

Tender specification

Sl no	Tender specification number	Unit number & project
1	BHE/PW/PUR/MAUDT2-STR U-4/1458	Unit 4 of 2x660 MW bunker structure

Supplying (Excluding BHEL supplied materials), Receipt, Collection & handling of materials from BHEL/CLIENT'S works/ stores/ storage yard; Transportation to erection site; Pre assembly, erection, alignment, bolting/ welding/ fastening, grouting, testing, final painting and handing over of bunker structures, raw coal bunkers, coal handling transfer points, coal conveyor galleries and its supporting trestle of bunker structures etc. at site of Unit # 4 of 2X660 MW NTPC MOUDA STPP STAGE II.

At

NATIONAL THERMAL POWER CORPORATION LIMITED (NTPC),
MOUDA
District: Nagpur
MAHARASHTRA

Technical specification - Volume- II B



Tender specification

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At

NATIONAL THERMAL POWER CORPORATION LIMITED (NTPC),

MOUDA

District: Nagpur

MAHARASHTRA

EARNEST MONEY DEPOSIT: Refer Notice Inviting Tender

LAST DATE FOR TENDER SUBMISSION: Refer Notice Inviting Tender

THESE TENDER SPECIFICATION DOCUMENTS CONTAINING VOLUME-II B ARE ISSUED TO:

M/s.

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PLEASE NOTE:
THESE TENDER SPECS DOCUMENTS ARE NOT TRANSFERABLE.

For Bharat Heavy Electricals Limited

AGM (Purchase)
Place: Nagpur
Date:



**TITLE: 2X660 MW MOUDA STPP STAGE-II,
MOUDA**

SCOPE OF WORK

SPECIFICATION NO. PE-TS-385-600-C001

VOLUME – IIB

SECTION “A”

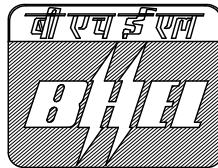
REV. 00

SHEET 1 OF 2


**NTPC
MOUDA, SUPER THERMAL POWER PROJECT
2X660 MW, STAGE-II**

**VOLUME: II B
SECTION - A
SCOPE OF WORK**

SPECIFICATION NO. PE-TS-385-600-C001



Bharat Heavy Electricals Limited
Project Engineering Management
Power Sector, PPEI Building
Noida-201 301

	TITLE: 2X660 MW MOUDA STPP STAGE-II, MOUDA SCOPE OF WORK	SPECIFICATION NO. PE-TS-385-600-C001	
		VOLUME – IIB	
		SECTION “A”	
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Scope of Work

- 1.0 The scope of work covers Civil, Structural Steel and Architectural works for Mouda STPP, Stage-II, including supply of all materials, labor, tools and plants. The scope of work is indicative but not limited to the given below.
 - Mill & Bunker Building including Bunkers
 - Transfer Points
 - Conveyor Galleries and its supporting Trestles including staircases, Gravity Take up Structure.
- 2.0 The works to be performed under this contract consist of providing all labour, supervision, material, scaffolding, construction equipments, tools and plants, temporary works, supplies including POL, transportation and all incidental items not shown or specified but reasonably implied or necessary for the proper completion of work in all respects & preparation of fabrication drawings (Contractor to engage an independent agency with the approval of BHEL for checking of fabrication drawings prepared by contractor before submitting them to BHEL for approval). Works shall only be carried out with approved structural fabrication drawings.
- 3.0 Supply, Fabrication and erection of structural steel work involving rolled section, sections fabricated out of plates, chequered / electroforged gratings, hand rails, primer and final painting for all steel structural works including supply of erection bolts if any, low hydrogen quality electrodes for welding, non destructive testing etc. Complete as per Quality Plan/Customer requirements.
- 4.0 All the works areas shall be adequately flood lighted to the satisfaction of the Engineer-in-Charge when the work is in progress during the night shifts.
- 5.0 The unit rates shall include all material equipment, fixtures, labour construction plant, temporary works and everything whether of permanent or temporary nature necessary for the completion of job in all respects.
- 6.0 The unit rates quoted for various items of B.O.Q shall include all the stipulations mentioned in Section C and technical specifications under Section D and nothing extra over B.O.Q rates shall be payable.
- 7.0 Design drawings showing enough details for the construction as per the specification shall be furnished to the contractor in a phased manner as far as possible.





SUB-SECTION - IIID


CIVIL WORKS


MOUDA SUPER THERMAL POWER PROJECT
STAGE-II (2x660 MW)
STEAM GENERATOR PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO. : CS-9575/9571/0370/0360/9586-102(R)-2

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
			
	CIVIL WORKS FOR STEAM GENERATOR & AUXILIARIES PACKAGE		
1.00.00	SCOPE OF CIVIL WORKS		
1.01.00	Scope of Bidder for Civil Works shall include but not be limited to the design, supply and erection of the following:		
1.01.01	All supporting steel structures (excluding foundation which shall be provided by Employer) for the areas, plants, systems and facilities (including all piping/cables/ducts therein) as mentioned below:		
	<ul style="list-style-type: none"> a) Steam Generator & Auxiliaries b) Power cycle piping consisting of MS, HRH, CRH and auxiliary steam piping c) Mill reject handling system d) Compressed Air System e) Mill Bunker Building, Transfer points, conveyor galleries and its supporting trestles. f) Equipment cooling water system. 		
1.01.02	All supporting steel structures for Boiler Elevator, cladding for elevator enclosure, machine room for elevator including structural steel beams for machine room floor, roof & wall beams, etc.		
1.01.03	All interconnecting steel platforms, between Boiler & Main Power House and Boiler & Mill Bunker Building, with associated ladders/stairs, gratings, handrails, etc.		
1.01.04	<p>All civil, structural and architectural works (excluding foundations) for mill bunker building, coal transfer points and coal conveyor galleries and supporting trestles in Boiler area including staircases, gravity take up structure for conveyors, etc.</p> <p>In the tender drawing, mill bunker building has been shown independent of boiler supporting structure. However, bidder has the option to integrate this building with the boiler supporting structure. Similarly, TPs/ trestles may be used for duct support structures and other facilities in the area. Bidder should indicate the arrangement proposed by him along with corresponding general arrangement drawings in his bid.</p>		
1.01.05	All anchor fasteners, foundation bolts along with templates, inserts and embedments along with lugs, pipe sleeves with lugs, monorail beams, etc., complete whatsoever required for supporting equipment and structures		
1.01.06	All miscellaneous steel structures such as gratings, handrails, ladders/stairs, platforms, edge protection angles/tees on equipment foundations, etc.		
1.01.07	Dressing of foundations, grouting of pockets and underpinning of base plates for structures/ equipment, etc.		
1.01.08	Furnishing of foundation loading data, anchor bolts plans, pocket details, equipment mounting details, opening details on floor / walls / cladding / roof, embedments and inserts details, etc., in the form of input drawings to the Employer, for the Employer's engineering work		
MOUDA SUPER THERMAL POWER PROJECT STAGE-II (2X660 MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-9575/9571/0370/ 0360/9586-102(R)-2	PART-A SUB-SECTION-III:D CIVIL WORKS	PAGE 1 OF 4

