					14.50	SPT	7	18,23,25	48							-	
	15																
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-59

Page : 2/2

Bh-59

Page : 2/2

METHOD OF DRILLING : Rotary	LOCATION: Boundary Wall

BORE DIA : 150 mm

RL OF GL : +127.0m

DEPTH OF BORING : 30.00m

WATER TABLE : @ +122.4m (4.6m)

METHOD OF DRILLING : Rotary	LOCATION: Boundary Wall

BORE DIA : 150 mm

RL OF GL : +127.0m

DEPTH OF BORING : 30.00m

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.				REMARKS		
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
	16	brownish silty sandy soil			5.50	16.00	UDS	7	-	-						-	
	18				17.50	SPT	8	29,30,32	62								-
	20				19.00	UDS	8	-	-								-
20.50					20.50	SPT	9	21,28,30	58								-
	22	brown silty clay soil			3.00	22.00	UDS	9	-	-						-	
					23.50	SPT	10	40,42,48	90								-
	24				brownish fine sandy soil			6.50	25.00	SPT	11	48,52(10cm)	>100				
	26	26.50	SPT	12				38,52(5cm)	>100								-
	28	28.00	SPT	13				52(10cm)	>100								-
30.00	30	29.50	SPT	14				52(8cm)	>100								-
		30.00	SPT	15				20,31,34	65								-
Bore terminated																	

30.00	SPT	15	20,31,34	65	0	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02,
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RECORD OF BORING

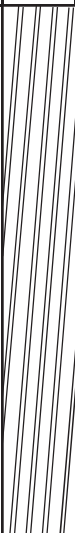
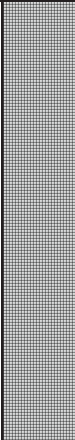
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-77

Page : 1/2

METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +126.7m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.4m (4.3m)

LOCATION: Administrative Building
CO ORDINATES : Easting : 656
Northing : -244
DATE : 30-06-2018 TO 30-06-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
	1	brown silty soil			7.00	0.00	DS	1	-	-						-
					1.00	SPT	1	5,8,10	18						-	
					2.00	UDS	1	-	-						-	
	3				3.00	SPT	2	6,11,15	26						-	
					4.00	UDS	2	-	-						-	
	5				5.00	SPT	3	8,12,17	29						-	
					6.00	UDS	3	-	-						-	
7.00	7	brownish silty sandy soil			2.00	7.00	SPT	4	9,13,19	32						-
	8.00				UDS	4	-	-						-		
9.00	9				9.00	SPT	5	11,15,18	33						-	
	11	brown silty clay soil			6.00	10.00	UDS	5	-	-						-
					11.50	SPT	6	10,14,26	40						-	
	13				13.00	UDS	6	-	-						-	
					14.50	SPT	7	12,19,29	48						-	
	15.00				15											-

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RECORD OF BORING

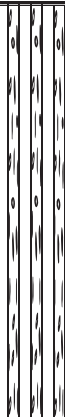
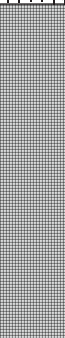
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-77

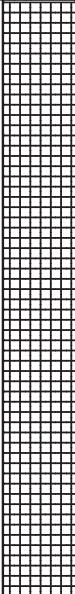
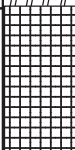
Page : 2/2

METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +126.7m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.4m (4.3m)

LOCATION: Administrative Building
CO ORDINATES : Easting : 656
Northing : -244
DATE : 30-06-2018 TO 30-06-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
	16	brownish fine sandy soil			5.50	16.00	UDS	7	-	-						-
	18				17.50	SPT	8	14,26,32	58						-	
	20				19.00	UDS	8	-	-						-	
20.50					20.50	SPT	9	17,28,35	63						-	
	22	brown silty clay soil			4.50	22.00	UDS	9	-	-						-
	24				23.50	SPT	10	20,23,30	53						-	
25.00					25.00	SPT	11	16,18,23	41						UDS Empty	
	26				brown silty soil			5.00	26.50	SPT	12	14,18,27	45			
	28	28.00	SPT	13				21,23,30	53						UDS Empty	
30.00	30	29.50	SPT	14				23,27,31	58						-	
		Bore terminated						30.00	SPT	15	25,29,33	62				-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02,
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RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-86																	
Page : 1/2																	
METHOD OF DRILLING : Rotary																	
BORE DIA : 150 mm																	
RL OF GL : +127.0m																	
DEPTH OF BORING : 30.00m																	
WATER TABLE : @ +122.4m (4.6m)																	
LOCATION: Boundary Wall																	
CO ORDINATES : Easting : 480																	
Northing : 116																	
DATE : 09-07-2018 TO 10-07-2018																	
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N	20	40	60	80	100		
2.00	1	brown silty soil			2.00	0.00	DS	1	-	-							-
	1.00					UDS	1	-	-							-	
10.00	3	brown silty clay soil			8.00	2.00	SPT	1	2,4,7	11							-
	3.00					UDS	2	-	-							-	
	4.00					SPT	2	4,6,9	15							-	
	5.00					UDS	3	-	-							-	
	6.00					SPT	3	3,7,10	17							-	
	7.00					UDS	4	-	-							-	
	8.00					SPT	4	9,11,14	25							-	
	9.00					UDS	5	-	-							-	
	10.00					SPT	5	11,13,13	26							-	
	11					11.50	UDS	6	-	-							-
13.00	13	brown silty clay soil			2.00	13.00	SPT	6	15,18,23	41						-	
15	14.50					UDS	7	-	-							-	
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-86

Page : 2/2

METHOD OF DRILLING : Rotary

BORE DIA : 150 mm

RL OF GL : +127.0m

DEPTH OF BORING : 30.00m

WATER TABLE : @ +122.4m (4.6m)

LOCATION: Boundary Wall

CO ORDINATES : Easting : 480

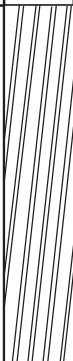
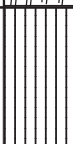
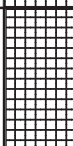
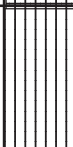
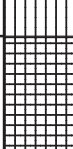
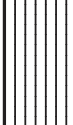
 Northing : 116

DATE : 09-07-2018 TO 10-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
	16	brown silty clay soil			5.50	16.00	SPT	7	12,19,25	44							-
	18				17.50	SPT	8	13,18,30	48							UDS Empty	
	20				19.00	SPT	9	16,22,26	48							-	
20.50					20.50	SPT	10	14,19,30	49							UDS Empty	
	22	brown silty soil			3.00	22.00	SPT	11	18,25,27	52							-
23.50					23.50	SPT	12	19,30,32	62							UDS Empty	
	24	brown silty clay soil			3.00	25.00	SPT	13	25,40,52	92							-
26.50	26				26.50	SPT	14	20,35,41	76							UDS Empty	
	28				28.00	SPT	15	21,42,46	88							-	
30.00	30	brownish silty sandy soil			3.50	29.50	SPT	16	22,43,48	91							UDS Empty
					30.00	SPT	17	27,39,50	89							-	
Bore terminated																	

Bore terminated

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RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-13																	
Page : 1/2																	
METHOD OF DRILLING : Rotary																	
BORE DIA : 150 mm																	
RL OF GL : +127.1m																	
DEPTH OF BORING : 30.00m																	
WATER TABLE : @ +122.2m (4.9m)																	
LOCATION: Construction Yard																	
CO ORDINATES : Easting : -52																	
Northing : -180																	
DATE : 30-07-2018 TO 01-08-2018																	
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
		brown silty soil			5.00	0.00	DS	1	-	-							-
	1				1.00	SPT	1	2,5,8	13							-	
					2.00	UDS	1	-	-							-	
	3				3.00	SPT	2	4,7,11	18							-	
					4.00	UDS	2	-	-							-	
5.00	5					5.00	SPT	3	3,6,12	18							-
		brownish silty sandy soil			2.00	6.00	UDS	3	-	-							-
7.00	7				7.00	SPT	4	7,10,15	25							-	
		brown silty clay soil			2.00	8.00	UDS	4	-	-							-
9.00	9				9.00	SPT	5	9,14,21	40							-	
		brownish silty sandy soil			2.50	10.00	UDS	5	-	-							-
11.50	11				11.50	SPT	6	11,21,27	48							-	
		brown silty clay soil			1.50	13.00	SPT	7	10,15,30	45							UDS Empty
13.00	13				14.50	SPT	8	13,25,31	56							-	
		brownish silty sandy soil			2.00												
15.00	15																
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RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-13

Page : 2/2

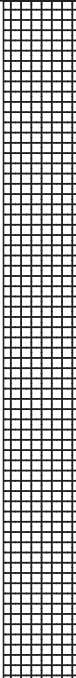
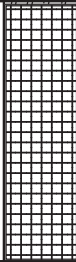
METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +127.1m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.2m (4.9m)

LOCATION: Construction Yard
CO ORDINATES : Easting : -52
 Northing : -180
DATE : 30-07-2018 TO 01-08-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
					15.00											
	16					16.00	UDS	7	-	-						-
						17.50	SPT	9	9,16,23	39						-
	18					19.00	SPT	10	13,21,29	50						UDS Empty
						20.50	SPT	11	15,28,35	63						-
	20					22.00	SPT	12	11,26,34	60						UDS Empty
						23.50	SPT	13	18,28,36	64						-
	22					25.00	SPT	14	15,19,26	45						UDS Empty
						26.50	SPT	15	12,28,38	66						-
	24					28.00	SPT	16	19,22,31	53						UDS Empty
						29.50	SPT	17	9,16,21	37						-
30.00	30					30.00	SPT	18	22,29,35	64						-

Bore terminated

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RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-20																
Page : 1/2																
METHOD OF DRILLING : Rotary																
LOCATION: CW Pump House																
BORE DIA : 150 mm																
CO ORDINATES : Easting : 48																
RL OF GL : +126.8m																
Northing : -587																
DEPTH OF BORING : 30.00m																
DATE : 10-07-2018 TO 11-07-2018																
WATER TABLE :@ +122.2m (4.6m)																
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
	1	brown silty clay soil			9.00	0.00	DS	1	-	-						-
					1.00	SPT	1	8,7,10	17						-	
					2.00	UDS	1	-	-						-	
	3				3.00	SPT	2	10,11,11	22						-	
					4.00	UDS	2	-	-						-	
	5				5.00	SPT	3	12,18,17	35						-	
					6.00	UDS	3	-	-						-	
	7				7.00	SPT	4	13,15,19	34						-	
					8.00	UDS	4	-	-						-	
9.00	9				9.00	SPT	5	18,20,19	39						-	
		brown silty soil			2.50	10.00	UDS	5	-	-						-
	11				11.50	SPT	6	17,22,18	40						-	
		brown silty clay soil			3.50	13.00	UDS	6	-	-						-
	13				14.50	SPT	7	18,24,26	50						-	
	15														-	
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-20																	
Page : 2/2																	
METHOD OF DRILLING : Rotary																	
LOCATION: CW Pump House																	
BORE DIA : 150 mm																	
CO ORDINATES : Easting : 48																	
RL OF GL : +126.8m																	
Northing : -587																	
DEPTH OF BORING : 30.00m																	
DATE : 10-07-2018 TO 11-07-2018																	
WATER TABLE :@ +122.2m (4.6m)																	
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
	16	brown silty clay soil			7.00	16.00	UDS	7	-	-							-
	18					17.50	SPT	8	13,17,19	36							-
	20					19.00	SPT	9	17,24,27	51							-
	22					20.50	UDS	8	-	-							-
22.00	22					22.00	SPT	10	19,27,30	57							-
	24	brownish fine sandy soil			8.00	23.50	UDS	8	-	-							-
	26					25.00	SPT	11	13,19,27	46							-
	28					26.50	SPT	12	19,22,35	57							UDS Empty
	30					28.00	SPT	13	22,29,35	64							-
30.00	30					29.50	SPT	14	23,31,37	68							UDS Empty
Bore terminated						30.00	SPT	15	27,32,38	70							-
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-21

Page : 1/2

METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +126.8m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.2m (4.6m)

LOCATION: CW Pump House
CO ORDINATES : Easting : 42
Northing : -544
DATE : 10-07-2018 TO 11-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N	20	40	60	80	100	
1.00	1	brownish silty sandy soil			1.00	0.00	DS	1	-	-						-
					8.00	1.00	SPT	1	7,8,11	19	6					-
						2.00	UDS	1	-	-						-
	3					3.00	SPT	2	10,11,13	24	9					-
						4.00	UDS	2	-	-						-
	5					5.00	SPT	3	9,10,19	29	10					-
						6.00	UDS	3	-	-						-
	7					7.00	SPT	4	18,22,24	46	11					-
						8.00	UDS	4	-	-						-
9.00	9					9.00	SPT	5	13,19,20	39	12					-
					2.50	10.00	UDS	5	-	-						-
11.50	11					11.50	SPT	6	16,20,18	38	13					-
					3.50	13.00	UDS	6	-	-						-
	13					14.50	SPT	7	15,13,14	27	14					-
	15															

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E mail : nagpur_atc@yahoo.in

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-21

Page : 2/2

METHOD OF DRILLING : Rotary

BORE DIA : 150 mm

RL OF GL : +126.8m

DEPTH OF BORING : 30.00m

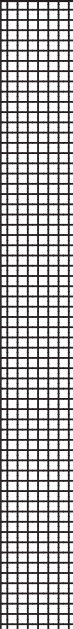
WATER TABLE : @ +122.2m (4.6m)

LOCATION: CW Pump House

CO ORDINATES : Easting : 42

 Northing : -544

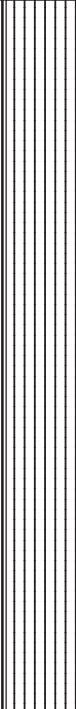
DATE : 10-07-2018 TO 11-07-2018

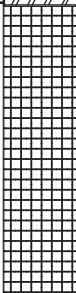
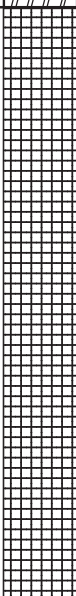
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
	16	brown silty clay soil			7.50	16.00	UDS	7	-	-						-
	18					17.50	SPT	8	21,21,24	45						-
	20					19.00	UDS	8	-	-						-
	22					20.50	SPT	9	21,28,29	57						-
	23.50					22.00	UDS	9	-	-						-
						23.50	SPT	10	14,30,32	62						-
	24	brownish fine sandy soil			6.50	25.00	SPT	11	27,27,30	57						UDS Empty
	26					26.50	SPT	12	15,20,30	50						-
	28					28.00	SPT	13	22,29,35	64						UDS Empty
	30.00					29.50	SPT	14	28,32,44	75						-
	30					30.00	SPT	15	25,30,41	71						-

Bore terminated

**ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02,
E mail : nagpur_atc@yahoo.in**

RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-23																
Page : 1/3																
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL OF GL : +127.0m DEPTH OF BORING : 30.00m WATER TABLE : @ +122.2m (4.8m)								LOCATION: CW Pump House CO ORDINATES : Easting : 41 Northing : -453 DATE : 01-07-2018 TO 01-07-2018								
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
					15.00	0.00	DS	1	-	-						-
	1					1.00	SPT	1	4,6,9	16						-
						2.00	UDS	1	-	-						-
	3					3.00	SPT	2	7,7,9	16						-
						4.00	UDS	2	-	-						-
	5					5.00	SPT	3	8,8,13	21						-
		brown silty soil				6.00	UDS	3	-	-						-
	7					7.00	SPT	4	8,10,13	23						-
						8.00	UDS	4	-	-						-
	9					9.00	SPT	5	9,11,14	25						-
						10.00	UDS	5	-	-						-
	11					11.50	SPT	6	10,11,14	25						-
						13.00	SPT	7	9,9,17	26						-
	13															
						14.50	SPT	8	9,9,20	29						-
	15															
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

RECORD OF BORING																			
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																			
Bh-23																			
Page : 2/3																			
METHOD OF DRILLING : Rotary																			
LOCATION: CW Pump House																			
BORE DIA : 150 mm																			
CO ORDINATES : Easting : 41																			
RL OF GL : +127.0m																			
Northing : -453																			
DEPTH OF BORING : 30.00m																			
DATE : 01-07-2018 TO 01-07-2018																			
WATER TABLE : @ +122.2m (4.8m)																			
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS			
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N									
	16	brown silty soil			5.50	16.00	SPT	9	9,13,18	31							-		
	18				17.50	SPT	10	9,10,19	29									-	
	20				19.00	SPT	11	12,17,28	45										-
20.50					20.50	SPT	12	15,20,32	52										-
	22	brownish silty sandy soil			10.50	22.00	SPT	13	17,22,30	52							-		
	24				23.50	SPT	14	14,16,25	41									-	
	26				25.00	SPT	15	11,10,20	31										-
	28				26.50	SPT	16	15,20,30	50										-
	30				28.00	SPT	17	18,20,40	60										-
30.00					29.50	SPT	18	20,29,42	71										-
					30.00	SPT	19	16,25,40	65										-
Bore terminated																			
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																			

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-56																	
Page : 1/2																	
METHOD OF DRILLING : Rotary																	
LOCATION: DM Plant Area																	
BORE DIA : 150 mm																	
CO ORDINATES : Easting : 355																	
RL OF GL : +125.9m																	
Northing : -519																	
DEPTH OF BORING : 30.00m																	
DATE : 30-06-2018 TO 30-06-2018																	
WATER TABLE :@ +122.3m (3.6m)																	
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
1.00	1	brown silty soil			1.00	0.00	DS	1	-	-							-
					4.00	1.00	SPT	1	4,6,8	14							-
	3	brown silty clay soil				2.00	UDS	1	-	-							-
						3.00	SPT	2	6,9,10	19							-
						4.00	UDS	2	-	-							-
5.00	5					5.00	SPT	3	7,10,13	29							-
		brown silty soil			2.00	6.00	UDS	3	-	-							-
7.00	7					7.00	SPT	4	9,11,15	26							-
	9	brown silty clay soil			8.00	8.00	UDS	4	-	-							-
						9.00	SPT	5	8,12,14	26							-
	11					10.00	UDS	5	-	-							-
						11.50	SPT	6	9,12,20	32							-
	13					13.00	UDS	6	-	-							-
						14.50	SPT	7	13,17,25	42							-
15.00	15																
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING																		
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																		
Bh-56																		
Page : 2/2																		
METHOD OF DRILLING : Rotary																		
LOCATION: DM Plant Area																		
BORE DIA : 150 mm																		
CO ORDINATES : Easting : 355																		
RL OF GL : +125.9m																		
Northing : -519																		
DEPTH OF BORING : 30.00m																		
DATE : 30-06-2018 TO 30-06-2018																		
WATER TABLE :@ +122.3m (3.6m)																		
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS		
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N								
					15.00													
	16	brownish silty sandy soil				16.00	SPT	7	14,19,29	43							UDS Empty	
	18					17.50	SPT	8	17,20,31	51								-
						19.00	SPT	9	15,22,34	56								UDS Empty
	20					20.50	SPT	10	14,18,37	55								-
	22					22.00	SPT	11	18,21,38	59								UDS Empty
						23.50	SPT	12	23,29,41	70								-
	24					25.00	SPT	13	25,30,43	73								UDS Empty
	26					26.50	SPT	14	23,31,44	75								-
						28.00	SPT	15	40,55(2cm)	>100								UDS Empty
	28																	
30.00	30			29.50	SPT	16	45,55(2cm)	>100								-		
Bore terminated																		
30.00 SPT 17 47,56(2cm) >100 -																		
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																		

RECORD OF BORING

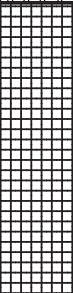
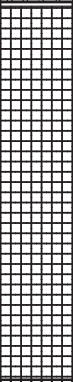
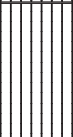
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-57

Page : 1/2

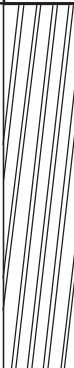
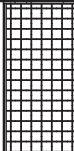
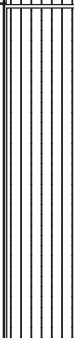
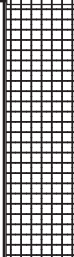
METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +126.1m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.3m (3.8m)

LOCATION: DM Plant Area
CO ORDINATES : Easting : 396
Northing : -534
DATE : 01-07-2018 TO 02-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
2.00	1	brown silty soil			2.00	0.00	DS	1	-	-						-
						1.00	UDS	1	-	-						-
						2.00	SPT	1	4,6,8	14						-
6.00	3	brown silty clay soil			4.00	3.00	UDS	2	-	-						-
						4.00	SPT	2	6,8,11	19						-
	5					5.00	UDS	3	-	-						-
						6.00	SPT	3	5,7,12	19						-
						7.00	UDS	4	-	-						-
8.00	7	brown silty soil			2.00	8.00	SPT	4	8,11,15	26						-
						9.00	SPT	5	6,9,11	20						UDS Empty
	9	brown silty clay soil			5.00	10.00	SPT	6	7,9,17	26						-
13.00	11					11.50	SPT	7	8,11,21	32						UDS Empty
						13.00	SPT	8	9,15,27	42						-
	13					14.50	SPT	9	11,18,30	48						UDS Empty
	15	brownish silty sandy soil			2.00											

**ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02,
E mail : nagpur_atc@yahoo.in**

RECORD OF BORING																		
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																		
Bh-57																		
Page : 2/2																		
METHOD OF DRILLING : Rotary																		
BORE DIA : 150 mm																		
RL OF GL : +126.1m																		
DEPTH OF BORING : 30.00m																		
WATER TABLE :@ +122.3m (3.8m)																		
LOCATION: DM Plant Area																		
CO ORDINATES : Easting : 396																		
Northing : -534																		
DATE : 01-07-2018 TO 02-07-2018																		
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS		
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N								
					13.00													
	16	brownish silty sandy soil				16.00	SPT	10	13,17,33	50						-		
								17.50	SPT	11	12,21,38	59						UDS Empty
	18							19.00	SPT	12	15,28,38	66						-
								20.50	SPT	13	13,19,31	50						UDS Empty
	20							22.00	SPT	14	15,22,40	62						-
								23.50	SPT	15	28,50	78						UDS Empty
	22							25.00	SPT	16	30,52	82						-
								26.50	SPT	17	35,55	90						UDS Empty
27.00																		
	28	brownish fine sandy soil			3.00													
						28.00	SPT	18	40,53	93								-
	30					29.50	SPT	19	43,56	99								UDS Empty
30.00																		
Bore terminated																		
30.00 SPT 20 45,58(6cm) >100 -																		
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02,																		
E mail : nagpur_atc@yahoo.in																		

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-58																	
Page : 1/3																	
METHOD OF DRILLING : Rotary																	
BORE DIA : 150 mm																	
RL : 126.2m																	
DEPTH OF BORING : 40.00m																	
WATER TABLE :@ 122.3m (3.9m)																	
LOCATION: ETP Area																	
CO ORDINATES : Easting : 480																	
Northing : -523																	
DATE : 29-06-2018 TO 29-06-2018																	
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
	1	brown silty soil			5.00	0.00	DS	1	-	-							-
					1.00	SPT	1	9,13,17	30								-
					2.00	UDS	1	-	-								-
	3				3.00	SPT	2	12,16,20	36								-
					4.00	UDS	2	-	-								-
5.00	5	brown silty clay soil			2.00	5.00	SPT	3	14,21,26	47							-
					6.00	UDS	3	-	-								-
7.00	7				7.00	SPT	4	12,13,21	34								-
		brownish silty sandy soil			4.50	8.00	UDS	4	-	-							-
	9				9.00	SPT	5	9,10,20	30								-
					10.00	SPT	6	14,19,22	41								UDS Empty
	11				11.50	SPT	7	16,20,29	49								-
11.50		brown silty clay soil			3.50	13.00	SPT	8	13,21,26	47							UDS Empty
	13				14.50	SPT	9	15,23,28	51								-
	15																
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-58

Page : 2/3

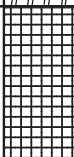
METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL : 126.2m
DEPTH OF BORING : 40.00m
WATER TABLE : @ 122.3m (3.9m)

LOCATION: ETP Area
CO ORDINATES : Easting : 480
Northing : -523
DATE : 29-06-2018 TO 29-06-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS				
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N										
		brown silty clay soil			5.50															
	16					16.00	SPT	10	17,24,29	53										UDS Empty
	18					17.50	SPT	11	15,25,28	53										-
	20					19.00	SPT	12	14,20,29	49										UDS Empty
20.50						20.50	SPT	13	18,23,30	53								-		
		brown silty soil			1.50															
22.00	22					22.00	SPT	14	20,25,31	56										UDS Empty
		brownish silty sandy soil			6.50															
	24					23.50	SPT	15	21,28,39	67										-
	26					25.00	SPT	16	22,29,36	65										UDS Empty
	28					26.50	SPT	17	29,31,38	69										-
28.50						28.00	SPT	18	28,32,39	71										UDS Empty
		brown silty soil			1.50															
30.00	30					29.50	SPT	19	17,18,24	42										-
		Bore terminated				30.00	SPT	20	17,18,22	40								-		

Bore terminated

**ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02,
E mail : nagpur_atc@yahoo.in**

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-34																	
Page : 1/3																	
METHOD OF DRILLING : Rotary																	
BORE DIA : 150 mm																	
RL OF GL : +126.6m																	
DEPTH OF BORING : 40.00m																	
WATER TABLE :@ +122.3m (4.3m)																	
LOCATION: Fire Water Boster																	
CO ORDINATES : Easting : 241																	
Northing : -302																	
DATE : 15-06-2018 TO 16-06-2018																	
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
1.00	1	filling material			1.00	0.00	DS	1	-	-						-	
		brown silty soil			4.00	1.00	SPT	1	4,7,11	18						-	
	3				2.00	UDS	1	-	-							-	
					3.00	SPT	2	5,8,10	18							-	
					4.00	UDS	2	-	-							-	
5.00	5	brown silty clay soil			2.00	5.00	SPT	3	7,11,12	23						-	
						6.00	UDS	3	-	-							-
7.00	7	brown silty soil			8.00	7.00	SPT	4	12,14,16	30						-	
	9					8.00	UDS	4	-	-							-
						9.00	SPT	5	7,13,15	28							-
	11					10.00	UDS	6	-	-							-
						11.50	SPT	7	8,12,17	29							-
	13					13.00	SPT	8	13,16,19	35							-
						14.50	SPT	9	13,18,30	48							-
	15																
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-34

Page : 2/3

Bh-34

Page : 2/3

METHOD OF DRILLING : Rotary

METHOD OF DRILLING: Rotary
BORE DIA : 150 mm

RL OF GL : +126.6m

DEPTH OF BORING : 40.00m

METHOD OF DRILLING : Rotary

METHOD OF DRILLING: Rotary
BORE DIA : 150 mm

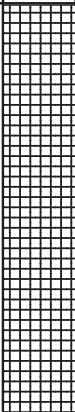
RL OF GL : +126.6m

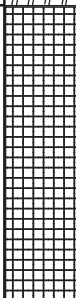
DEPTH OF BORING : 40.00m

WATER TABLE : @ +122.3m (4.3m)

[illegible]

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02,
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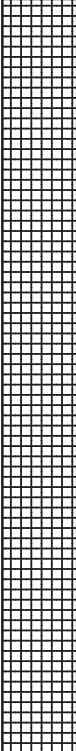
RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-34																
Page : 3/3																
METHOD OF DRILLING : Rotary																
BORE DIA : 150 mm																
RL OF GL : +126.6m																
DEPTH OF BORING : 40.00m																
WATER TABLE :@ +122.3m (4.3m)																
LOCATION: Fire Water Boster																
CO ORDINATES : Easting : 241																
Northing : -302																
DATE : 15-06-2018 TO 16-06-2018																
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
	31	brown silty clay soil			5.50	31.00	SPT	20	23,38,42	80						-
	33				32.50	SPT	21	27,39,45	84						-	
	35				34.00	SPT	22	21,29,39	68						-	
35.50					35.50	SPT	23	30,36,43	79						-	
	37	brown silty soil			4.50	37.00	SPT	24	39,44,55 (14cm)	>100						-
	39				38.50	SPT	25	42,52(4cm)	>100						-	
40.00					40.00	SPT	26	55(11cm)	>100						-	
	41	Bore terminated														
	43															
	45															
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