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES		
1.01.09	Fixing supports, filling and finishing of openings for pipes/cables/ducts in floors/walls/cladding/roof, etc.		
1.01.10	PTFE bearings for supporting of Bidder's structures on Employer's structure (TG building) and for conveyor gallery supports on Bunker building, trestles and TPs.		
1.01.11	Corrosion protection painting for structures		
1.01.12	Painting of portions of Employer's structures wherever connection/welding is carried out by Bidder for supporting his structures		
1.01.13	All rectification including painting of Employer's structures which are damaged by Bidder during his work		
1.01.14	Sheeting work for roof (penthouse)/ canopy/ side cladding of Steam Generator, mill bunker building, transfer points and conveyor galleries.		
1.01.15	Placement of the embedments/anchor bolts supplied by the Contractor, shall be done by the Employer. However the accuracy of the embedments/anchor bolts in plan and elevation shall be checked and ensured by the Contractor during the placement of the same. Any modification required on these embedments/anchor bolts subsequent to their placement shall be done by the Contractor.		
1.01.16	Supply, installation and erection of steel helical springs and viscous dampers for PA, FD and ID Fans shall be in Bidder's scope.		
1.01.17	Any other facilities / structures that would be required, as per the system requirements covered under various sections / chapters of this specification but not covered here above.		
1.01.18	Doors, windows & ventilators, glazing with polycarbonate sheets.		
1.01.19	Roof & floor drainage of SG supporting structure, mill bunker building and TPs		
1.01.20	Detailed technical requirements for Civil Works are covered elsewhere in the specification		
2.00.00	<p>CONSTRUCTION FACILITIES</p> <p>The following are also in the Contractor's scope of work :</p> <ol style="list-style-type: none"> 1. Providing drinking and service water for Bidder's labour, staff and other personnel working for Bidder at the work site and in his staff/labour colony. He shall install necessary borewells with associated pumping and treatment facilities to supply quality water as per standards. 2. Developing temporary staff colony and labour colony along with fencing etc. Land if required shall be arranged by the Bidder himself. 3. Providing all arrangements for distribution of construction power at various locations as per his requirements from the supply point of Employer. 4. Providing all arrangements for the supply of construction water including bore-wells. 5. Providing temporary construction office, construction stores (open / covered), workshops, material / field testing laboratory, any other temporary buildings 		
MOUDA SUPER THERMAL POWER PROJECT STAGE-II (2X660 MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-9575/9571/0370/ 0360/9586-102(R)-2	PART-A SUB-SECTION-III:D CIVIL WORKS	PAGE 2 OF 4

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	<p>6. Providing all construction equipment, labour and materials. The Bidder shall provide all the tools and tackles required for the work.</p> <p>7. Development of the pre-assembly and storage yard with fencing, drainage, internal roads, boulder soling, etc.</p> <p>8. i) Approach road to project site is available. Further, Employer intends to construct the roads as per the layout shown in the General Layout plan in a progressive manner. Some of these roads may not be available to the bidder for his use. Similarly the drainage network for the plant site being constructed by the employer may not be available to full extent. The bidder shall plan his work within the plant area considering the above constraints of roads and drains. Access roads to his work sites, offices, stores, preassembly / fabrication yard, etc. as required for providing approach/access for men, materials, equipment, cranes, trailer, construction/erection activities etc., what so ever are required by the bidder, shall be constructed and maintained by the bidder.</p> <p>ii) Hard crusting (boulder soling) of 200mm thick shall be provided below the column envelope of boiler and air preheater area and 7.0 m width access from the roads shown in General Layout Plan for feeding material for each boiler erection either from left hand side or right hand side of boiler shall be provided, as indicated in General Layout Plan, by the employer. All other hard crusting for approach/access by the bidder for movement of material, equipment etc to be constructed and maintained by the bidder.</p> <p>9. Area lighting at the construction / erection site, pre-assembly and storage yard, office areas and labour / staff colony.</p> <p>10. Providing all necessary fire fighting devices / equipment / fire tender etc. required during the project execution stage. He shall maintain all such equipment / devices in proper working conditions throughout the period of work.</p> <p>11. Providing first aid facilities at the construction / erection sites, workshops, laboratories, pre-assembly and storage yard and other places of work as per the requirement.</p> <p>12. The Contractor shall arrange skilled / semiskilled / unskilled manpower from local source(s) as far as available in this country. He shall also arrange supervisory staff for quality execution of all works in his scope.</p> <p>13. Contractor's office, store, workshop, laboratory or any other temporary buildings:</p> <p>The Contractor shall adopt pre-engineered/ pre-fabricated constructions made of steel with single / double skin, insulated for un-insulated roof and wall coverings (fabricated out of permanently color coated metal sheets) for his site office, covered store workshop, laboratory or any other temporary buildings. Alternatively, bidder can adopt readymade 'Portacabin' or similar construction. Bidder shall ensure that all such constructions are well-engineered, neatly constructed and overall present a pleasing look. The above requirements shall be applicable to his sub-vendors also and bidder shall be responsible for enforcing the same on his sub-vendors.</p>		
MOUDA SUPER THERMAL POWER PROJECT STAGE-II (2X660 MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-9575/9571/0370/ 0360/9586-102(R)-2	PART-A SUB-SECTION-III-D CIVIL WORKS	PAGE 3 OF 4

CLAUSE NO.	SCOPE OF SUPPLY & SERVICES 		
	<p>14. Use of ash and ash based products:</p> <p>In line with Gazette Notification on Ash Utilization issued by MOEF and its amendment thereafter, Bidder shall use ash and ash based products in construction of his offices, stores, staff quarters and labour huts etc. He shall furnish a compliance report along with all details of use of ahs and ash based products along with each bill. The above requirements shall be applicable to his sub-vendors also and Contractor shall be responsible for enforcing the same on his sub-vendors.</p> <p>15. Repair & Maintenance Facilities by the Bidder:</p> <p>Bidder shall establish/set up at site suitable repair facilities for construction plant, equipment and machinery (like cranes, hydra, forklifts, welding equipments, etc.) He will also make arrangements/tie up with manufacturers/ suppliers of such construction plant, equipment & machinery, for periodic overhaul/maintenance and for major breakdown, if any. He shall also keep adequate stock of spares at site for various construction plant, equipment and machinery to meet day to day requirements as recommended by the equipment manufacturer/suppliers or as instructed by the Engineer. Bidder shall deploy dedicated qualified, full time mechanical/electrical foreman/supervisors for manning the repair facilities as specified above.</p>		
<p>MOUDA SUPER THERMAL POWER PROJECT STAGE-II (2X660 MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-9575/9571/0370/ 0360/9586-102(R)-2</p>	<p>PART-A SUB-SECTION-III:D CIVIL WORKS</p>	<p>PAGE 4 OF 4</p>



**TITLE: 2X660 MW MOUDA STPP, STAGE-II
MOUDA**

PROJECT INFORMATION

SPECIFICATION NO. PE-TS-385-600-C001

VOLUME – IIB

SECTION “B”

REV. 00

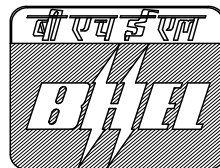
SHEET 1 OF 3

**NTPC
MOUDA, SUPER THERMAL POWER PROJECT
2X660 MW, STAGE-II**

**VOLUME: II B
SECTION - B**


PROJECT INFORMATION

SPECIFICATION NO. PE-TS-385-600-C001



Bharat Heavy Electricals Limited

**Project Engineering Management
Power Sector, PPEI Building
Noida – 201 301**

	TITLE: 2X660 MW MOUDA STPP, STAGE-II MOUDA PROJECT INFORMATION	SPECIFICATION NO. PE-TS-385-600-C001	
		VOLUME – IIB	
		SECTION “B”	
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		SHEET 2 OF 3	

INTRODUCTION

2X660 MW MOUDA STPP, STAGE-II is being setting up by NATIONAL THERMAL POWER CORPORATION LIMITED (NTPC) near the existing 2X500 MW Thermal Power Plant under implementation at MOUDA in the state of MAHARASTRA. The plant will have an ultimate capacity of 2320MW.



**TITLE: 2X660 MW MOUDA STPP, STAGE-II
MOUDA**

PROJECT INFORMATION

SPECIFICATION NO. PE-TS-385-600-C001

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SECTION “B”

REV. 00

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SPECIFIC PROJECT INFORMATION





SUB-SECTION - II


PROJECT INFORMATION


MOUDA SUPER THERMAL POWER PROJECT
STAGE-II (2x660 MW)
STEAM GENERATOR PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOCUMENT NO. : CS-9575/9571/0370/0360/9586-102(R)-2

CLAUSE NO.	PROJECT INFORMATION			
1.00.00	<p>BACKGROUND</p> <p>Mouda STPP Stage-I comprising of two units of 500 MW each is presently under implementation. Now in view the huge power generation capacity requirement and future capacity addition plans, it is proposed to enhanced capacity of Mouda STPP. The present proposal is to install additional two units of 660 MW in Stage-II this making the ultimate capacity of the project to 2320 MW.</p>			
1.01.00	<p>LOCATION AND APPROACH</p> <p>The plant site is located in Mouda Tehsil, district Nagpur of Maharashtra Stage, having latitude and longitude of 20° 10'50" N and 79° 23'52" E respectively. The site is bounded by villages Kumbhari on North, Lapka & Mouda on South, Koradi on East & Rahli on West and is at a distance of about 4 Kms. From Mouda town and approachable from NH-6. Nearest railway station is Chacker 8 Kms away from site on Nagpur – Kolkata Broad Gauge (BG) section of South Eastern Railway (main line). The nearest commercial airport is at Nagpur located at a distance of approximately 42 Kms form the project site.</p> <p>Vicinity Plan is enclosed as Annexure – I</p> <p>For further information apart from given in this sub-section and Bidders are also advised to visit the project site and collect data regarding local site conditions.</p>			
1.02.00	<p>LAND</p> <p>For Stage-I of Mouda project, about 1580 acres of land required for the project is acquired/under acquisition.</p> <p>About 125 acres of additional land for plant and 50 acres for Township required. The same has been identified contiguous to existing plant and township areas. The township is to be located in North West of the plant area and on Mouda – Ramtek road, 6 kms away from Mouda town. No major problem anticipated in acquisition as per site visit and discussions with State Govt. officials.</p> <p>About 550 acres of land is required for ash disposal. Alternatives suggested by Mouda site visited on 09.07.09 and the land near Kirnapur & Kpra villages have been finalized. In principle land availability for Mouda Stage-II has been obtained from Office of the Collector, Nagpur vide letter ref. No. Desk-17/Resettlement/T-1/w.s. 323/09 dated 27.08.09.</p>			
1.03.00	<p>WATER</p> <p>Make up water requirement for Stage-II of this project would be about 4800 m³/hr. Water requirement for the project will be met from pondage created on river Wain Ganga/ Kanhan by construction of dam near Gosikhurd by Govt. of Maharashtra. Make-up water shall be drawn from above mentioned source and shall be pumped to the raw water reservoir located about 24 Kms from intake well.</p> <p>Maharashtra Government has approved the reservation of 100 MCM water including the evaporation losses for NTPC in Goshikhurd Project for the ultimate stage of the project (Stage-I 2x500 MW) + Stage-II (2x660 MW). Ministry of Industries, Energy and Labour Department, Government of Maharashtra vide letter dated 10.12.2002 has given in principle consent for making available the required water for the Mouda project.</p>			
<p>MOUDA SUPER THERMAL POWER PROJECT STAGE-II (2X660 MW) STEAM GENERATOR PACKAGE</p>		<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-9575/9571/0370/ 0360/9586-102(R)-2</p>	<p>PART-A SUB SECTION-II PROJECT INFORMATION</p>	<p>PAGE 1 OF 17</p>

CLAUSE NO.	PROJECT INFORMATION			
1.04.00	<p>Railway Siding</p> <p>Employer intends to construct the railway siding to project site from the nearest existing railway line. However the same may not be available to the bidder for his use to transport equipment and material.</p> <p>Bidder may visit the site and acquaint themselves with the facilities available.</p>			
1.05.00	<p>COAL AVAILABILITY AND TRANSPORTATION</p> <p>Coal Availability</p> <p>Raw coal is proposed as fuel. The annual coal requirement would be about of 7.5 MTPA for 2X660 MW of Mouda STPP Stage-II.</p> <p>Likely coal source for the expansion project is similar to Mouda TPP Stage-I. The matter has been taken up with Ministry of Coal, Govt. of India for Long Term Coal Linkage.</p> <p>Coal Transportation</p> <p>Coal is proposed to be transported through Indian Railways network.</p>			
1.06.00	<p>Coal Quality Parameters / Fuel Oil Characteristics</p> <p>The coal quality parameters and Fuel oil Characteristics are attached at SUB-SECTION-V, PART-A.</p>			
1.07.00	<p>Capacity</p> <p>Stage-I : 2x500 MW Under Construction / Implementation</p> <p>Stage-II : 2x660 MW Present proposal</p>			
1.08.00	<p>Construction Power</p> <p>The requirements of the construction power supply for the project would be met from the existing 11 kV Miscellaneous Switchgear located near 132 KV switchyard. Necessary 11 kV ring main/LT sub-stations shall be provided for the required power plant area.</p>			
1.09.00	<p>Metrological Data</p> <p>The metrological data from nearest observatory is placed at Annexure-II.</p>			
1.10.00	<p>Plant Water Scheme</p> <p>The Plant water scheme is described below.</p>			
1.10.01	<p>Condenser Cooling (CW) Water System</p> <p>It is proposed to provide recirculating type CW system with induced draft type cooling towers. For the recirculating type CW system it is proposed to supply clarified water as make up. Raw water from the make-up water pump house shall be pumped to a Water Pretreatment Plant (PT - CW system). The treated clarified water shall be led to the cold water channel of CW system. CW system shall be operated at a C.O.C of about 4 . Chemical treatment programme (using acid dosing and scale cum corrosion inhibitors dosing) may be employed in addition to blow down of CW water to control the CW system chemistry in case CW system is required to be operated beyond 4COC. The expected circulating water analysis is</p>			
<p>MOUDA SUPER THERMAL POWER PROJECT STAGE-II (2X660 MW) STEAM GENERATOR PACKAGE</p>		<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-9575/9571/0370/ 0360/9586-102(R)-2</p>	<p>PART-A SUB SECTION-II PROJECT INFORMATION</p>	<p>PAGE 2 OF 17</p>