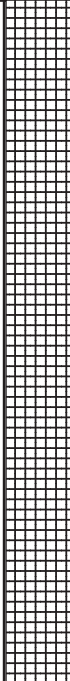
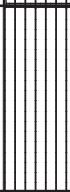
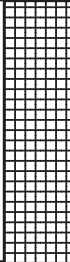
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NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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CO ORDINATES : Easting : 241																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
3.00	1	brown silty soil			3.00	0.00	DS	1	-	-							-																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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7.00	3	brown silty clay soil			3.00	SPT	2	6,8,11	19								-																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
	4.00				UDS	2	-	-								-																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
	5.00				SPT	3	9,13,18	31								-																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
15	5	brownish silty sandy soil			6.00	UDS	3	-	-								-																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
	7.00				SPT	4	6,10,16	26								-																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										
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	9	9.00	SPT	5	6,9,12	21								-																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
	11	10.00	UDS	5	-	-								-																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
	13	11.50	SPT	6	8,16,23	39								-																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
	14.50	UDS	6	-	-									-																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
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RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-33 Page : 2/3																
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL OF GL : +126.7m DEPTH OF BORING : 30.00m WATER TABLE :@ +122.4m (4.3m)					LOCATION: HFO LDO DYKAArea CO ORDINATES : Easting : 241 Northing : -198 DATE : 21-07-2018 TO 21-07-2018											
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
					15.00											
	16	brownish silty sandy soil				16.00	UDS	7	-	-						-
	18					17.50	SPT	8	16,23,32	55						-
						19.00	UDS	8	-	-						-
	20					20.50	SPT	9	13,19,27	46						-
	22					22.00	SPT	10	15,25,38	63						-
	24					23.50	SPT	11	13,21,33	54						-
	26					25.00	SPT	12	14,21,31	52						-
						26.50	SPT	13	17,22,36	58						-
	28					28.00	SPT	14	18,24,39	63						-
						29.50	SPT	15	16,22,36	58						-
30.00	30				30.00	SPT	16	15,20,35	55						-	
Bore terminated ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-71																	
Page : 1/3																	
METHOD OF DRILLING : Rotary																	
BORE DIA : 150 mm																	
RL OF GL : +127.4m																	
DEPTH OF BORING : 40.00m																	
WATER TABLE :@ +122.4m (5.0m)																	
LOCATION: HFO LDO DYKA Area																	
CO ORDINATES : Easting : 276																	
Northing : -226																	
DATE : 27-07-2018 TO 28-07-2018																	
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
					15.00	0.00	DS	1	-	-							-
	1					1.00	SPT	1	3,4,6	10							-
						2.00	UDS	1	-	-							-
	3					3.00	SPT	2	4,6,8	14							-
						4.00	UDS	2	-	-							-
	5					5.00	SPT	3	6,9,11	20							-
						6.00	UDS	3	-	-							-
	7					7.00	SPT	4	6,9,13	22							-
						8.00	UDS	4	-	-							-
	9					9.00	SPT	5	4,6,10	16							-
						10.00	UDS	5	-	-							-
	11					11.50	SPT	6	6,10,16	26							-
						13.00	UDS	6	-	-							-
	13																
						14.50	SPT	7	8,13,19	32							-
	15																
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING																		
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																		
Bh-71 Page : 2/3																		
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL OF GL : +127.4m DEPTH OF BORING : 40.00m WATER TABLE :@ +122.4m (5.0m)					LOCATION: HFO LDO DYKAArea CO ORDINATES : Easting : 276 Northing : -226 DATE : 27-07-2018 TO 28-07-2018													
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS		
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N								
					15.00													
	16	brown silty clay soil				16.00	UDS	7	-	-						-		
	18					17.50	SPT	8	7,9,13	22								-
	20					19.00	SPT	9	7,9,13	22								UDS Empty
	22					20.50	SPT	10	10,15,21	36								-
	24					22.00	SPT	11	13,16,23	39								UDS Empty
	26					23.50	SPT	12	15,21,27	48								-
	28					25.00	SPT	13	19,16,27	43								UDS Empty
	30					26.50	SPT	14	6,10,14	24								-
						28.00	SPT	15	11,16,23	39								UDS Empty
						29.50	SPT	16	18,22,32	54								-
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																		

RECORD OF BORING																			
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																			
Bh-71																			
Page : 3/3																			
METHOD OF DRILLING : Rotary																			
BORE DIA : 150 mm																			
RL OF GL : +127.4m																			
DEPTH OF BORING : 40.00m																			
WATER TABLE :@ +122.4m (5.0m)																			
LOCATION: HFO LDO DYKAArea																			
CO ORDINATES : Easting : 276																			
Northing : -226																			
DATE : 27-07-2018 TO 28-07-2018																			
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS			
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N									
	31	brown silty clay soil			10.00														
					31.00	SPT	17	14,21,31	52										UDS Empty
	33				32.50	SPT	18	16,23,35	58										-
					34.00	SPT	19	13,20,36	56										UDS Empty
	35				35.50	SPT	20	17,21,39	60										-
					37.00	SPT	21	19,27,42	69										UDS Empty
	39				38.50	SPT	22	18,28,39	67								-		
40.00																			
	41	Bore terminated				40.00	SPT	23	19,27,43	70								-	
	43																		
	45																		
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																			

RECORD OF BORING																			
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																			
Bh-12																			
Page : 1/3																			
METHOD OF DRILLING : Rotary																			
BORE DIA : 150 mm																			
RL OF GL : +127.4m																			
DEPTH OF BORING : 40.00m																			
WATER TABLE : @ +122.1m (5.3m)																			
LOCATION: HFO LDO Pump House																			
CO ORDINATES : Easting : -6																			
Northing : 39																			
DATE : 30-07-2018 TO 01-08-2018																			
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS			
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N	20	40	60	80	100				
	1	brown silty clay soil			9.00	0.00	DS	1	-	-							-		
					1.00	SPT	1	2,5,9	14							-			
					2.00	UDS	1	-	-							-			
	3				3.00	SPT	2	5,7,11	18							-			
					4.00	UDS	2	-	-							-			
	5				5.00	SPT	3	5,7,13	20							-			
					6.00	UDS	3	-	-							-			
	7				7.00	SPT	4	9,13,17	30							-			
					8.00	UDS	4	-	-							-			
9.00	9				9.00	SPT	5	12,14,18	32							-			
	11	brownish silty sandy soil			2.50	10.00	UDS	5	-	-							-		
					11.50	SPT	6	17,19,19	38							-			
	13	brown silty clay soil			3.50	13.00	UDS	6	-	-							-		
					14.50	SPT	7	13,19,20	39							-			
	15																		
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																			

RECORD OF BORING

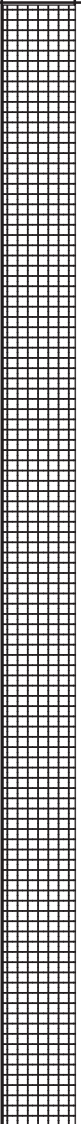
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-12

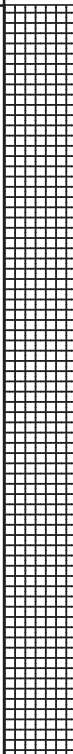
Page : 2/3

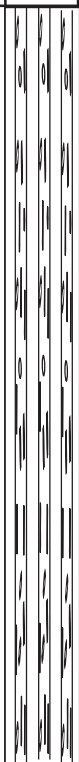
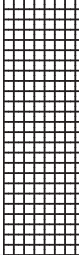
METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +127.4m
DEPTH OF BORING : 40.00m
WATER TABLE : @ +122.1m (5.3m)

LOCATION: HFO LDO Pump House
CO ORDINATES : Easting : -6
Northing : 39
DATE : 30-07-2018 TO 01-08-2018

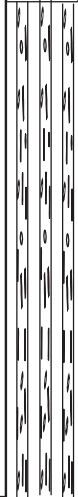
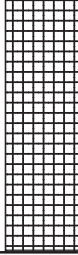
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N	20	40	60	80	100	
	16	brown silty clay soil			15.00											
						16.00	UDS	7	-	-						-
	18					17.50	SPT	8	22,24,29	53						-
						19.00	UDS	8	-	-						-
	20					20.50	SPT	9	13,25,27	52						-
	22					22.00	UDS	9	-	-						-
						23.50	SPT	10	27,29,32	61						-
	24					25.00	SPT	11	30,37,39	76						UDS Empty
	26					26.50	SPT	12	32,33,35	68						-
	28					28.00	SPT	13	29,35,37	72						UDS Empty
	30					29.50	SPT	14	31,37,40	77						-

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E mail : nagpur_atc@yahoo.in

RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-12 Page : 3/3																
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL OF GL : +127.4m DEPTH OF BORING : 40.00m WATER TABLE : @ +122.1m (5.3m)					LOCATION: HFO LDO Pump House CO ORDINATES : Easting : -6 Northing : 39 DATE : 30-07-2018 TO 01-08-2018											
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
	31	brown silty clay soil			10.00	31.00	SPT	15	28,35,40	75						UDS Empty
	33				32.50	SPT	16	35,37,40	77						-	
	35				34.00	SPT	17	33,37,42	79						UDS Empty	
	37				35.50	SPT	18	39,40,43	83						-	
	39				37.00	SPT	19	34,44,44	88						UDS Empty	
40.00					38.50	SPT	20	41,43,45	88						-	
	41	Bore terminated			40.00	SPT	21	38,47,48	95						-	
	43															
	45															
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-84																
Page : 1/2																
METHOD OF DRILLING : Rotary																
BORE DIA : 150 mm																
RL OF GL : +126.1m																
DEPTH OF BORING : 30.00m																
WATER TABLE :@ +122.1m (4.0m)																
LOCATION: LHP Storage Shed																
CO ORDINATES : Easting : 480																
Northing : -446																
DATE : 27-06-2018 TO 28-06-2018																
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
1.50	1	filling material			1.50	0.00	DS	1	-	-						-
					1.00	UDS	1	-	-						-	
9.00	3	brownish fine sandy soil			2.00	SPT	1	10,13,19	32						-	
	3.00				UDS	2	-	-						-		
	4.00				SPT	2	14,16,21	37						-		
	5.00				UDS	3	-	-						-		
	6.00				SPT	3	8,10,15	25						-		
	7.00				UDS	4	-	-						-		
	8.00				SPT	4	9,17,25	42						-		
	9.00				UDS	5	-	-						-		
	10.00				SPT	5	8,19,27	46						-		
	11.50				SPT	6	8,16,30	46						UDS Empty		
	3.50				13	brown silty clay soil		13.00	SPT	7	10,17,33	50				
14.50		SPT	8	19,23,28	51								UDS Empty			
15.00	15															
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RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-84																
Page : 2/2																
METHOD OF DRILLING : Rotary																
BORE DIA : 150 mm																
RL OF GL : +126.1m																
DEPTH OF BORING : 30.00m																
WATER TABLE :@ +122.1m (4.0m)																
LOCATION: LHP Storage Shed																
CO ORDINATES : Easting : 480																
Northing : -446																
DATE : 27-06-2018 TO 28-06-2018																
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
	16	brown silty soil			5.50	16.00	SPT	9	15,25,32	57						-
	18				17.50	SPT	10	11,23,26	49							UDS Empty
	20				19.00	SPT	11	19,18,22	40							-
20.50					20.50	SPT	12	15,24,28	52							UDS Empty
	22	brownish silty sandy soil			6.50	22.00	SPT	13	16,21,27	48						-
	24				23.50	SPT	14	14,22,28	50							UDS Empty
	26				25.00	SPT	15	16,25,29	54							-
27.00					26.50	SPT	16	15,23,28	48							UDS Empty
	28	brownish fine sandy soil			3.00	28.00	SPT	17	22,31,34	65						-
	30				29.50	SPT	18	30,32,36	68							UDS Empty
30.00					30.00	SPT	19	17,20,40	60							-
Bore terminated																
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RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-60																
Page : 1/2																
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL OF GL : +126.0m DEPTH OF BORING : 30.00m WATER TABLE : @ +122.1m (3.9m)										LOCATION: Plant Gate CO ORDINATES : Easting : 599 Northing : -451 DATE : 27-06-2018 TO 28-06-2018						
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
	1	brown silty soil			5.00	0.00	DS	1	-	-						-
					1.00	SPT	1	3,6,10	16						-	
					2.00	UDS	1	-	-						-	
	3				3.00	SPT	2	4,7,11	18						-	
					4.00	UDS	2	-	-						-	
5.00	5	brownish fine sandy soil			5.00	SPT	3	8,10,16	26							-
	6.00				UDS	3	-	-						-		
7	7.00				SPT	4	11,17,21	38						-		
	8.00				SPT	5	-	-						-		
9	9.00				SPT	6	13,18,24	42						-		
	10.00				SPT	7	-	-						-		
11	11.50				SPT	8	11,16,23	39						-		
	13	brown silty clay soil			3.50	13.00	SPT	9	9,11,16	37						UDS Empty
	14.50				SPT	10	13,17,21	38						-		
15																
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RECORD OF BORING

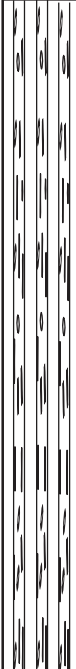
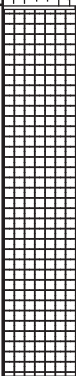
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-60

Page : 2/2

METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +126.0m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.1m (3.9m)

LOCATION: Plant Gate
CO ORDINATES : Easting : 599
Northing : -451
DATE : 27-06-2018 TO 28-06-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
16.00	16	brown silty clay soil			1.00											
						16.00	SPT	11	35,50(5cm)	>100						UDS Empty
	18	brownish fine sandy soil			14.00											
						17.50	SPT	12	37,52(10cm)	>100						-
						19.00	SPT	13	34,50(6cm)	>100						UDS Empty
	20															
						20.50	SPT	14	39,52(3cm)	>100						-
	22															
						22.00	SPT	15	42,52(5cm)	>100						UDS Empty
	24															
						23.50	SPT	16	39,50(1cm)	>100						-
25.00						25.00	SPT	17	21,30,42	72						UDS Empty
	26				5.00											
		brown silty clay soil				26.50	SPT	18	26,35,39	74						-
	28															
						28.00	SPT	19	20,31,38	69						UDS Empty
30.00	30					29.50	SPT	20	19,26,35	61						-
		Bore terminated				30.00	SPT	21	19,25,34	59						-

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RECORD OF BORING																		
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																		
Bh-16																		
Page : 1/2																		
METHOD OF DRILLING : Rotary																		
BORE DIA : 150 mm																		
RL : 126.6m																		
DEPTH OF BORING : 30.00m																		
WATER TABLE :@ 122.4m (4.2m)																		
LOCATION: PT Plant																		
CO ORDINATES : Easting : -69																		
Northing : -429																		
DATE : 02-07-2018 TO 02-07-2018																		
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS		
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N								
					5.00	0.00	DS	1	-	-						-		
	1	brown silty clay soil				1.00	SPT	1	7,10,14	24						-		
						2.00	UDS	1	-	-							-	
	3					3.00	SPT	2	6,10,13	23							-	
						4.00	UDS	2	-	-							-	
	5					5.00	SPT	3	11,16,21	37							-	
		brownish silty sandy soil			10.00	6.00	UDS	3	-	-						-		
	7					7.00	SPT	4	9,16,23	39							-	
						8.00	SPT	5	16,21,30	51							UDS Empty	
	9					9.00	SPT	6	18,24,34	58							-	
						10.00	SPT	7	21,30,45	75							UDS Empty	
	11					11.50	SPT	8	19,28,43	71							-	
						13.00	SPT	9	23,37,48	75							UDS Empty	
	13					14.50	SPT	10	23,37,48	85							-	
	15																	
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RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-16

Page : 2/2

METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL : 126.6m
DEPTH OF BORING : 30.00m
WATER TABLE : @ 122.4m (4.2m)

LOCATION: PT Plant
CO ORDINATES : Easting : -69
Northing : -429
DATE : 02-07-2018 TO 02-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
	16	brownish silty sandy soil			15.00											
						16.00	SPT	11	12,18,24	42						UDS Empty
	18					17.50	SPT	12	14,21,29	50						-
						19.00	SPT	13	14,21,36	57						UDS Empty
	20					20.50	SPT	14	16,24,38	62						-
						22.00	SPT	15	18,25,39	64						UD S Empty
	22					23.50	SPT	16	20,29,40	69						-
						25.00	SPT	17	23,38,47	85						UDS Empty
	26					26.50	SPT	18	29,36,49	85						-
						28.00	SPT	19	30,37,49	86						UDS Empty
	28					29.50	SPT	20	29,37,49	86						-
30.00	30					30.00	SPT	21	27,38,48	86						-

Bore terminated

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RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-17 Page : 1/3

Bh-17

Page : 1/3

METHOD OF DRILLING: Rotary LOCATION: PT Plant

BORE DIA : 150 mm

RL : 126.8m Northing : -476

DEPTH OF BORING : 40.00m

WATER TABLE :@ 122.4m (4.4m)

METHOD OF DRILLING: Rotary LOCATION: PT Plant

BORE DIA : 150 mm

RL : 126.8m Northing : -476

DEPTH OF BORING : 40.00m DATE : 17-07-2018 TO 17-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N	20	40	60	80	100	
					15.00	0.00	DS	1	-	-						-
	1					1.00	SPT	1	4,7,10	17	9					-
						2.00	UDS	1	-	-						-
	3					3.00	SPT	2	7,11,18	29	10					-
						4.00	UDS	2	-	-						-
	5					5.00	SPT	3	11,17,20	37	11					-
						6.00	UDS	3	-	-						-
	7					7.00	SPT	4	8,10,15	25	12					-
						8.00	UDS	4	-	-						-
	9					9.00	SPT	5	10,10,16	26	13					-
						10.00	UDS	5	-	-						-
	11					11.50	SPT	6	10,13,18	31	14					-
						13.00	SPT	7	7,9,15	24	15					UDS Empty
	15					14.50	SPT	8	9,11,18	29	16					-

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RECORD OF BORING

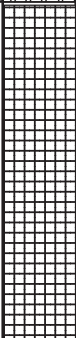
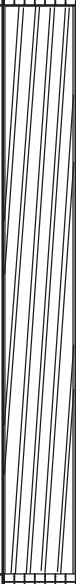
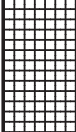
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-17

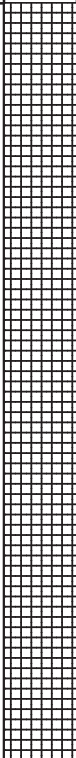
Page : 2/3

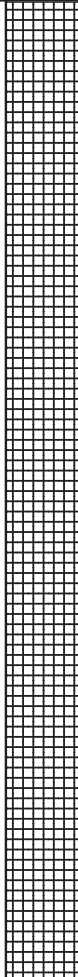
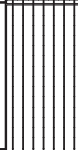
METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL : 126.8m
DEPTH OF BORING : 40.00m
WATER TABLE : @ 122.4m (4.4m)

LOCATION: PT Plant
CO ORDINATES : Easting : -69
Northing : -476
DATE : 17-07-2018 TO 17-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
16.00	16	brown silty soil			1.00	16.00	SPT	9	10,10,19	29	0	0	0	0	0	UDS Empty
	18	brown silty clay soil			4.50	17.50	SPT	10	13,18,22	40	0	0	0	0	0	-
	20					19.00	SPT	12	17,21,32	53	0	0	0	0	0	UDS Empty
20.50	20.50					20.50	SPT	13	11,17,21	38	0	0	0	0	0	-
	22	brown silty soil			7.50	22.00	SPT	14	14,19,25	44	0	0	0	0	0	UDS Empty
	24					23.50	SPT	15	19,22,38	60	0	0	0	0	0	-
	26					25.00	SPT	16	18,26,36	62	0	0	0	0	0	UDS Empty
	28					26.50	SPT	17	20,32,48	80	0	0	0	0	0	-
28.00	28					28.00	SPT	18	10,15,27	42	0	0	0	0	0	UDS Empty
	30	brown silty clay soil			2.00	29.50	SPT	19	10,13,25	38	0	0	0	0	0	-

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RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-17 Page : 3/3																
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL : 126.8m DEPTH OF BORING : 40.00m WATER TABLE :@ 122.4m (4.4m)					LOCATION: PT Plant CO ORDINATES : Easting : -69 Northing : -476 DATE : 17-07-2018 TO 17-07-2018											
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
	31	brown silty clay soil			10.00	31.00	SPT	20	13,22,33	55						UDS Empty
	33				32.50	SPT	21	16,26,38	64							-
	35				34.00	SPT	22	11,17,28	45							UDS Empty
	37				35.50	SPT	23	11,19,31	50							-
	39				37.00	SPT	24	17,23,39	62							UDS Empty
40.00					38.50	SPT	25	14,17,37	54							-
	41	Bore terminated				40.00	SPT	26	16,23,42	65						-
	43															
	45															
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RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-18																
Page : 1/2																
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL : 126.8m DEPTH OF BORING : 30.00m WATER TABLE : @ 122.4m (4.4m)										LOCATION: PT Plant CO ORDINATES : Easting : -28 Northing : -525 DATE : 03-07-2018 TO 04-07-2018						
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
	1	brown silty clay soil			13.00	0.00	DS	1	-	-						-
					1.00	UDS	1	-	-						-	
					2.00	SPT	1	4,6,8	14						-	
	3				3.00	UDS	2	-	-						-	
					4.00	SPT	2	5,7,9	16						-	
	5				5.00	UDS	3	-	-						-	
					6.00	SPT	3	5,8,13	21						-	
	7				7.00	UDS	4	-	-						-	
					8.00	SPT	4	9,12,22	34						-	
	9				9.00	UDS	5	-	-						-	
					10.00	SPT	5	11,15,25	40						-	
	11				11.50	UDS	6	-	-						-	
	13.00	13	brownish silty sandy soil			2.00	13.00	SPT	6	15,17,28	45					-
		14.50				SPT	7	14,19,31	50					UDS Empty		
15																
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

RECORD OF BORING

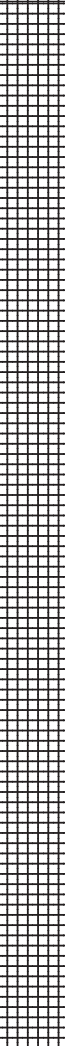
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-18

Page : 2/2

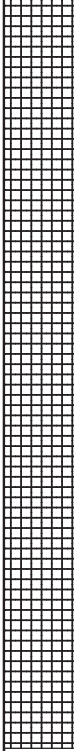
METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL : 126.8m
DEPTH OF BORING : 30.00m
WATER TABLE : @ 122.4m (4.4m)

LOCATION: PT Plant
CO ORDINATES : Easting : -28
Northing : -525
DATE : 03-07-2018 TO 04-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
16.00	16	brownish silty sandy soil			1.00	16.00	SPT	8	17,21,34	55						-
	18	brown silty clay soil			14.00	17.50	SPT	9	16,23,30	53						UDS Empty
	20					19.00	SPT	10	14,21,29	50						-
	22					20.50	SPT	11	15,22,34	56						UDS Empty
	24					22.00	SPT	12	16,24,35	59						-
	26					23.50	SPT	13	17,25,37	62						UDS Empty
	28					25.00	SPT	14	18,28,38	66						-
						26.50	SPT	15	18,25,45	70						UDS Empty
						28.00	SPT	16	21,38,52	90						-
30.00	30					29.50	SPT	17	29,40,53	93						UDS Empty
						30.00	SPT	18	55(5cm)	>100						-

Bore terminated

**ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02,
E mail : nagpur_atc@yahoo.in**

RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-24																
Page : 1/2																
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL : 126.6m DEPTH OF BORING : 30.00m WATER TABLE :@ 122.4m (4.2m)										LOCATION: PT Plant CO ORDINATES : Easting : -2 Northing : -448 DATE : 01-07-2018 TO 01-07-2018						
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
	1	brown silty clay soil			10.00	0.00	DS	1	-	-						-
					1.00	SPT	1	4,6,10	16						-	
					2.00	UDS	1	-	-						-	
	3				3.00	SPT	2	6,8,12	20						-	
					4.00	UDS	2	-	-						-	
	5				5.00	SPT	3	9,14,18	32						-	
					6.00	UDS	3	-	-						-	
	7				7.00	SPT	4	13,17,21	38						-	
					8.00	UDS	4	-	-						-	
	9				9.00	SPT	5	16,23,32	55						-	
10.00					10.00	SPT	6	16,24,34	58						UDS Empty	
	11	brownish silty sandy soil			5.00											
					11.50	SPT	7	18,23,35	58						-	
	13				13.00	SPT	8	19,28,39	67						UDS Empty	
					14.50	SPT	9	21,29,42	71						-	
	15															
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RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-24

Page : 2/2

METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL : 126.6m
DEPTH OF BORING : 30.00m
WATER TABLE : @ 122.4m (4.2m)

LOCATION: PT Plant
CO ORDINATES : Easting : -2
Northing : -448
DATE : 01-07-2018 TO 01-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS		
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N								
	16	brownish silty sandy soil			2.50	16.00	SPT	10	23,30,42	72						UDS Empty		
17.50																		
	18			brown silty clay soil			12.50	17.50	SPT	11	20,27,36	63						-
										19.00	SPT	12	21,26,38	64				
20								20.50	SPT	13	19,27,36	63						-
								22.00	SPT	14	21,28,40	68						UD S Empty
22								23.50	SPT	15	23,30,44	74						-
								25.00	SPT	16	10,24,30	54						UDS Empty
24								26.50	SPT	17	17,20,35	57						-
								28.00	SPT	18	19,27,36	63						UDS Empty
26								29.50	SPT	19	21,29,38	67						-
28								30.00	SPT	20	21,29,40	69						-
30.00	30	Bore terminated																

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RECORD OF BORING

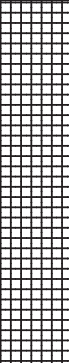
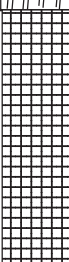
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

BH-10

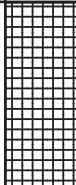
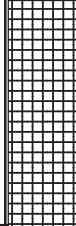
Page : 1/2

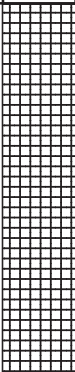
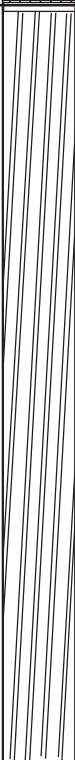
METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +126.9m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.1m (4.8m)

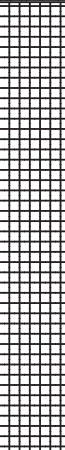
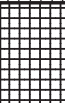
LOCATION: Rain Water Reservoir Pond
CO ORDINATES : Easting : -240
Northing : -360
DATE : 17-07-2018 TO 17-07-2018

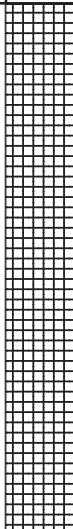
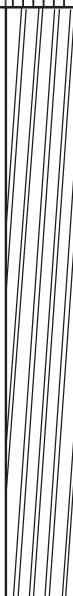
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
 5.00	1	brown silty clay soil			5.00	0.00	DS	1	-	-						-
					1.00	SPT	1	7,11,12	23						-	
					2.00	UDS	1	-	-						-	
	3				3.00	SPT	2	8,12,13	25						-	
					4.00	UDS	2	-	-						-	
11.50	5	brown silty soil			6.50	5.00	SPT	3	10,14,16	30						-
					6.00	UDS	3	-	-						-	
	7				7.00	SPT	4	11,15,18	33						-	
					8.00	UDS	4	-	-						-	
	9				9.00	SPT	5	12,17,20	37						-	
					10.00	UDS	5	-	-						-	
	11				11.50	SPT	6	16,21,23	44						-	
	13	brown silty clay soil			3.50	13.00	UDS	6	-	-						UDS Empty
					14.50	SPT	7	18,22,24	46						-	
	15															

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E mail : nagpur_atc@yahoo.in

RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
BH-10																
Page : 2/2																
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL OF GL : +126.9m DEPTH OF BORING : 30.00m WATER TABLE : @ +122.1m (4.8m)										LOCATION: Rain Water Reservoir Pond CO ORDINATES : Easting : -240 Northing : -360 DATE : 17-07-2018 TO 17-07-2018						
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
	16	brown silty clay soil			2.50	16.00	UDS	7	-	-						-
17.50																
	18	brownish silty sandy soil			9.50	17.50	SPT	8	18,25,27	52						-
					19.00	SPT	9	21,26,22	48							UDS Empty
	20				20.50	SPT	10	20,27,30	57							-
					22.00	SPT	11	19,25,31	56							UDS Empty
	22				23.50	SPT	12	21,27,34	61							-
					25.00	SPT	13	23,28,30	58							UDS Empty
	24				26.50	SPT	14	22,27,32	59							-
27.00																
	28	brown silty clay soil			3.00	28.00	SPT	15	14,19,24	43						UDS Empty
					29.50	SPT	16	23,25,29	54							-
30.00	30	Bore terminated														
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RECORD OF BORING																		
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																		
Bh-2																		
Page : 1/2																		
METHOD OF DRILLING : Rotary																		
BORE DIA : 150 mm																		
RL OF GL : +126.3m																		
DEPTH OF BORING : 30.00m																		
WATER TABLE : @ +122.2m (4.1m)																		
LOCATION: Raw Water Reservoir																		
CO ORDINATES : Easting : -1140																		
Northing : -157																		
DATE : 04-06-2018 TO 05-06-2018																		
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS		
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N								
	1	brown silty clay soil			5.00	0.00	DS	1	-	-						-		
						1.00	SPT	1	6,9,12	21							-	
						2.00	UDS	1	-	-							-	
	3					3.00	SPT	2	13,18,22	40							-	
						4.00	UDS	2	-	-							-	
	5	brown silty soil			10.00	5.00	SPT	3	4,8,15	23						-		
						6.00	UDS	3	-	-							-	
	7					7.00	SPT	4	9,17,23	40							-	
						8.00	UDS	4	-	-							-	
	9					9.00	SPT	5	11,19,25	44							-	
						10.00	UDS	5	-	-							-	
	11					11.50	SPT	6	12,27,31	58							-	
						13.00	UDS	6	-	-							-	
	13					14.50	SPT	7	20,29,36	65							-	
	15																	-
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																		