CLAUSE NO.	PROJECT INFORMATION 		
1.10.02	<p>given in this sub-section Annexure-III. CW blow down shall be drawn from the discharge of CW pumps and the same shall be led to a Service water Tank. For carrying circulating water from CW pump house to TG-area and from TG area to cooling tower, steel lined concrete encased duct would be provided. For interconnecting CW duct with CW pump, condenser and cooling towers, steel pipes would be used. Cooled water from cooling tower will be led to CW pump house through the cold water channel by gravity.</p> <p>Equipment Cooling Water (ECW) System (Unit Auxiliaries)</p> <p>The plant auxiliaries of Steam Generator and Turbine Generator shall be cooled by Demineralized (DM) water in a closed circuit. The primary circuit DM water shall be cooled through plate type heat exchangers by Circulating Water tapped from CW system in a closed secondary circuit. The hot secondary circuit cooling water shall be cooled in the cooling towers and shall be returned back to the system. It is proposed to provide independent primary cooling water circuit for Steam Generator & auxiliaries and TG & its auxiliaries.</p>		
1.10.03	<p>Station Auxiliaries Cooling Water System</p> <p>The station auxiliaries such as Air compressors, Compressors of ash handling plant, Cooling water circuit of Air Conditioning system, compressor of mill reject system etc. shall be cooled by separate cooling water System using separate set of pumps and cooling towers.</p>		
1.10.04	<p>Ash Water System</p> <p>Gland sealing are provided in necessary LP & HP water pumps, flushing water pumps & seal water pumps for slurry disposal pump .</p>		
1.10.05	<p>Other Miscellaneous Water Systems</p> <p>a) CW system blow down water shall be used for the plant service water requirement, dust suppression system of coal handling plant, ash slurry pumps sealing, sealing of Vacuum pumps (if applicable) of Ash Handling plant, make-up to fire water storage tanks and cooling water requirement of hydrogen generation plant. The service (wash water) water collected from various areas shall be treated using oil water separators, tube settlers, coal settling pits etc. as per requirement and treated water from liquid effluent treatment plant shall be recycled back to the service water system for re-use. The excess service water shall be led to central monitoring basin for disposal.</p> <p>b) Separate water Pre-treatment plants are proposed for Circulating Water (PT-CW) system, Demineralization Plant (PT-DM) plant.</p> <p>c) The drinking water requirement of the plant and colony shall be provided from the above mentioned Water (PT- CW) pretreatment plant.</p> <p>d) Steam Cycle make-up water, makeup to the primary circuit of ECW (unit auxiliaries) system, boiler fill water and makeup to the hydrogen generation plant shall be provided from Dematerializing plant.</p> <p>e) The quality of cooling water & DM water is given in this sub-section as Annexure-III & IV respectively.</p>		
1.11.00	<p>Criteria for Earthquake Resistant Design of Structures and Equipment</p> <p>All power plant structures and equipment, including plant auxiliary structures and equipment shall be designed for seismic forces as given in this sub-section as Annexure-V.</p>		
MOUDA SUPER THERMAL POWER PROJECT STAGE-II (2X660 MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-9575/9571/0370/ 0360/9586-102(R)-2	PART-A SUB SECTION-II PROJECT INFORMATION	PAGE 3 OF 17

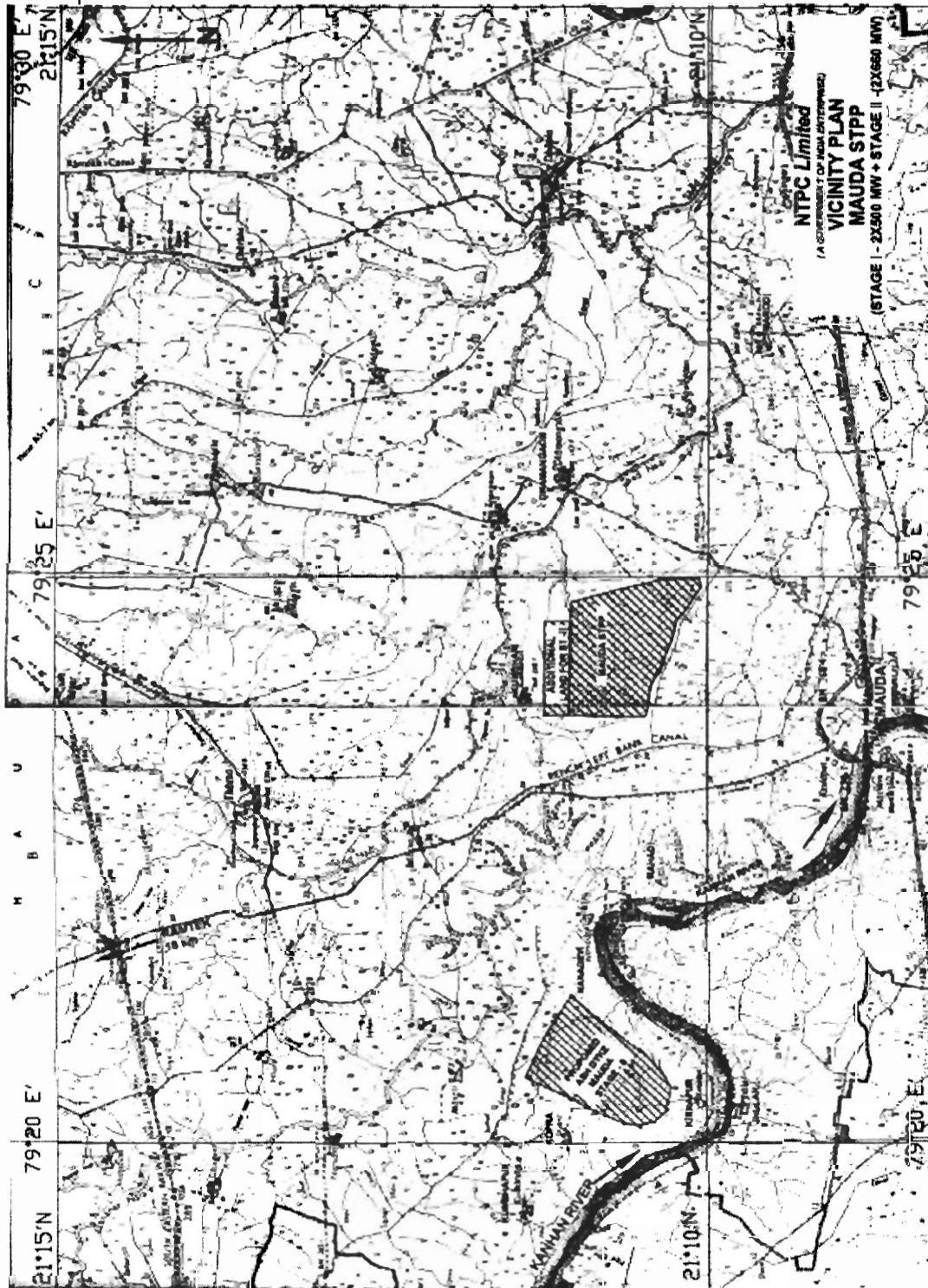
CLAUSE NO.	PROJECT INFORMATION			
1.12.00	<p>Criteria for Wind Resistant Design of Structures and Equipment</p> <p>All structures and equipment of the power plant, including plant auxiliary structures and equipment, shall be designed for wind forces as given as given in this sub-section as Annexure-VI.</p>			
MOUDA SUPER THERMAL POWER PROJECT STAGE-II (2X660 MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-9575/9571/0370/ 0360/9586-102(R)-2	PART-A SUB SECTION-II PROJECT INFORMATION	PAGE 4 OF 17	

CLAUSE NO.

PROJECT INFORMATION



ANNEXURE-I



MOUDA SUPER THERMAL POWER PROJECT
STAGE-II (2X660 MW)
STEAM GENERATOR PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOC. NO.: CS-9575/9571/0370/
0360/9586-102(R)-2

PART-A
SUB SECTION-II
ANNEXURE-I

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CLAUSE NO.