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-2																	
Page : 2/2																	
METHOD OF DRILLING : Rotary																	
BORE DIA : 150 mm																	
RL OF GL : +126.3m																	
DEPTH OF BORING : 30.00m																	
WATER TABLE :@ +122.2m (4.1m)																	
LOCATION: Raw Water Reservoir																	
CO ORDINATES : Easting : -1140																	
Northing : -157																	
DATE : 04-06-2018 TO 05-06-2018																	
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
	16	brown silty soil			2.50	16.00	UDS	7	-	-							
17.50																	
	18	brown silty clay soil			6.00	17.50	SPT	8	21,38,42	80							
						19.00	UDS	8	-	-							
	20																
						20.50	SPT	9	16,39,41	80							
	22																
		brown silty soil			1.50	22.00	UDS	9	-	-							
23.50																	
	24	brown silty soil			1.50	23.50	SPT	10	20,25,34	59							
25.00																	
	26	brownish fine sandy soil			3.00	25.00	SPT	11	24,29,42	71					UDS Empty		
						26.50	SPT	12	25,35,48	83							
28.00	28	brown silty clay soil			2.00												
						28.00	UDS	10	-	-							
		brown silty clay soil			2.00												
30.00	30					29.50	SPT	13	22,30,48	78							
Bore terminated						30.00	SPT	14	21,35,52(4m)	>100							
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-3																	
Page : 1/2																	
METHOD OF DRILLING : Rotary																	
LOCATION: Raw Water Reservoir																	
BORE DIA : 150 mm																	
CO ORDINATES : Easting : -1140																	
RL OF GL : +126.3m																	
Northing : -274																	
DEPTH OF BORING : 30.00m																	
DATE : 31-05-2018 TO 31-05-2018																	
WATER TABLE :@ +122.2m (4.1m)																	
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
 7.00	1	brown silty clay soil			7.00	0.00	DS	1	-	-							-
					1.00	SPT	1	4,6,7	13							-	
					2.00	UDS	1	-	-							-	
	3				3.00	SPT	2	7,10,14	24							-	
					4.00	UDS	2	-	-							-	
	5				5.00	SPT	3	8,13,15	28							-	
					6.00	UDS	3	-	-							-	
	7	brown silty soil			8.00	7.00	SPT	4	11,14,20	34							-
					8.00	UDS	4	-	-							-	
	9				9.00	SPT	5	13,16,22	38							-	
					10.00	UDS	5	-	-							-	
	11				11.50	SPT	6	7,12,15	27							-	
					13.00	UDS	6	-	-							-	
	15				14.50	SPT	7	12,18,23	41							-	
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-3

Page : 2/2

METHOD OF DRILLING : Rotary

BORE DIA : 150 mm

RL OF GL : +126.3m

DEPTH OF BORING : 30.00m

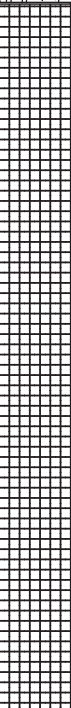
WATER TABLE : @ +122.2m (4.1m)

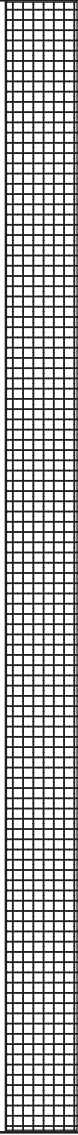
LOCATION: Raw Water Reservoir

CO ORDINATES : Easting : -1140

Northing : -274

DATE : 31-05-2018 TO 31-05-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
	16	brown silty soil			5.50	16.00	UDS	7	-	-							-
	18				17.50	SPT	8	18,22,26	48						-		
	20				19.00	UDS	8	-	-						-		
	20.50				20.50	SPT	9	20,26,30	56						-		
	22	brown silty clay soil			9.50	22.00	UDS	9	-	-							-
	24				23.50	SPT	10	23,28,35	63						-		
	26				25.00	UDS	10	-	-						-		
	28				26.50	SPT	11	21,34,39	73						-		
					28.00	SPT	12	25,37,50	87						-		
	30.00				29.50	SPT	13	27,37,38	75						-		
					30.00	SPT	14	28,36,38	74						-		
Bore terminated																	
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-5																
Page : 1/3																
METHOD OF DRILLING : Rotary					LOCATION: Raw Water Reservoir											
BORE DIA : 150 mm					CO ORDINATES : Easting : -900											
RL OF GL : +126.4m					Northing : -180											
DEPTH OF BORING : 30.00m					DATE : 24-05-2018 TO 25-05-2018											
WATER TABLE : @ +122.2m (4.2m)																
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
	1	brown silty clay soil		15.00	0.00	DS	1	-	-							-
				1.00	UDS	1	-	-								-
				2.00	SPT	1	13,15,20	35								-
	3			3.00	UDS	2	-	-								-
				4.00	SPT	2	10,26,28	54								-
	5			5.00	UDS	3	-	-								-
				6.00	SPT	3	8,10,14	24								-
	7			7.00	UDS	4	-	-								-
				8.00	SPT	4	9,12,14	26								-
	9			9.00	UDS	5	-	-								-
				10.00	SPT	5	12,19,22	41								-
	11			11.50	SPT	6	22,33,45	78								-
				13.00	UDS	6	-	-								-
	13															
	15			14.50	SPT	7	19,22,22	44								-
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

RECORD OF BORING

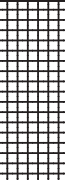
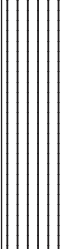
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-5

Page : 2/3

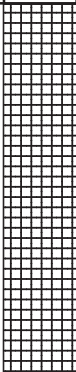
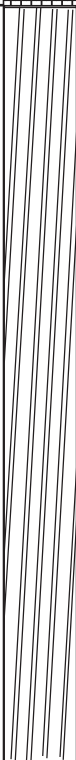
METHOD OF DRILLING : Rotary
BORE DIA : 150 mm
RL OF GL : +126.4m
DEPTH OF BORING : 30.00m
WATER TABLE : @ +122.2m (4.2m)

LOCATION: Raw Water Reservoir
CO ORDINATES : Easting : -900
Northing : -180
DATE : 24-05-2018 TO 25-05-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
	16	brown silty clay soil			2.50	16.00	UDS	7	-	-						-
17.50																
	18	brown silty soil			9.00	17.50	SPT	8	20,21,24	45						-
						19.00	UDS	8	-	-						-
	20															
						20.50	SPT	9	18,27,28	55						-
	22															
						22.00	UDS	9	-	-						-
	24															
						23.50	SPT	10	22,30,32	62						-
	26	brownish silty sandy soil			3.50	25.00	UDS	10	-	-						-
26.50																
	28					26.50	SPT	11	25,29,34	63						-
						28.00	UDS	11	-	-						-
	30	Bore terminated			3.50	29.50	SPT	12	24,39,40	79						-
30.00						30.00	SPT	13	26,52(14cm)	>100						-

Bore terminated

**ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02,
E mail : nagpur_atc@yahoo.in**

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-6																	
Page : 1/2																	
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL OF GL : +126.3m DEPTH OF BORING : 30.00m WATER TABLE :@ +122.2m (4.1m)								LOCATION: Raw Water Reservoir CO ORDINATES : Easting : -960 Northing : -272 DATE : 29-05-2018 TO 29-05-2018									
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
	1	brown silty clay soil			5.00	0.00	DS	1	-	-						-	
					1.00	SPT	1	3,4,6	10							-	
					2.00	UDS	1	-	-							-	
	3				3.00	SPT	2	6,8,11	19							-	
					4.00	UDS	2	-	-							-	
5.00	5	brown silty soil			10.00	5.00	SPT	3	7,11,12	23						-	
					6.00	UDS	3	-	-							-	
	7				7.00	SPT	4	9,12,20	32							-	
					8.00	UDS	4	-	-							-	
	9				9.00	SPT	5	10,18,22	40							-	
					10.00	UDS	5	-	-							-	
	11				11.50	SPT	6	12,21,25	46							-	
					13.00	UDS	6	-	-							-	
	13				14.50	SPT	7	12,16,22	38							-	
	15																
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-6

Page : 2/2

Bh-6

Page : 2/2

METHOD OF DRILLING : Rotary

METHOD OF DRILLING: Rotary
BORE DIA : 150 mm

RL OF GL : +126.3m

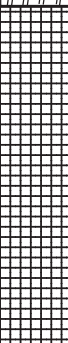
DEPTH OF BORING : 30.00m

METHOD OF DRILLING: Rotary
BORE DIA : 150 mm

RL OF GL : +126.3m

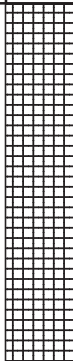
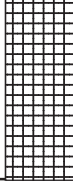
DEPTH OF BORING : 30.00m

WATER TABLE : @ +122.2m (4.1m)

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS			
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N									
		brown silty soil			4.00														
	16					16.00	UDS	7	-	-									-
	18					17.50	SPT	8	14,20,25	45									-
19.00																			
		brown silty clay soil			4.50														
	20					19.00	UDS	12	-	-									-
	22					20.50	SPT	9	14,28,36	64									-
						22.00	UDS	14	-	-									-
23.50																			
		brownish fine sandy soil			6.50														
	24					23.50	SPT	10	14,22,26	48									-
	26					25.00	UDS	16	-	-									-
						26.50	SPT	11	27,55(8cm)	>100									-
	28					28.00	SPT	12	30,55(7cm)	>100									-
30.00																			
	30																-		
Bore terminated						30.00	SPT	14	28,37,39	76							-		

30.00	SPT	14	28,37,39	76	0	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02,
E mail : nagpur_atc@yahoo.in

RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-7																
Page : 1/2																
METHOD OF DRILLING : Rotary																
BORE DIA : 150 mm																
RL OF GL : +126.3m																
DEPTH OF BORING : 30.00m																
WATER TABLE :@ +122.2m (4.1m)																
LOCATION: Raw Water Reservoir																
CO ORDINATES : Easting : -896																
Northing : -406																
DATE : 02-06-2018 TO 03-06-2018																
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
 5.00	1	brown silty clay soil			5.00	0.00	DS	1	-	-						-
					1.00	SPT	1	5,6,9	15						-	
					2.00	UDS	1	-	-						-	
	3				3.00	SPT	2	8,11,14	25						-	
					4.00	UDS	2	-	-						-	
9.00	5	brown silty soil			4.00	5.00	SPT	3	6,8,20	28						-
	7				6.00	UDS	3	-	-						-	
					7.00	SPT	4	10,14,19	33						-	
					8.00	UDS	4	-	-						-	
	9				9.00	SPT	5	9,22,24	46						-	
11.50	11	brown silty clay soil			2.50	10.00	UDS	5	-	-						-
					11.50	SPT	6	12,26,30	56						-	
	13	brown silty soil			3.50	13.00	UDS	6	-	-						-
					14.50	SPT	7	15,30,45	75						-	
	15															
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-7

Page : 2/2

METHOD OF DRILLING : Rotary

BORE DIA : 150 mm

RL OF GL : +126.3m

DEPTH OF BORING : 30.00m

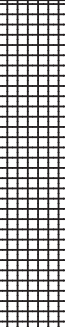
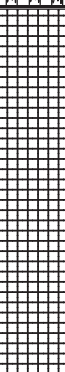
WATER TABLE : @ +122.2m (4.1m)

LOCATION: Raw Water Reservoir

CO ORDINATES : Easting : -896

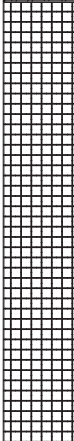
 Northing : -406

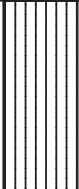
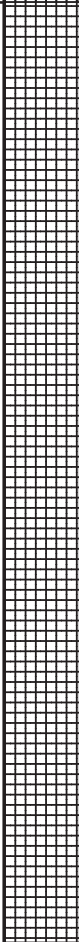
DATE : 02-06-2018 TO 03-06-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
	16	brown silty soil			2.50	16.00	UDS	7	-	-						-
17.50																
	18	brown silty clay soil			4.50	17.50	SPT	8	18,28,36	64						-
						19.00	UDS	8	-	-						-
20						20.50	SPT	9	18,30,45	75						-
22.00	22					22.00	SPT	10	24,39,48	87						UDS Empty
		brownish fine sandy soil			3.00	23.50	SPT	11	27,34,46	80						-
25.00	24					25.00	UDS	9	-	-						-
	26	brown silty clay soil			5.00	26.50	SPT	12	16,28,55 (9cm)	>100						-
	28					28.00	SPT	14	42,45,50	95						UDS Empty
						29.50	SPT	15	18,34,41	75						-
30.00	30															

Bore terminated

**ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02,
E mail : nagpur_atc@yahoo.in**

RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-8																
Page : 1/2																
METHOD OF DRILLING : Rotary																
BORE DIA : 150 mm																
RL OF GL : +127.0m																
DEPTH OF BORING : 30.00m																
WATER TABLE :@ +122.2m (4.8m)																
LOCATION: Township																
CO ORDINATES : Easting : -636																
Northing : 159																
DATE : 02-07-2018 TO 02-07-2018																
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2, N3	N						
1.00	1	brown silty soil			1.00	0.00	DS	1	-	-						-
		brown silty clay soil			6.00	1.00	SPT	1	7,10,12	22						-
	3				2.00	UDS	1	-	-						-	
					3.00	SPT	2	10,13,14	27						-	
	5				4.00	UDS	2	-	-						-	
					5.00	SPT	3	11,15,18	33						-	
					6.00	UDS	3	-	-						-	
7.00	7	brownish silty sandy soil			8.00	7.00	SPT	4	13,16,20	36						-
	9				8.00	SPT	5	15,18,22	40						UDS Empty	
					9.00	SPT	6	17,23,26	49						-	
	11				10.00	SPT	7	17,26,28	54						UDS Empty	
					11.50	SPT	8	19,23,31	54						-	
	13				13.00	SPT	9	20,27,32	59						UDS Empty	
					14.50	SPT	10	17,27,33	60						-	
	15															
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

RECORD OF BORING																			
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																			
Bh-8 Page : 2/2																			
METHOD OF DRILLING : Rotary BORE DIA : 150 mm RL OF GL : +127.0m DEPTH OF BORING : 30.00m WATER TABLE :@ +122.2m (4.8m)							LOCATION: Township CO ORDINATES : Easting : -636 Northing : 159 DATE : 02-07-2018 TO 02-07-2018												
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS			
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N									
	16	brownish silty sandy soil			2.50	16.00	SPT	11	15,20,28	48						UDS Empty			
17.50																			
	18	brown silty clay soil			12.50	17.50	SPT	12	19,22,29	51						-			
								19.00	SPT	13	16,23,30	53						UDS Empty	
20								20.50	SPT	14	18,21,27	48						-	
								22.00	SPT	15	18,24,39	63						UDS Empty	
22								23.50	SPT	16	20,26,28	54						-	
	24							25.00	SPT	17	21,27,31	58						UDS Empty	
								26.50	SPT	18	27,33,35	68						-	
26								28.00	SPT	19	30,38,42	80						UDS Empty	
	28																		
30.00	30								29.50	SPT	20	32,34,45	79						-
Bore terminated						30.00	SPT	21	31,37,43	80						-			
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																			

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-4																	
Page : 1/2																	
METHOD OF DRILLING : Rotary																	
BORE DIA : 150 mm																	
RL OF GL : +126.7m																	
DEPTH OF BORING : 30.00m																	
WATER TABLE :@ +122.2m (4.5m)																	
LOCATION: Training center																	
CO ORDINATES : Easting : -979																	
Northing : 37																	
DATE : 05-07-2018 TO 06-07-2018																	
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
1.00	1	brown silty soil			1.00	0.00	DS	1	-	-							-
						1.00	SPT	1	6,7,9	16							-
		brown silty clay soil			2.00	2.00	UDS	1	-	-							-
3.00	3					3.00	SPT	2	7,8,10	18							-
		brown silty soil			2.00	4.00	UDS	2	-	-							-
5.00	5					5.00	SPT	3	8,9,11	20							-
		brown silty clay soil			2.00	6.00	UDS	3	-	-							-
7.00	7					7.00	SPT	4	10,12,14	26							-
		brown silty soil			2.00	8.00	UDS	4	-	-							-
9.00	9					9.00	SPT	5	11,15,18	33							-
		brown silty clay soil			6.00	10.00	UDS	5	-	-							-
	11					11.50	SPT	6	13,16,19	35							-
	13					13.00	UDS	6	-	-							-
	15					14.50	SPT	7	15,17,20	37							-
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING

NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.