PROJECT INFORMATION



Annexure-II

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन का नाम: Mouda (Mouda)
 स्थिति: उत्तर प्रदेश, भारत
 निर्देशांक: LAT 24°06' N, LONG 79°03' E
 उचाई: 310 Meters
 आधारित अवधि: 1961 से 1993 तक के अवधि पर आधारित
 BASED ON OBSERVATIONS FROM 1961 TO 1993

MONTH	DAILY MEAN TEMPERATURE			AIR TEMPERATURE			EXTREMES			HUMIDITY			CLOUD AMOUNT			RAINFALL			HEAVIEST FALL IN MONTH	DATE AND YEAR
	MAX	MIN	MEAN	HIGHEST	LOWEST	MEAN	HIGHEST	LOWEST	RELATIVE	AVERAGE	ALL	LOW	NO OF DAYS	TOTAL	NO OF DAYS	TOTAL	NO OF DAYS	TOTAL		
JAN	20.0	10.0	15.0	35.0	3.0	19.0	80	12.1	2.0	0.5	10.2	1.0	10.2	0.0	60.3	0.7	1963	8.6		
FEB	22.0	12.0	17.0	38.0	5.0	20.0	75	11.7	1.7	0.5	12.3	1.1	12.3	0.0	51.6	0.5	1962	7.9		
MAR	25.0	15.0	20.0	40.0	8.0	22.0	65	11.0	1.9	1.0	17.8	1.5	17.8	0.0	45.0	0.8	1961	8.5		
APR	28.0	18.0	23.0	42.0	10.0	24.0	55	10.0	2.5	1.4	13.2	1.4	13.2	0.0	38.4	1.9	1968	8.8		
MAY	31.0	21.0	26.0	45.0	13.0	26.0	45	9.0	3.0	2.0	16.0	1.2	16.0	0.0	31.0	1.2	1968	13.4		
JUN	34.0	24.0	29.0	47.0	16.0	28.0	35	8.0	3.7	3.7	17.2	0.0	17.2	0.0	25.0	1.2	1961	14.1		
JUL	36.0	26.0	31.0	49.0	19.0	30.0	25	7.0	4.0	4.0	15.0	1.0	15.0	0.0	21.0	1.0	1961	15.0		
AUG	35.0	25.0	30.0	48.0	18.0	29.0	30	8.0	3.6	3.6	14.0	1.0	14.0	0.0	19.0	1.0	1961	12.0		
SEPT	32.0	22.0	27.0	45.0	15.0	27.0	40	9.0	3.2	3.2	12.0	1.0	12.0	0.0	16.0	1.0	1961	11.0		
OCT	28.0	18.0	23.0	40.0	10.0	24.0	50	11.0	2.2	2.2	11.0	0.7	11.0	0.0	8.5	0.7	1962	7.2		
NOV	24.0	14.0	19.0	35.0	7.0	21.0	60	12.0	1.9	1.9	17.2	0.8	17.2	0.0	61.0	0.9	1962	6.4		
ANNUAL	27.0	16.0	21.5	48.0	12.0	24.0	45	10.0	2.5	2.5	112.7	50.3	112.7	364.7	315.0	9.5				

CLAUSE NO.

PROJECT INFORMATION



मौदावादी सारणी
CLIMATOLOGICAL TABLE

स्टेशन नाम (Station Name):
STATION : RAIPUR (Sourapur)

MONTH	WIND		TEMPERATURE (°C)		RELATIVE HUMIDITY (%)		WIND SPEED (km/hr)		NO. OF DAYS WITH		NO. OF DAYS WITH		NO. OF DAYS WITH		NO. OF DAYS WITH		NO. OF DAYS WITH		NO. OF DAYS WITH	
	VELOCITY (km/hr)	DIR.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.	MAX.	MAX.	MIN.	MAX.	MIN.	MAX.	MAX.	MIN.	MAX.	MIN.	MAX.	MIN.
JAN	1.5	0.0	1.4	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FEB	1.5	0.0	1.4	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAR	2.0	0.1	4.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
APR	3.3	0.1	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MAY	2.8	0.0	5.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
JUN	1.3	0.0	12.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
JUL	2.1	0.0	10.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AUG	2.3	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SEP	1.4	0.0	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
OCT	4.3	0.0	2.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NOV	1.1	0.0	3.5	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
DEC	1.9	0.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ANNUAL	67.7	1.1	63.0	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

MOUDA SUPER THERMAL POWER PROJECT
STAGE-II (2X660 MW)
STEAM GENERATOR PACKAGE

TECHNICAL SPECIFICATION
SECTION-VI
BID DOC. NO.: CS-9575/9571/0370/
0360/9586-102(R)-2

PART-A
SUB SECTION-II
ANNEXURE-II

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24

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PROJECT INFORMATION




Annexure – III

COOLING WATER ANALYSIS

Constituent	as	mg per litre
Calcium	CaCO ₃	407
Magnesium	CaCO ₃	250
Sodium & Potassium	CaCO ₃	175
Cations	CaCO ₃	832
Bicarbonates	CaCO ₃	516
Chloride	CaCO ₃	162
Sulphate	CaCO ₃	154
Anions	CaCO ₃	832
Silica	SiO ₂	50
Iron	Fe	< 0.8
pH Value	-	8.4
TSS	mg/l	< 25

Note : The C.W system is expected to operate at about 3.0 Cycles of Concentration.

CLAUSE NO.	PROJECT INFORMATION																										
	<p style="text-align: right;">Annexure – IV</p> <p style="text-align: center;">ANALYSIS OF DM WATER TO BE USED FOR MAKE-UP WATER TO CONDENSER</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%;">S.No.</th> <th style="width: 60%;">Characteristics</th> <th style="width: 10%;"></th> <th style="width: 20%;">Value</th> </tr> </thead> <tbody> <tr> <td>i)</td> <td>Silica (Max.)</td> <td style="text-align: center;">-</td> <td>0.02 ppm as SiO₂</td> </tr> <tr> <td>ii)</td> <td>Iron as Fe</td> <td style="text-align: center;">-</td> <td>Nil</td> </tr> <tr> <td>iii)</td> <td>Total hardness</td> <td style="text-align: center;">-</td> <td>Nil</td> </tr> <tr> <td>iv)</td> <td>pH value</td> <td style="text-align: center;">-</td> <td>6.8 to 7.2</td> </tr> <tr> <td>v)</td> <td>Conductivity</td> <td style="text-align: center;">-</td> <td>Not more than 0.1 excluding the effects of free CO₂</td> </tr> </tbody> </table>			S.No.	Characteristics		Value	i)	Silica (Max.)	-	0.02 ppm as SiO ₂	ii)	Iron as Fe	-	Nil	iii)	Total hardness	-	Nil	iv)	pH value	-	6.8 to 7.2	v)	Conductivity	-	Not more than 0.1 excluding the effects of free CO ₂
S.No.	Characteristics		Value																								
i)	Silica (Max.)	-	0.02 ppm as SiO ₂																								
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MOUDA SUPER THERMAL POWER PROJECT STAGE-II (2X660 MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC. NO.: CS-9575/9571/0370/ 0360/9586-102(R)-2	PART-A SUB SECTION-II ANNEXURE-IV	PAGE 9 OF 17																								



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MW , STAGE-II MOUDA, SUPER
CRITICAL TPS**

SPECIFICATION NO. PE-TS-385-600-001

VOLUME - IIB

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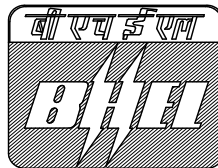
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**MOUDA, SUPER CRITICAL TPS
2X660 MW , STAGE-II**

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**SPECIFIC TECHNICAL REQUIREMENTS FOR CIVIL,
STRUCTURAL & ARCHITECTURAL WORKS**



**Bharat Heavy Electricals Limited
Project Engineering Management
Power Sector, BHEL**



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- PART-I : GENERAL CIVIL REQUIREMENT
PART-II : SPECIFIC DESIGN REQUIREMENTS - CIVIL



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PART-I

GENERAL CIVIL REQUIREMENT



**SPECIFIC TECHNICAL REQUIREMENT
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1. GENERAL

Two Volumes-Section C & Section D of this specification covers design and construction of Civil, Structural and Architectural works. The scope of works covers complete Civil, Structural and Architectural Works **including** supply of all materials, labour, tools and plants as required for successful execution of the packages. This Part-I of Section-C lists Codes and Standards to be adopted and the principal structures of the plant, and briefly describes the basic concept, requirements and features pertinent to each. **If there is any ambiguity and/or contradiction between Section C and Section D, the provisions / requirements laid in Section C shall prevail. In case of ambiguity between BOQ and Part C former shall prevail.**

(Contractor shall read the parts of the specification relevant to the contract and shall ignore the other parts of the specification. Relevant clauses of this section as applicable for respective package to be followed.)

2. CODES AND STANDARDS

Following is a general listing of Codes and Standards to be used in the design of the Plant. Specific applicable codes and standards will be identified in System Design Descriptions/ Technical Specifications as appropriate. The latest editions/ revision of following codes and standards along with addendums/ amendments, if any, shall be followed :

2.1. Concrete

- a) IS-269 : Ordinary and low heat portland cement.
- b) IS-383 : Coarse and fine aggregate from natural sources for concrete.
- c) IS-432 : Mild Steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
- d) IS-455 : Portland Slag Cement.
- e) IS-456 : Code of Practice for Plain and reinforced concrete.
- f) IS-460 : Test Sieves (all parts).
- g) IS-516 : Methods of test for strength of concrete.
- h) IS-1199 : Methods of sampling and analysis of concrete.
- i) IS-1566 : Hard drawn steel wire fabric for concrete Reinforcement.
- j) IS-1786 : High strength deformed steel bars and wires for concrete reinforcement.
- k) IS-1834 : Hot applied sealing compounds for joints in concrete.
- l) IS-2386 : Methods of test for aggregates for concrete (all parts).
- m) IS-2502 : Code of practice for bending and fixing of bars for concrete reinforcement.
- n) IS-3370 : Code of practice for concrete structures for storage of liquids (all parts).
- o) IS-3414 : Code of practice for design and installation of joints in buildings.

- p) IS-4948 : Welded steel wire fabrics for general use.
- q) IS-6452 : High Alumina Cement for Structural use.

- r) IS-7320 : Concrete slump test apparatus.
- s) IS-7861 : Code of practice for extreme weather concreting (all



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- parts).
- t) IS-8041 : Rapid Hardening Portland Cement.
 - u) IS-8112 : High strength ordinary Portland Cement.
 - v) IS-10262 : Recommended guidelines for concrete mix design.
 - w) IS-458 : Specification for precast concrete pipes.
 - x) IS-3935 : Code of practice for composite construction.
 - y) IS-4995 : Criteria for design of reinforced concrete bins for storage of granular (all parts) and powdery materials.
 - z) IS-5525 : Recommendation for detailing of reinforced concrete works.
 - aa) IS-11384 : Code of practice for composite construction in structural steel and concrete.
 - bb) IS-11682 : Criteria for design of RCC staging for overhead water tanks.
 - bb) IS-13920 : Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces.

2.2. Foundations

- a) IS-1904 : Code of practice for structural safety of buildings : Shallow foundations.
- b) IS-2950 : Code of practice for design and construction of raft foundations.
- c) IS-2974 : Code of practice for design and construction of Machine foundations (all parts).
- d) IS 2911 : Code of practice for Design and Construction of Pile foundations (all parts).
- e) IS 1080 : Code of practice for Design and Construction of shallow foundations on soils (other than raft, ring and shell)
- f) IS 4091 : Code of practice for Design and Construction of foundations for transmission line towers and poles
- g) IS 8009 : Code of practice for calculation of settlement of foundations: (all parts)
- h) IS 9556 : Code of practice for Design and Construction of diaphragm walls.
- i) IS 11089 : Code of practice for Design and Construction of ring foundation.
- j) IS 13301 : Guidelines for vibration isolation for machine foundation.

2.3. Loading

- a) IS-875 : Code of practice for Structural safety of buildings - loading standards.
- b) : Bridge Rules of Government of India, Ministry of Railways (Railway Board).
- c) IS-1911 : Schedule of unit weights of building materials.

2.4. Masonry

- a) IS-712 : Building limes.
- b) IS-1077 : Common Burnt Clay Building Bricks.
- c) IS-1127 : Recommendations for dimensions and workmanship of natural building stones for masonry work.
- d) IS-1528 : Methods of sampling and physical tests for refractory materials.

- e) IS-1597 : Code of practice for construction of stone masonry (all parts).

- f) IS-2212 : Code of practice for brickwork.
- g) IS-2116 : Sand for masonry mortars



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- h) IS-2185 : Concrete masonry units. (all parts - Hollow and Solid concrete blocks).
i) IS-2250 : Code of practice for preparation and use of masonry mortars.
j) IS-2572 : Code of practice for construction of hollow concrete block masonry.
k) IS-2691 : Burnt clay facing bricks.
l) IS-3414 : Code of practice for design and installation of joints in buildings.
m) IS-3495 : Methods of tests of burnt clay building bricks.
n) IS-4441 : Code of practice for use of Silicate type chemical resistant mortars.
o) IS-4860 : Acid Resistant Bricks.
p) IS-1905 : Code of practice for structural use of unreinforced masonry.
q) IS-10440 : Code of practice for construction of reinforced brick and reinforced brick concrete floors and roofs.

2.5.Doors, Windows and Ventilators

- a) IS-399 : Classification of commercial timbers and their zonal distribution.
- b) IS-883 : Code of practice for design of structural timber in building.
c) IS-1003 : Timber panelled and glazed shutters (all parts).
d) IS-1038 : Steel doors, windows and ventilators.
e) IS-1081 : Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
f) IS-1361 : Steel windows for industrial buildings.
g) IS-2835 : Transparent sheet glass for glazing and framing purposes.
h) IS-1948 : Aluminium doors windows and ventilators.
i) IS-1949 : Aluminium windows for industrial building.
j) IS-2191 : Wooden flush door shutters (Cellular and hollow core type).
k) IS-2202 : Wooden flush door shutters (solid core type).
l) IS-3103 : Code of practice for Industrial ventilation.
m) IS-3548 : Code of practice for glazing in buildings.
n) IS-3614 : Fire check doors.
o) IS-4021 : Timber door, windows and ventilator frames.
p) IS-4351 : Steel door frames.
q) IS-6248 : Metal rolling shutters and rolling grills.

2.6.Roof and Flooring

- a) IS-2204 : Code of practice for construction of reinforced concrete shell roof.
b) IS-3201 : Criteria for the design and construction of precast concrete trusses.
c) IS-2210 : Criteria for Design of R.C. shell structures and folded plates.
d) IS-809 : Rubber flooring materials for general purposes.
e) IS-1195 : Bitumen mastic for flooring.
f) IS-1196 : Code of practice for laying bitumen mastic flooring.
g) IS-1198 : Code of practice for laying, fixing and maintenance of linoleum floors.
h) IS-1237 : Cement concrete flooring tiles.
i) IS-1443 : Code of practice for laying and finishing of cement concrete flooring tiles.
j) IS-2114 : Code of practice for laying in situ terrazzo floor finish.
k) IS-2571 : Code of practice for laying in situ cement concrete flooring.
l) IS-5491 : Code of practice for laying in situ granolithic concrete floor topping.
m) IS-5766 : Code of practice for laying burnt clay brick flooring.
n) IS-1197 : Code of practice for laying of rubber floors.
o) IS-2441 : Code of practice for fixing ceiling coverings.

2.7.Waterproofing

- a) IS-1322 : Bitumen felts for waterproofing and damp proofing.



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- b) IS-1346 : Code of practice for waterproofing of roofs with bitumen felts.
- c) IS-1609 : Code of practice for laying damp proof treatment using bituminous felts.
- d) IS-3036 : Code of practice for laying lime concrete for a waterproofed roof finish.
- e) IS-3037 : Bitumen mastic for use in waterproofing of roofs.
- f) IS-3067 : Code of practice for general design, details and preparatory work for damp proofing and water proofing of buildings.
- g) IS-3384 : Bitumen primer for use in water proofing and damp proofing.
- h) IS-4365 : Code of practice for application of bitumen mastic for waterproofing of roofs.