Bh-4

Page : 2/2

Bh-4

Page : 2/2

METHOD OF DRILLING : Rotary

BORE DIA : 150 mm

RL OF GL : +126.7m

Northing : 37

DEPTH OF BORING : 30.00m

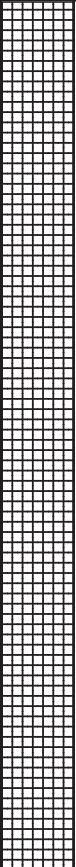
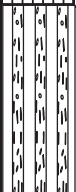
WATER TABLE : @ +122.2m (4.5m)

METHOD OF DRILLING : Rotary LOCATION: Training center

BORE DIA : 150 mm

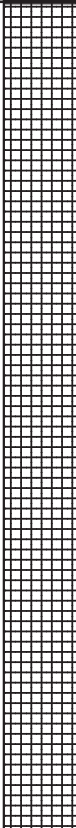
RL OF GL : +126.7m

DEPTH OF BORING : 30.00m DATE : 05-07-2018 TO 06-07-2018

DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS		
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N								
		brown silty clay soil			11.50													
	16				16.00	UDS	7	-	-									-
	18				17.50	SPT	8	16,18,23	41									-
					19.00	SPT	9	19,20,25	45									UDS Empty
	20				20.50	SPT	10	18,21,27	48									-
	22				22.00	SPT	11	15,23,28	51									UDS Empty
					23.50	SPT	12	20,24,29	53									-
	24				25.00	SPT	13	19,26,31	57									UDS Empty
26.50	26																	
		brownish fine sandy soil			2.50	26.50	SPT	14	22,28,35	63							-	
	28				28.00	SPT	15	27,31,38	69									-
29.00																		
		brown silty clay soil			1.00	29.50	SPT	16	25,29,37	66							-	
30.00	30				30.00	SPT	17	27,34,39	73									-
Bore terminated																		

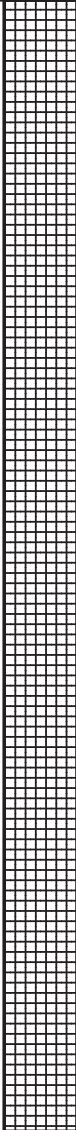
30.00	SPT	17	27,34,39	73	0	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02,
E mail : nagpur_atc@yahoo.in

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-28																	
Page : 1/2																	
METHOD OF DRILLING : Rotary																	
BORE DIA : 150 mm																	
RL OF GL : +127.1m																	
DEPTH OF BORING : 30.00m																	
WATER TABLE : @ +122.1m (5.0m)																	
LOCATION: Workshop																	
CO ORDINATES : Easting : 51																	
Northing : -221																	
DATE : 29-07-2018 TO 30-07-2018																	
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
4.00	1	brown silty soil			4.00	0.00	DS	1	-	-							-
					1.00	SPT	1	3,4,6	10						-		
					2.00	UDS	1	-	-						-		
	3				3.00	SPT	2	4,7,7	14						-		
		brown silty clay soil			11.00	4.00	UDS	2	-	-							-
	5				5.00	SPT	3	3,5,8	13						-		
					6.00	UDS	3	-	-						-		
	7				7.00	SPT	4	6,7,9	16						-		
					8.00	UDS	4	-	-						-		
	9				9.00	SPT	5	5,8,10	18						-		
					10.00	UDS	5	-	-						-		
	11				11.50	SPT	6	7,9,11	20						-		
					13.00	SPT	7	9,10,12	22						UDS Empty		
	13																
	15				14.50	SPT	8	8,11,14	25						-		
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING																
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																
Bh-28																
Page : 2/2																
METHOD OF DRILLING : Rotary																
LOCATION: Workshop																
BORE DIA : 150 mm																
CO ORDINATES : Easting : 51																
RL OF GL : +127.1m																
Northing : -221																
DEPTH OF BORING : 30.00m																
DATE : 29-07-2018 TO 30-07-2018																
WATER TABLE :@ +122.1m (5.0m)																
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N						
					15.00											
	16					16.00	SPT	9	9,12,14	26						UDS Empty
	18					17.50	SPT	10	10,13,16	29						-
						19.00	SPT	11	9,12,15	27						UDS Empty
	20					20.50	SPT	12	11,14,17	31						-
	22	brown silty clay soil				22.00	SPT	13	13,17,19	36						UDS Empty
						23.50	SPT	14	14,19,24	43						-
	24					25.00	SPT	15	15,20,26	46						-
	26					26.50	SPT	16	16,22,29	51						-
						28.00	SPT	17	14,24,30	54						-
	28															
	30					29.50	SPT	18	18,26,35	61						-
30.00						30.00	SPT	19	19,27,38	65						-
Bore terminated																
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																

RECORD OF BORING																	
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																	
Bh-29																	
Page : 1/2																	
METHOD OF DRILLING : Rotary																	
LOCATION: Workshop																	
BORE DIA : 150 mm																	
CO ORDINATES : Easting : 114																	
RL OF GL : +127.2m																	
Northing : -223																	
DEPTH OF BORING : 30.00m																	
DATE : 05-08-2018 TO 05-08-2018																	
WATER TABLE :@ +122.1m (5.1m)																	
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS	
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N							
					11.50	0.00	DS	1	-	-							-
	1					1.00	SPT	1	3,3,5	8							-
						2.00	UDS	1	-	-							-
	3					3.00	SPT	2	3,5,7	12							-
						4.00	UDS	2	-	-							-
	5					5.00	SPT	3	4,5,9	14							-
						6.00	UDS	3	-	-							-
	7					7.00	SPT	4	5,7,11	18							-
						8.00	UDS	4	-	-							-
	9					9.00	SPT	5	6,9,15	24							-
						10.00	UDS	5	-	-							-
	11																
11.50																	
					3.50	11.50	SPT	6	7,10,17	27							-
	13					13.00	UDS	6	-	-							-
						14.50	SPT	7	10,17,22	39							-
15.00	15																
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																	

RECORD OF BORING																			
NAME OF PROJECT : Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																			
Bh-29 Page : 2/2																			
METHOD OF DRILLING : Rotary					LOCATION: Workshop														
BORE DIA : 150 mm					CO ORDINATES : Easting : 114														
RL OF GL : +127.2m					Northing : -223														
DEPTH OF BORING : 30.00m					DATE : 05-08-2018 TO 05-08-2018														
WATER TABLE :@ +122.1m (5.1m)																			
DEPTH (m)	Depth (meter)	DESCRIPTION OF STRATA	Soil Classification	STRATA		SAMPLE			SPT VALUES		N value/ 30cms.					REMARKS			
				Legend	Thickness (m)	DEPTH (m)	TYPE	NO.	N1, N2 , N3	N									
		brown silty clay soil			15.00														
	16				16.00	SPT	8	13,21,33	54										UDS Empty
	18				17.50	SPT	9	15,18,30	48										-
					19.00	SPT	10	16,20,31	51										UDS Empty
	20				20.50	SPT	11	14,18,33	51										-
					22.00	SPT	12	15,20,35	55										UDS Empty
	22				23.50	SPT	13	17,22,36	58										-
	24				25.00	SPT	14	18,23,35	58										UDS Empty
					26.50	SPT	15	21,23,32	55										-
	26				28.00	SPT	16	24,26,36	62										UDS Empty
	28	29.50	SPT	17	25,24,37	61										-			
30.00	30	Bore terminated		30.00	SPT	18	20,27,38	65								-			
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																			

ANNEXURE-2

SUMMARY OF LAB TEST RESULTS

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Customer Site Office															RL (m):		+126.3							
		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.															BH No.:		78							
Type of structure:		Customer Site Office															TABLE NO.:		1 of 2							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	Northing:			(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)	CLAY (%)	ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS			SPECIFIC GRAVITY	COMP.INDEX, Cc	IN. VOID RATIO eo	FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS
							COARSE	MED.	FINE			LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)		TYPE OF TEST	C (kg/cm²)	φ (°)								
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.00	SPT	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.00	SPT	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.00	SPT	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	UDS	-	1.68	1.48	13.6	0	1	8	7	84	-	--	NP	-	ML	-	-	-	2.58	-	-	-	-	-	-	-
8.00	SPT	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.00	SPT	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.00	SPT	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.50	SPT	40	1.75	1.49	17.2	2	1	1	2	78	16	32	18	14	CL	-	-	-	2.57	-	0.72	18	7	0.08	-	-
13.00	SPT	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14.50	SPT	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16.00	SPT	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17.50	SPT	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19.00	SPT	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20.50	SPT	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22.00	SPT	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23.50	SPT	23	-	-	-	0	3	8	46	43	--	NP	NP	--	SM	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Customer Site Office																			RL (m):		+126.3			
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):										30.00		Easting:		556		BH No.:		78						
Type of structure:		Customer Site Office										4.10		Northing:		-271		TABLE NO.:		2 of 2						
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SIEVE ANALYSIS				ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS			SPECIFIC GRAVITY	CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS	
							COARSE	MED.	FINE	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	TYPE OF TEST		C (kg/cm²)	φ (°)	COMP.INDEX, Cc		IN. VOID RATIO eo							
25.00	SPT	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26.50	SPT	47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28.00	SPT	68	-	-	-	1	2	3	7	87	-	--	NP	-	MIL	-	-	-	-	-	-	-	-	-	-	-
29.50	SPT	68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31.00	SPT	>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Ammonia Unloading and Storage Area																	RL (mt.):								
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(mt.):																	280								
Ammonia Unloading and Storage Area		GROUND WATER TABLE(mt.):																	BH No.:								
Type of structure:		Northing:																	TABLE NO.:								
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	
DEPTH BELOW G.L. (mt.)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)			CLAY (%)	ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS		SPECIFIC GRAVITY	CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS
							COARSE	MED.	FINE	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)		C (kg/cm²)	φ (°)	COMP. INDEX, Cc		IN. VOID RATIO eo									
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
1.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
2.00	SPT	30	-	-	-	6	2	5	7	80	32	21	11	-	CL	-	-	-	-	-	-	-	-	-	-	-	
3.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
4.00	SPT	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
5.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
6.00	SPT	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7.00	UDS	-	1.79	1.49	20.2	9	5	3	11	72	29	19	10	-	CL	-	-	-	-	2.54	-	0.71	-	-	-	-	
8.00	SPT	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
10.00	SPT	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
11.50	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
13.00	SPT	64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
14.50	UDS	-	1.86	1.54	21.0	12	4	3	11	54	16	33	20	13	CL	-	-	-	-	2.53	-	0.65	10	8	0.06	-	
16.00	SPT	76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
17.50	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
19.00	SPT	>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
20.50	SPT	>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
22.00	SPT	>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
23.50	SPT	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104-606600/01/02, E mail : nagpur_atc@yahoo.in																											

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Ammonia Unloading and Storage Area																			RL (mt.):							
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(mt.):																			280		BH No.:					
Ammonia Unloading and Storage Area		GROUND WATER TABLE(mt.):																			-271		TABLE NO.:					
DEPTH BELOW G.L. (mt.)	TYPE OF SAMPLE	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	ATTERBERG LIMITS			(16)	SHEAR PARAMETERS		(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)	
														GRAVEL (%)	SAND (%)			SILT (%)	CLAY (%)		LIQUID LIMIT (%)	PLASTIC LIMIT (%)						PLASTICITY INDEX (%)
25.00	SPT			90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
26.50	SPT			73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28.00	SPT			69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29.50	SPT			62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31.00	SPT			91	-	-	13	3	7	15	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32.50	SPT			>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34.00	SPT			>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35.50	SPT			>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
37.00	SPT			>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
38.50	SPT			>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
40.00	SPT			>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: H2 Regeneration Area														RL (m):		+129									
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):														343		Easting:		30.00		BH No.:		85			
Type of structure:		GROUND WATER TABLE(m):														Northing:		-910		TABLE NO.:		1 of 2					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	SHEAR PARAMETERS			(19)	(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			ATTERBERG LIMITS			I.S. CLASSIFICATION	TYPE OF TEST			C (kg/cm²)	φ (°)	SPECIFIC GRAVITY	COMP.INDEX, Cc	IN. VOID RATIO eo	FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS	
							COARSE	MED.	FINE	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)															
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.00	SPT	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.00	UDS	-	1.62	1.51	7.3	0	0	1	8	87	4	--	NP	--	ML	-	0.00	19°15'	2.61	-	0.73	-	-	-	-	-	-
3.00	SPT	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	SPT	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	SPT	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.00	SPT	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.50	SPT	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.00	UDS	-	1.77	1.52	16.1	0	0	1	2	85	12	33	24	9	CL	-	-	-	2.58	-	0.69	13	10	0.07	-	-	-
14.50	SPT	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16.00	SPT	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	-
17.50	SPT	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19.00	SPT	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	-
20.50	SPT	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22.00	SPT	32	-	-	-	3	2	2	58	35	--	--	NP	--	SM	-	-	-	-	-	-	-	-	-	-	UDS Empty	-
23.50	SPT	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: H2 Regeneration Area														RL (m):		+129								
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):														343		Easting:		BH No.:		85				
Type of structure:		H2 Regeneration Area														6.90		Northing:		-910		TABLE NO.:		2 of 2		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	SHEAR PARAMETERS			(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
																ATTERBERG LIMITS										
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)	CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	I.S. CLASSIFICATION	TYPE OF TEST	C (kg/cm²)	∅ (°)	SPECIFIC GRAVITY	COMP.INDEX, Cc	IN. VOID RATIO eo	FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS
							COARSE	MED.	FINE																	
25.00	SPT	52	-	-	-	0	0	0	64	36	-	NP	-	SM	-	-	-	-	-	-	-	-	-	-	UDS Empty	
26.50	SPT	54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
28.00	SPT	56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
29.50	SPT	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30.00	SPT	68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: BHEL site office														RL (m):												
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):														BH No.:												
BHEL site office		GROUND WATER TABLE(m):														TABLE NO.:												
Type of structure:		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SIEVE ANALYSIS			ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS			SPECIFIC GRAVITY	CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS				
							COARSE	MED.	FINE	SILT (%)	CLAY (%)	LIQUID LIMIT (%)		PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	TYPE OF TEST		C (kg/cm²)	∅ (°)						COMP. INDEX, Cc	IN. VOID RATIO eo		
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.00	SPT	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.00	UDS	-	1.63	1.49	9.2	14	2	4	2	78	31	19	12	CL	-	0.27	25°45'	2.59	-	0.74	13	10	0.1	0.54	-	-	-	-
3.00	SPT	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	SPT	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	SPT	31	-	-	-	15	1	1	1	82	34	22	12	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.00	SPT	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.50	SPT	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.00	UDS	-	1.80	1.59	13.5	1	0	0	1	98	--	NP	--	ML	-	-	-	2.58	-	-	-	-	-	-	-	-	-	-
14.50	SPT	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17.50	SPT	51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19.00	UDS	-	-	-	-	2	11	12	10	65	32	17	15	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20.50	SPT	56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23.50	SPT	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104-606600/01/02, E mail : nagpur_atc@yahoo.in																												