2.8. Soil Engineering

- a) IS-1498 : Classification and identification of soils for general engineering purposes.
- b) IS-1892 : Code of practice for sub-surface investigation for foundations.
- c) IS-2131 : Method for standard penetration test for soils.
- d) IS-2720 : Methods of test for soils (all parts).

2.9. Water Supply, Drainage and Sewerage

- a) IS-404 : Lead pipes
- b) IS-458 : Concrete pipes
- c) IS-651 : Salt glazed stoneware pipes and fittings.
- d) IS-771 : Glazed fire-clay sanitary appliances (all parts).
- e) IS-774 : Flushing cisterns for water closets and urinals other than plastic cisterns.
- f) IS-783 : Code of practice for laying of concrete pipes.
- g) IS-1172 : Code of basic requirements for water supply, drainage and sanitation.
- h) IS-1626 : Asbestos cement building pipes, gutters and fittings (all parts).
- i) IS-1742 : Code of practice for building drainage.
- j) IS-2064 : Code of practice for selection, installation and maintenance of sanitary appliances.
- k) IS-2065 : Code of practice for water supply in buildings.
- l) IS-2470 : Code of practice for installation of septic tanks (all parts).
- m) IS-3114 : Code of practice for laying of Cast Iron pipes.
- n) IS-4127 : Code of practice for laying of glazed stoneware pipes.
- o) IS-12251 : Code of practice for Drainage of Building Basement.
- p) IS-1200 : Method of measurement : Laying of water and [Part- XVI] sewer lines including appurtenant items.
- q) IS-1536 : Centrifugally cast (spun) iron pressure pipes for water, gas and sewage.
- r) IS-1537 : Vertically cast iron pressure pipe for water, gas and sewage.
- s) IS-3486 : Cast iron spigot and socket drain pipes .
- t) IS-5329 : Code of practice for sanitary pipe work above ground for buildings.
- u) IS-3076 : Low density polyethylene pipes for potable water supplies.
- v) IS-1538 : Cast iron fittings for pressure pipes for water, gas and sewage.
- w) IS-1230 : Cast iron rainwater pipes and fittings.
- x) IS-1729 : Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
- y) IS-784 : Prestressed concrete pipes.
- z) IS-1726 : Cast iron manhole covers and frames.
- aa) IS-5961 : Cast iron grating for drainage purposes.
- bb) IS-5219 : "P" and "S" traps.
[Part-I]
- cc) IS-772 : General requirements for enamelled cast iron sanitary appliances.
- dd) IS-775 : Cast iron brackets and supports for wash basins and sinks.



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- ee) IS-777 : Glazed earthenware wall tiles.
ff) IS-2548 : Plastic water closet seats and covers (all parts).
gg) IS-2527 : Code of practice for fixing rainwater gutters and downpipes for roof drainage.

2.10. Paving and Road works

- a) IS-73 : Paving bitumen
b) IS-702 : Industrial Bitumen
c) IS-1201 : Method of testing tar and bituminous materials. thru' 1220
d) : Practice followed by Indian Road Congress (all parts).

2.11. Earthquake Resistant Design

- a) IS-1893 : Criteria for earthquake resistant design of structures.
b) IS-4326 : Code of practice for earthquake resistant design and construction of buildings.

2.12. Structural Steelwork

- a) IS-800 : Code of practice for general construction in steel.
b) IS-802 : Code of practice for use of structural steel in Overhead Transmission Line (All Parts).
c) IS-806 : Code of practice for use of steel tubes in general building construction.
d) IS-808 : Rolled steel beams, channels and angle sections.
e) IS-813 : Scheme of symbols for welding.
f) IS-814 : Covered electrodes for manual metal arc welding of carbon and carbon manganese steel.
g) IS-816 : Code of practice for use of metal arc welding for general construction in mild steel.
h) IS-817 : Code of practice for training and testing of metal arc welders.
i) IS-818 : Code of practice for safety and health requirements in electric and gas welding and cutting operation.
j) IS-819 : Code of practice for Resistance spot welding for light assemblies in Mild Steel.
k) IS-919 : Recommendations for limits and fits for engineering.
l) IS-1024 : Code of practice for use of welding in Bridges and Structures subjected to Dynamic loading.
m) IS-1161 : Steel tubes for structural purposes.
n) IS-1182 : Recommended practice for Radiographic Examination of Fusion Welded Butt joints in steel plates.
o) IS-1200 : Method of measurement of steelwork and ironwork.
[Part-VIII]
p) IS-1239 : Mild steel tubes, tubulars and other wrought steel fittings (all parts).
q) IS-1363 : Black hexagonal bolts, nuts and locknuts (dia. 6 to 39 mm) and black hexagon screws (dia.6 to 24 mm). [all parts]
r) IS-1364 : Precision and semi-precision hexagon bolts, screws, nuts and locknuts (dia. range 6 to 39 mm). [all parts]
s) IS-1365 : Slotted counter sunk head screws (dia range 1.6 to 20 mm).
t) IS-1367 : Technical supply conditions for threaded steel fasteners.
u) IS-1443 : Code of practice for laying and finishing of cement concrete flooring tiles.



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- v) IS-1608 : Method for tensile testing of steel products.
- w) IS-1730 : Dimensions for steel plate, sheet and strip for structural and general engineering purpose.
- x) IS-1731 : Dimensions for steel flats for structural and general engineering purposes.
- y) IS-1852 : Rolling and cutting tolerances for hot rolled steel products.
- z) IS-1977 : Structural steel (Ordinary quality)
- aa) IS-2016 : Plain Washers
- bb) IS-2062 : Steel for General structural purposes.
- cc) IS-2074 : Ready mixed paint, air drying, red oxide zinc-chrome, priming.
- dd) IS-2633 : Methods of testing uniformity of coating of zinc coated articles.
- ee) IS-3613 : Acceptance tests for wire-flux combinations for submerged-arc welding of structural steels.
- ff) IS-3664 : Code of practice for Ultrasonic Pulse echo testing by contact and immersions methods.
- gg) IS-3757 : High strength structural bolts.
- hh) IS-4000 : High strength bolts in steel structures.
- ii) IS-4759 : Hot dip zinc coatings on structural steel and other allied products.
- jj) IS-5334 : Code of practice for Magnetic Particle Flaw detection of welds.
- kk) IS-7215 : Tolerances for fabrication of steel structures.
- ll) IS-7280 : Base-wire electrodes for sub-merged arc welding of structural steels.
- mm) IS-7318 : Approval test for welders when welding procedure approval is not required.
[Part-I]
- nn) IS-8500 : Structural steel - microalloyed (medium and high strength qualities).
- oo) IS-9595 : Recommendation for metal arc welding of carbon and carbon manganese steels.
- pp) AWS D.1.1 Structural Welding Code.
- qq) IS-8640 : Recommendations for dimensional parameters for industrial building.
- rr) IS-9178 : Criteria for design of steel bins for storage of bulk material (all parts).
- ss) IS-12843 : Tolerances for erection of steel structures.

2.13. Painting

- a) IS-348 : Specification for French Polish.
- b) IS-427 : Specification for Distemper, dry colour as required.
- c) IS-428 : Specification for Distemper, oil emulsion, colour as required.
- d) IS-1477 : Code of practice for painting of ferrous metal in buildings.
[I & II]
- e) IS-2338 : Code of practice for finishing of wood and wood based materials.
[I & II]
- f) IS-2339 : Specification for Aluminium Paints for general purposes in dual containers.
- g) IS-2395 : Code of practice for painting concrete, masonry and plaster surface.
- h) IS-2932 : Specification for enamel, synthetic, exterior - a) undercoating, b) finishing.
- i) IS-2933 : Specification for enamel, exterior - a) undercoating, b) finishing.
- j) IS-5410 : Specification for cement paint.