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: BHEL site office														RL (m):		+127.2									
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):														377		BH No.:		72							
Type of structure:		BHEL site office														GROUND WATER TABLE(m):		5.00		Northing:		-221		TABLE NO.:		2 of 2	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SIEVE ANALYSIS			ATTENBERG LIMITS			I.S. CLASSIFICATION			SHEAR PARAMETERS			SPECIFIC GRAVITY	CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS	
							COARSE	MED.	FINE	CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	TYPE OF TEST	C (kg/cm²)	Ø (°)	COMP. INDEX, Cc	IN. VOID RATIO eo									
25.00	SPT	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
26.50	SPT	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
28.00	SPT	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
29.50	SPT	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
30.00	SPT	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Warehouse / Store															RL (m):		+127.2										
		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.										TERMINATION DEPTH(m):					30.00		Easting:		438		BH No.:		73				
Type of structure:		Warehouse / Store										GROUND WATER TABLE(m):					5.00					Northing:		-219		TABLE NO.:		1 of 2	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)			
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SIEVE ANALYSIS			SILT (%)	CLAY (%)	ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS			SPECIFIC GRAVITY	CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS			
							COARSE	MED.	FINE			LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)		TYPE OF TEST	C (kg/cm²)	φ (°)		COMP. INDEX, Cc	IN. VOID RATIO eo								
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
1.00	SPT	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
2.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
3.00	SPT	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
4.00	UDS	-	1.64	1.51	8.9	0	0	0	2	98	--	NP	--	--	ML	-	-	-	2.57	-	0.71	-	-	-	-	-			
5.00	SPT	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
6.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
7.00	SPT	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
8.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
9.00	SPT	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
10.00	UDS	-	1.71	1.52	12.2	0	0	1	3	82	14	33	23	10	CL	-	-	-	2.58	-	0.69	17	11	0.13	-	-			
12.00	SPT	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
13.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
14.50	SPT	37	-	-	-	0	0	0	4	96	31	23	8	CL	-	-	-	-	-	-	-	-	-	-	-	-			
16.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
17.50	SPT	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
19.00	SPT	47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty			
20.50	SPT	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			
22.00	SPT	56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty			
23.50	SPT	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Warehouse / Store																			RL (m):		+127.2									
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):																			30.00		Eastng:		438		BH No.:		73			
Type of structure:		Warehouse / Store																			GROUND WATER TABLE(m):		5.00		Northing:		-219		TABLE NO.:		2 of 2	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)						
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)		CLAY (%)	ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS			CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS						
							COARSE	MED.	FINE					LIQUID LIMIT (%)	PLASTIC LIMIT (%)		PLASTICITY INDEX (%)	COMP. INDEX, Cc	IN. VOID RATIO eo													
25.00	SPT	65	-	-	-	0	0	1	62	37	-	-	NP	-	SM	-	-	-	-	-	-	-	-	-	-	UDS Empty						
26.00	SPT	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty						
28.00	SPT	71	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty						
29.50	SPT	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						
30.00	SPT	84	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-						

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:			LOCATION: Canteen														RL (m):		+127.2												
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.			TERMINATION DEPTH(m):														30.00		Easting:		497		BH No.:		74						
Type of structure:			Canteen			GROUND WATER TABLE(m):											5.00		Northing:		-221		TABLE NO.:		1 of 2						
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	SHEAR PARAMETERS			(17)	(18)	(19)	(20)	CONSOLIDATION		(21)	(22)	(23)	(24)	(25)	(26)	(27)
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)	CLAY (%)	ATTERBERG LIMITS			I.S. CLASSIFICATION	TYPE OF TEST			C (kg/cm²)	ø (°)	SPECIFIC GRAVITY	COMP. INDEX, Cc	IN. VOID RATIO eo	FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS			
							COARSE	MED.	FINE			LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)																	
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.00	SPT	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.00	UDS	-	1.62	1.47	10.1	0	1	0	2	97	-	-	NP	-	ML	-	-	0.00	23°15'	-	-	-	-	-	-	-	-	-	-	-	-
3.00	SPT	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	SPT	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.00	UDS	-	-	-	-	0	0	0	2	98	28	20	8	CL	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	SPT	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.00	SPT	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.50	SPT	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.00	UDS	-	1.72	1.54	11.6	0	0	1	4	84	11	27	19	8	CL	-	-	-	-	-	2.59	-	0.68	10	7	0.03	-	-	-	-	-
14.50	SPT	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17.50	SPT	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20.50	SPT	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22.00	SPT	44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	-
23.50	SPT	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Canteen														RL (m):		+127.2								
Type of structure:		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.														BH No.:		74								
		Canteen														TABLE NO.:		2 of 2								
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SIEVE ANALYSIS			SILT (%)	CLAY (%)	ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS			SPECIFIC GRAVITY	CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS
							COARSE	MED.	FINE			LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)		TYPE OF TEST	C (kg/cm²)	φ (°)		COMP.INDEX, Cc	IN. VOID RATIO eo					
25.00	SPT	45	-	-	-	10	4	3	8	75	-	-	NP	-	ML	-	-	-	-	-	-	-	-	-	-	UDS Empty
26.50	SPT	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
28.00	SPT	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
29.50	SPT	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30.00	SPT	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Fire Station Building															RL (m):		+127.2							
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):															Easting:		555		BH No.:		75			
Type of structure:		GROUND WATER TABLE(m):															Northing:		-211		TABLE NO.:		1 of 2			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SIEVE ANALYSIS			SILT (%)	CLAY (%)	ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS			SPECIFIC GRAVITY	CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS
							COARSE	MED.	FINE			LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)		TYPE OF TEST	C (kg/cm²)	φ (°)		COMP.INDEX, Cc	IN. VOID RATIO eo					
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.00	SPT	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.00	SPT	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.00	UDS	-	1.67	1.53	9.4	4	1	1	2	78	14	32	21	11	CL	-	-	-	2.59	0.03	0.70	13	10	0.08	-	-
5.00	SPT	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	SPT	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.00	UDS	-	1.72	1.51	13.6	0	1	1	3	95	-	28	20	8	CL	-	-	-	2.58	-	-	-	-	-	-	-
9.00	SPT	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.50	SPT	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14.50	SPT	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16.00	UDS	-	-	-	-	0	0	0	67	33	-	--	NP	--	SM	-	-	-	-	-	-	-	-	-	-	-
17.50	SPT	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20.50	SPT	44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22.50	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23.50	SPT	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR																												
LOCATION: Fire Station Building																												
PROJECT:		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.										30.00		Easting:		555		BH No.:		75		RL (m):		+127.2				
Type of structure:		Fire Station Building										GROUND WATER TABLE(m):		5.00		Northing:		-211		TABLE NO.:		2 of 2						
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	CONSOLIDATION		(22)	(23)	(24)	(25)	(26)	(27)	
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)		CLAY (%)	ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS			SPECIFIC GRAVITY	COMP.INDEX, Cc	IN. VOID RATIO eo	FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS	
							COARSE	MED.	FINE	29	LIQUID LIMIT (%)		PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	TYPE OF TEST		C (kg/cm²)	Ø (°)										
25.00	SPT	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty		
26.00	SPT	53	-	-	-	8	1	0	62	29	-	-	NP	-	SM	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
28.00	SPT	56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
29.50	SPT	68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30.00	SPT	67	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																												

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Security Complex																				RL (m):		+127.7			
		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																				BH No.:		76			
Type of structure:		Security Complex										GROUND WATER TABLE(m):										Easting:		605	TABLE NO.:		1 of 2
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	SHEAR PARAMETERS			(19)	(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT W.T. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			ATTERBERG LIMITS			CLAY (%)	TYPE OF TEST	C (kg/cm²)		∅ (°)	SPECIFIC GRAVITY	COMP. INDEX, Cc	IN. VOID RATIO eo	FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS		
							COARSE	MED.	FINE	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)															
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.00	SPT	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.00	SPT	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.00	UDS	-	1.65	1.49	10.4	6	1	1	3	77	12	32	22	10	CL	-	-	-	2.60	-	0.74	13	12	0.09	-	-	-
5.00	SPT	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	SPT	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.00	SPT	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.50	SPT	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14.50	SPT	41	-	-	-	5	2	1	57	35	-	-	NP	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
16.00	SPT	51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
17.50	SPT	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19.50	SPT	56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
20.50	SPT	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22.00	SPT	60	-	-	-	6	1	1	66	26	-	-	NP	-	SM	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
23.50	SPT	74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Security Complex																			RL (m):		+127.7					
		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																			BH No.:		76					
Type of structure:		Security Complex																			TABLE NO.:		2 of 2					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)		
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SIEVE ANALYSIS				SILT (%)	CLAY (%)	ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS			SPECIFIC GRAVITY	CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS	
							SAND (%)			LIQUID LIMIT (%)			PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	TYPE OF TEST		C (kg/cm²)	ø (°)	COMP. INDEX, Cc		IN. VOID RATIO eo							
							COARSE	MED.	FINE																			
25.00	SPT	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty			
26.50	SPT	77	-	-	-	2	8	10	66	14	-	-	NP	-	SM	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
28.00	SPT	79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
29.50	SPT	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
30.00	SPT	74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR																												
LOCATION: Boundary Wall																												
PROJECT:		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.													30.00		Eastng:		-1158		RL (m):		+126.8					
Type of structure:		Boundary Wall													GROUND WATER TABLE(m):		4.40		Northing:		99		TABLE NO.:		1 of 2			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	SHEAR PARAMETERS		(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)		
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)	CLAY (%)	ATTERBERG LIMITS			PLASTICITY INDEX (%)	I.S. CLASSIFICATION	TYPE OF TEST		C (kg/cm²)	Ø (°)	SPECIFIC GRAVITY	COMP. INDEX, Cc	IN. VOID RATIO eo	FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS
							COARSE	MED.	FINE			LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY														
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.00	SPT	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.00	UDS	-	1.68	1.47	14.0	1	1	1	4	72	21	30	11	19	CL	-	-	-	0.28	24°15'	2.58	0.03	0.75	13	9	0.07	0.57	-
3.00	SPT	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	SPT	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	SPT	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.00	UDS	-	1.69	1.46	15.6	0	0	1	3	96	25	13	12	12	CL	-	-	-	-	-	2.57	-	-	-	-	-	-	-
9.00	SPT	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.00	SPT	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
11.50	SPT	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
13.00	SPT	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
14.50	SPT	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
16.00	SPT	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
17.50	SPT	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
19.00	SPT	43	-	-	-	2	1	0	4	93	27	13	14	14	CL	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
20.50	SPT	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
22.00	SPT	47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
23.50	SPT	51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/0																												

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR																																
PROJECT:		LOCATION: Boundary Wall															RL (m):															
Type of structure:		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.															30.00		Easting:		-1158		BH No.:		1							
		Boundary Wall															4.40		Northing:		99		TABLE NO.:		2 of 2							
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)						
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SIEVE ANALYSIS			ATTERBERG LIMITS			I.S. CLASSIFICATION			SHEAR PARAMETERS			CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS				
							COARSE	MED.	FINE	CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	ML	TYPE OF TEST	C (kg/cm²)	Ø (°)	SPECIFIC GRAVITY	COMP. INDEX, Cc	IN. VOID RATIO eo												
25.00	SPT	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty					
26.50	SPT	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
28.00	SPT	69	-	-	-	0	0	1	13	86	-	-	NP	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
29.50	SPT	61	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
30.00	SPT	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-					
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in																																

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Boundary wall														RL (m):											
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):														BH No.:											
Type of structure:		GROUND WATER TABLE(m):														TABLE NO.:											
Boundary wall		30.00														-418											
		4.30														-495											
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SIEVE ANALYSIS			ATTENBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS			SPECIFIC GRAVITY	CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS
							COARSE	MED.	FINE	CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	C (kg/cm²)	φ (°)		COMP. INDEX, Cc	IN. VOID RATIO eo									
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
1.00	SPT	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
2.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
3.00	SPT	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
4.00	UDS	-	1.66	1.51	10.1	0	0	0	1	99	--	NP	--	--	ML	-	-	-	-	2.56	-	0.70	-	-	-	-	
5.00	SPT	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
6.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7.00	SPT	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9.00	SPT	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
10.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
11.50	SPT	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
13.00	SPT	47	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
14.50	UDS	-	1.69	1.49	13.2	0	0	1	1	98	--	NP	--	--	ML	-	-	-	-	2.65	-	0.78	-	-	-	-	
16.00	SPT	55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
17.50	SPT	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
19.00	SPT	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
20.50	SPT	69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
22.00	SPT	74	-	-	-	0	0	0	58	42	--	NP	--	--	SM	-	-	-	-	-	-	-	-	-	-	UDS Empty	
23.50	SPT	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104-606600/01/02, E mail : nagpur_atc@yahoo.in																											

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E mail : nagpur_atc@yahoo.in

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR																											
PROJECT: Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.													LOCATION: Boundary wall														
Type of structure: Boundary wall													GROUND WATER TABLE(m):				30.00		Easting:		-418		BH No.:		+126.7		
																	4.30		Northing:		-495		TABLE NO.:		2 of 2		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	SIEVE ANALYSIS				ATTERBERG LIMITS				(16)	SHEAR PARAMETERS		(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)		
							GRAVEL (%)	SAND (%)			CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)		I.S. CLASSIFICATION	TYPE OF TEST		C (kg/cm ²)	∅ (°)						SPECIFIC GRAVITY	COMP. INDEX, C _c
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSTU BULK UNIT WT. (gm/cm ³)	DRY UNIT WT. (gm/cm ³)	INSITU WATER CONTENT (%)																						
25.00	SPT	79	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
26.50	SPT	78	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
28.00	SPT	82	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
29.50	SPT	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
30.00	SPT	63	-	-	-	0	0	1	4	95	22	15	7	-	CL	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Boundary Wall															RL (m):											
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):															30.00		Easting:		-60		BH No.:		11			
Type of structure:		GROUND WATER TABLE(m):															5.60		Northing:		143		TABLE NO.:		1 of 2			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	ATTERBERG LIMITS			(15)	(16)	SHEAR PARAMETERS			(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)	
												GRAVEL (%)	SAND (%)				CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)		PLASTICITY INDEX (%)	I.S. CLASSIFICATION						TYPE OF TEST
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)																							
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.00	SPT	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.00	UDS	-	1.67	1.48	13.1	0	0	0	13	81	6	-	NP	-	ML	-	0.00	17°30'	-	2.59	-	0.75	-	-	-	-	-	-
3.00	SPT	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	SPT	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	SPT	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.00	SPT	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.50	SPT	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14.50	SPT	68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16.00	UDS	-	1.73	1.49	15.8	1	0	3	16	80	-	-	NP	-	ML	-	-	-	-	2.57	-	-	-	-	-	-	-	-
17.50	SPT	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19.00	SPT	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
20.50	SPT	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22.00	SPT	66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
23.50	SPT	78	-	-	-	0	4	0	12	84	-	-	NP	-	ML	-	-	-	-	-	-	-	-	-	-	-	-	-

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ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Boundary Wall														RL (m):											
		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.														+128											
		Termination Depth (m):														-60		BH No.:									
																11											
Type of structure:		Ground Water Table (m):														143		TABLE NO.:									
		5.60														Northing:		2 of 2									
																Eastings:											
																143											
DEPTH BELOW G.L. (m)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Boundary Wall																			RL (m):		+126.9					
		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.																			BH No.:		19					
Type of structure:		Boundary Wall																			Easting:		-600					
		GROUND WATER TABLE(m):																			Northing:		-711		TABLE NO.:		1 of 2	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)		
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS			SPECIFIC GRAVITY	COMP. INDEX, C _c		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS				
							COARSE	MED.	FINE	CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)		PLASTICITY INDEX (%)	TYPE OF TEST	C (kg/cm²)		∅ (°)	COMP. INDEX, C _c						IN. VOID RATIO e _o			
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
1.00	SPT	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2.00	UDS	-	1.66	1.48	11.8	0	0	0	2	84	14	32	21	11	CL	-	0.31	24° 30'	2.58	0.03	0.74	15	9	0.1	0.63	-		
3.00	SPT	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
4.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
5.00	SPT	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
6.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7.00	SPT	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8.00	SPT	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty		
9.00	SPT	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
10.00	SPT	49	-	-	-	1	0	1	5	93	33	20	13	CL	-	-	-	-	-	-	-	-	-	-	-	UDS Empty		
11.50	SPT	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
13.00	SPT	49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty		
14.50	SPT	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
16.00	SPT	55	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty		
17.50	SPT	54	-	-	-	5	2	1	9	83	--	NP	-	-	ML	-	-	-	-	-	-	-	-	-	-	-		
19.00	SPT	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty		
20.50	SPT	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
22.00	SPT	64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty		
23.50	SPT	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Boundary Wall														RL (m):		+126.9											
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):														30.00		Eastng:		-600		BH No.:		19					
Type of structure:		GROUND WATER TABLE(m):														4.50		Northing:		-711		TABLE NO.:		2 of 2					
DEPTH BELOW G.L. (m)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	SIEVE ANALYSIS				(12)	ATTERBERG LIMITS			(16)	SHEAR PARAMETERS			(20)	CONSOLIDATION			(23)	(24)	(25)	(26)	(27)	
								GRAVEL (%)	SAND (%)				CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)		PLASTICITY INDEX (%)	TYPE OF TEST	C (kg/cm ²)		Ø (°)	COMP. INDEX, C _c	IN. VOID RATIO e _o						
									COARSE	MED.	FINE																		
25.00		SPT	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
26.50		SPT	59	-	-	-	11	1	1	16	71	-	NP	-	ML	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
28.00		SPT	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
29.50		SPT	59	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
30.00		SPT	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Boundary wall															RL (m):		+126.5									
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):															30.00		Easting:		606		BH No.:		59			
Type of structure:		Boundary wall															GROUND WATER TABLE(m):		4.60		Northing:		-573		TABLE NO.:		1 of 2	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)		
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)	CLAY (%)	ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS			SPECIFIC GRAVITY	COMP. INDEX, Cc	IN. VOID RATIO eo	FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS		
							COARSE	MED.	FINE			LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)		TYPE OF TEST	C (kg/cm²)	φ (°)										
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
1.00	SPT	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3.00	SPT	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
4.00	UDS	-	1.66	1.47	13.2	0	0	0	13	87	-	29	17	12	CL	-	-	-	2.57	-	0.75	8	5	0.06	-	-		
5.00	SPT	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
6.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7.00	SPT	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
9.00	SPT	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
10.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
11.50	SPT	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
13.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
14.50	SPT	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
16.00	UDS	-	1.72	1.52	13.21	1	1	8	44	46	-	-	NP	-	SM	-	-	-	2.64	-	0.74	-	-	-	-	-		
17.50	SPT	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
19.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
20.50	SPT	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
22.00	UDS	-	-	-	-	0	1	2	17	80	-	32	17	15	CL	-	-	-	-	-	-	-	-	-	-	-		
23.50	SPT	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR																													
LOCATION: Boundary wall													RL (m): +126.5																
PROJECT: Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.													BH No.: 59																
Type of structure: Boundary wall													TABLE NO.: 2 of 2																
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13) (14) (15) GROUND WATER TABLE(m):			(16)	(17)	(18) (19) (20) Northing:		(21)	(22)	(23)	(24)	(25)	(26)	(27)				
												TERMINATION DEPTH(m):					SHEAR PARAMETERS									CONSOLIDATION			
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSTU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)			CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	I.S. CLASSIFICATION	TYPE OF TEST	C (kg/cm²)	∅ (°)	SPECIFIC GRAVITY	COMP. INDEX, Cc	IN. VOID RATIO eo	FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm³)	UCS (kg/cm²)	REMARKS	
25.00	SPT	>100	-	-	-	2	1	7	48	-	42	-	NP	-	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	-
26.50	SPT	>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
28.00	SPT	>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29.50	SPT	>100	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30.00	SPT	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Administrative Building															RL (m):										
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):															BH No.:										
Administrative Building		GROUND WATER TABLE(m):															TABLE NO.:										
Type of structure:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)
DEPTH BELOW G.L. (m)		TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)		CLAY (%)	ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS		SPECIFIC GRAVITY	COMP. INDEX, Cc	IN. VOID RATIO eo	FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS
0.00		DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.00		SPT	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.00		UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.00		SPT	26	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.00		UDS	-	1.65	1.48	11.4	2	0	4	17	77	-	NP	-	-	ML	-	-	-	2.61	-	0.76	-	-	-	-	-
5.00		SPT	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.00		UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00		SPT	32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.00		UDS	-	1.71	1.53	12.1	1	0	9	51	39	-	NP	-	-	SM	-	-	-	2.64	-	0.73	-	-	-	-	-
9.00		SPT	33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.00		UDS		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.50		SPT	40	-	-	-	3	1	0	8	88	31	19	12	CL	-	-	-	-	-	-	-	-	-	-	-	-
13.00		UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14.50		SPT	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16.00		UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17.50		SPT	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19.00		UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20.50		SPT	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22.00		UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23.50		SPT	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Administrative Building															RL (m):		+126.7								
Type of structure:		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.															BH No.:		77								
		Administrative Building															TABLE NO.:		2 of 2								
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	SHEAR PARAMETERS			(19)	(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)	CLAY (%)	ATTERBERG LIMITS			I.S. CLASSIFICATION	TYPE OF TEST	C (kg/cm²)		∅ (°)	SPECIFIC GRAVITY	COMP. INDEX, Cc	IN. VOID RATIO eo	FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS
							COARSE	MED.	FINE			LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)													
25.00	SPT	41	-	-	-	0	1	0	10	89	-	-	NP	-	ML	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
26.50	SPT	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
28.00	SPT	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
29.50	SPT	58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30.00	SPT	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Boundary wall															RL (m):													
		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.															BH No.:													
		TERMINATION DEPTH(m):															480													
		GROUND WATER TABLE(m):															116													
Type of structure:		Boundary wall															TABLE NO.:													
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)				
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)			CLAY (%)			ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS			SPECIFIC GRAVITY	CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS
							COARSE	MED.	FINE	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	TYPE OF TEST	C (kg/cm²)	φ (°)	COMP. INDEX, Cc	IN. VOID RATIO eo													
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
1.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
2.00	SPT	11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
3.00	UDS	-	1.63	1.46	11.3	10	1	2	3	71	13	31	19	12	CL	-	-	-	-	2.59	-	0.77	13	10	0.05	-	-	-		
4.00	SPT	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
5.00	UDS	-	1.66	1.48	12.1	13	2	1	2	82	-	33	17	16	CL	-	-	-	-	2.62	-	0.77	14	12	0.07	-	-	-		
6.00	SPT	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
7.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
8.00	SPT	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
9.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
10.00	SPT	26	-	-	-	4	1	2	1	92	-	-	NP	-	ML	-	-	-	-	-	-	-	-	-	-	-	-	-		
11.50	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
13.00	SPT	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
14.50	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
16.00	SPT	44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
17.50	SPT	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
19.00	SPT	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty		
20.50	SPT	49	-	-	-	3	2	3	3	89	-	-	NP	-	ML	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty		
22.00	SPT	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
23.50	SPT	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104-606600/01/02, E mail : nagpur_atc@yahoo.in																														

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Boundary wall														RL (m):		+127									
		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.														Eastng:		480		BH No.:		86					
		TERMINATION DEPTH(m):																									
Type of structure:		Boundary wall														GROUND WATER TABLE(m):		4.60		Northing:		116		TABLE NO.:		2 of 2	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSTU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSTU WATER CONTENT (%)	GRAVEL (%)	SIEVE ANALYSIS			ATTERBERG LIMITS			I.S. CLASSIFICATION		SHEAR PARAMETERS		CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS				
							COARSE	MED.	FINE	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	TYPE OF TEST	C (kg/cm²)	Ø (°)	COMP.INDEX, Cc	IN. VOID RATIO eo										
25.00	SPT	92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
26.50	SPT	76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
28.00	SPT	88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
29.50	SPT	91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty	
30.00	SPT	89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Construction yard														RL (m):											
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):														BH No.:											
Construction yard		GROUND WATER TABLE(m):														TABLE NO.:											
Type of structure:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			ATTERBERG LIMITS			CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	I.S. CLASSIFICATION	SHEAR PARAMETERS		SPECIFIC GRAVITY	CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS
							COARSE	MED.	FINE									COMP. INDEX, Cc	IN. VOID RATIO eo								
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1.00	SPT	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2.00	UDS	-	1.63	1.48	10.3	6	2	1	11	73	7	-	NP	-	-	ML	-	0.00	24°30'	2.60	-	0.76	-	-	-	-	-
3.00	SPT	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.00	SPT	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7.00	SPT	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9.00	SPT	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11.50	SPT	48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
13.00	SPT	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
14.50	SPT	56	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
16.00	UDS	-	1.73	1.50	15.1	7	2	0	6	85	-	33	18	15	CL	-	-	-	2.57	-	0.71	8	7	0.04	-	-	-
17.50	SPT	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19.00	SPT	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
20.50	SPT	63	-	-	-	9	1	0	11	79	-	28	19	9	CL	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
22.00	SPT	60	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
23.50	SPT	64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104-606600/01/02, E mail : nagpur_atc@yahoo.in																											

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: Construction yard															RL (m):		+127.1								
		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.					TERMINATION DEPTH(m):					30.00					Easting:		-52		BH No.:		13				
Type of structure:		Construction yard					GROUND WATER TABLE(m):					4.90					Northing:					-180		TABLE NO.:		2 of 2	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)	
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SIEVE ANALYSIS			ATTERBERG LIMITS			I.S. CLASSIFICATION			SHEAR PARAMETERS		SPECIFIC GRAVITY	CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS		
							COARSE	MED.	FINE	SILT (%)	CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	TYPE OF TEST	C (kg/cm²)	Ø (°)		COMP. INDEX, Cc	IN. VOID RATIO eo							
25.00	SPT	45	-	-	-	5												8			0	17	70	28	20	8	CL
26.50	SPT	66	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
28.00	SPT	53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty
29.50	SPT	37	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
30.00	SPT	64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: CW Pump House															RL (mt.):																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(mt.):															BH No.:																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
Type of structure:		GROUND WATER TABLE(mt.):															TABLE NO.:																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
CW Pump House		4.60															-58.7		1 of 2																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	ATTERBERG LIMITS			(16)	SHEAR PARAMETERS			(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
												GRAVEL (%)	SAND (%)			CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)		PLASTICITY INDEX (%)	I.S. CLASSIFICATION						TYPE OF TEST	C (kg/cm²)	∅ (°)	COMP. INDEX, Cc	IN. VOID RATIO eo																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
SPT-N VALUE	WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.															30.00		Eastings:		48		RL (mt.):		+126.8							
Type of structure:		CW Pump House															GROUND WATER TABLE(mt.):		4.60		Northing:		-58.7		TABLE NO.:		2 of 2		BH No.:		20	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	CONSOLIDATION		(23)	(24)	(25)	(26)	(27)	REMARKS					
DEPTH BELOW G.L. (mt.)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)		CLAY (%)	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	I.S. CLASSIFICATION	SHEAR PARAMETERS		SPECIFIC GRAVITY	COMP. INDEX, Cc	IN. VOID RATIO eo	FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	UDS Empty						
25.00	SPT	46	-	-	-	3	2	2	54	-	39	-	NP	-	-	SM	-	-	-	-	-	-	-	-	-	-	-	UDS Empty				
26.50	SPT	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty				
28.00	SPT	64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty				
29.50	SPT	68	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty				
30.00	SPT	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	UDS Empty				

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR. Tel : 07104 -606600/01/02, E mail : nagpur_atc@yahoo.in

ANANDJIWALA TECHNICAL CONSULTANCY, NAGPUR

PROJECT:		LOCATION: CW Pump House														RL (m):											
Geotechnical Investigation For 1X660 MW PANKI Thermal Power Station at Kanpur, U.P.		TERMINATION DEPTH(m):														30.00		Eastings:		42		BH No.:		21			
Type of structure:		GROUND WATER TABLE(m):														4.60		Northing:		-544		TABLE NO.:		1 of 2			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)		(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
DEPTH BELOW G.L. (m)	TYPE OF SAMPLE	SPT-N VALUE	INSITU BULK UNIT WT. (gm/cm³)	DRY UNIT WT. (gm/cm³)	INSITU WATER CONTENT (%)	GRAVEL (%)	SAND (%)			SILT (%)			CLAY (%)	ATTERBERG LIMITS			I.S. CLASSIFICATION	SHEAR PARAMETERS		SPECIFIC GRAVITY	CONSOLIDATION		FREE SWELL (%)	SHRINKAGE LIMIT (%)	SWELL PRESSURE (kg/cm²)	UCS (kg/cm²)	REMARKS
							COARSE	MED.	FINE	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)		TYPE OF TEST	C (kg/cm²)	φ (°)		COMP. INDEX, Cc	IN. VOID RATIO eo								
0.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
1.00	SPT	19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
2.00	UDS	-	1.68	1.49	12.4	1	1	1	5	79	13	29	18	11	CL	-	0.28	26° 00'	2.56	0.03	0.71	10	5	0.03	0.57	-	
3.00	SPT	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
4.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
5.00	SPT	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
6.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
7.00	SPT	46	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
8.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
9.00	SPT	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
10.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
11.50	SPT	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
13.00	UDS	-	1.79	1.57	14.2	3	1	1	2	93	25	18	7	CL	-	-	-	2.54	-	-	-	-	-	-	-	-	
14.50	SPT	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
16.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
17.50	SPT	45	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
19.00	UDS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
20.50	SPT	57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
22.00	UDS	-	-	-	-	2	0	2	40	56	29	17	12	CL	-	-	-	-	-	-	-	-	-	-	-	-	
23.50	SPT	62	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
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