2.14. Other

- a) Indian Road Congress (IRC) Bridge Codes
- b) Indian Railway Standard Bridge Rules

3. General



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All the quality standards, tolerances, welding standards and other technical requirements shall be strictly adhered to. The Bidder shall fully apprise himself of the prevailing conditions at the proposed site, climatic conditions including monsoon pattern, soil conditions, local conditions and site specific parameters and shall include for all such conditions and contingent measures in the bid, including those which may not have been specifically brought out in the specifications. In case of any conflict between stipulations in various portions of the specification, most stringent stipulation would be applicable for implementation by the Bidder without any extra cost to the Employer.

4. LAYOUT

Before starting the work, the Contractor shall carry out the setting out of foundation and structures and provide levels, with reference to general existing grid and bench mark. **If the Contractor uses the grid, bench mark and reference pillar made by other Contractors, he shall co ordinate with the Contractor and shall satisfy himself of the accuracy of the reference marks.** If he is required to set out the foundation afresh, he shall do so independently with reference to the one existing grid and bench

mark which has been followed by other agency at the instruction of the Engineer. In case any discrepancy is found, it shall be immediately brought to the notice of the Engineer for any rectification/modification necessary. No complaint shall be entertained at a later stage. The Contractor shall accurately set out the position for holding down bolts and inserts.

If required, in the opinion of the Engineer, he shall construct and maintain pillars for grid, references and bench marks and maintain them till the completion of the construction. He shall also help the Engineer with instruments, materials and labours for checking the detailed layouts and levels. The Contractor shall be solely responsible for the correctness of the layout and levels, and Engineer's approval shall not be deemed to imply any warranty in carrying out the works correctly. The Tenderer's shall take into account the cost of these in quoting their price.

5. WORKMANSHIP

Workmanship shall be of the best possible quality and all work shall be carried out by skilled workmen except for those which normally require unskilled persons. Welding shall be done by experienced and certified welders in proper sequence using necessary jigs and fixtures. Fabrication shall be done in shops having proper equipment for accurate edge and shaping and dimensioning of anchor bolt assembly, inserts and other misc. items. In addition to the requirement specified above, if the bye laws of the local Govt., Municipal or other authorities require the employment of licensed or registered workmen for various trades, the Contractor shall arrange to have the work done by such registered or licensed personnel. In case of manufactured materials, the Contractor shall have, with no additional cost to the Owner, the services of the supervisors of the manufacturers to ensure that the work is being done according to the manufacturer's specifications.

6. TEMPORARY WORK

All scaffoldings, staging, temporary bracing and other necessary temporary work required for proper execution of the Contract shall be provided by the Contractor at his own cost and inclusive of all materials, labour, supervision and other facilities.

The layout and details of such Temporary work shall have the prior approval of the Engineer, but the Contractor shall be responsible for proper strength and safety of the same. All Temporary work shall be so constructed as not to interfere with any permanent work or with the work by other agencies. If it



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is necessary to remove any of the temporary work at any time to facilitate execution of the work or with the work of other agencies, such removal and re erection, if required, shall be carried out by the Contractor at the direction of the Engineer without any delay and any extra cost on this account shall be borne by the Contractor.

7. INTERFACE WITH STRUCTURES UNDER OTHER'S SCOPE

Modification in layout of foundation/structure during detail engineering stage may be necessary to avoid fouling with those under other's scope. Necessary changes on this account will be made without any extra cost to Owner.

8. SEQUENCE OF WORK AND PROGRESS REPORT

The sequence in which the works are to be carried out shall be as approved by the Engineer in accordance with the construction method accepted by the Engineer and to be followed by the Contractor. A programme of work is to be submitted for the Engineer's review and approval and this has to be periodically updated and modified as per actual progress to enable timely completion.

The Contractor shall regularly submit to the Engineer progress reports for periods of working as specified by the Engineer showing up to date progress on all important items of work.

9. CONSTRUCTION METHODOLOGY

Construction and erection activities shall be fully mechanized from the start of the work. All excavation and backfilling work shall be done using excavators, loaders, dumpers, dozers, poclains, excavator mounted rock breakers, rollers, sprinklers, water tankers, etc. Manual excavation can be done only on isolated places with specific approval of engineer.

Dewatering shall be done using the combination of electrical and standby diesel pumps.

For concreting, weigh batching plants, transit mixers, concrete pumps, hoists, etc. shall be used.

All handling of materials shall be with cranes.

Heavy trailers shall be used for transportation.

Mechanized modular units of scaffolding and shuttering shall be used.

Grouting shall be carried out using hydraulically controlled grouting equipment.

All finishing items shall be installed using appropriate modern mechanical tools. Manual punching etc. shall not be permitted.

Heavy duty hoists for lifting of construction materials shall be deployed.

Compressors for cleaning of foundations and other surfaces shall be used.

Field laboratory shall be provided with all modern equipment for survey, testing of soil, aggregates, concrete, welding, etc.



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All persons working at site shall be provided with necessary safety equipment and all safety aspects shall be duly considered for each construction/ erection activity. Moreover, only the persons who are trained in the respective trade shall be employed for executing that particular work.



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PART-II

SPECIFIC TECHNICAL REQUIREMENT



SUB-SECTION-V

CIVIL WORKS

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NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW)
/RAGHUNATHPUR TPP PHASE-I (2 x660MW)
STEAM GENERATOR PACKAGE

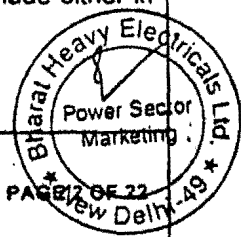
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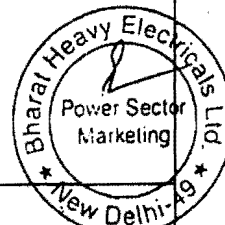
CLAUSE NO.	TECHNICAL REQUIREMENTS		
1.00.00	GENERAL		
1.01.01	This section of the Technical Specification covers the technical requirements for Design, preparation of General Arrangement Drawings, Design Drawings, Civil task drawings (for engineering by Employer for areas covered under Employer's scope), Supply of Labour, Materials, plant & equipment, Construction, fabrication and Erection of Civil and Structural works included in Contractor's scope.		
1.01.02	Description of various items of work under this Specification and nature of work in detail are given hereinafter. The complete works under this Specification is referred to as "Civil Works". Various Structures, Plant, Systems, Facilities, etc., covered under the Scope of this Specification is given in Part - A and herein.		
1.01.03	The work to be performed under this Specification shall also include Design, Engineering and providing of all Labour, Materials, Plant & Equipment, Consumables, Construction Facilities and all Incidental Items though not shown or specified but are reasonably implied and / or are necessary for the completion and proper functioning of the Plant, Systems and Facilities, all in strict accordance with the Specifications, including revisions and amendments thereto.		
1.01.04	All Materials required for works under the Contractor's scope shall be arranged and supplied by the Contractor.		
1.01.05	All support structures (as covered under the Scope) including those for pipes/cables/ducts above Foundation Level or Grade Level, whichever is lower shall be of Steel and shall be supplied and provided by the Contractor.		
1.01.06	All interconnecting platforms shall be supplied and provided by the Contractor.		
1.01.07	All mono-rails, monorail beams required for equipment handling, etc. shall be supplied and provided by the Contractor.		
1.01.08	Foundation Bolts along with templates, inserts and embedments along with lugs, pipe sleeves, etc. whatsoever required in concrete/masonry for supporting Equipment and Structures shall be supplied by the Contractor and placed by Employer. However the accuracy of these fixtures shall be checked and ensured by the Contractor during placement. Any modification required on these fixtures subsequent to their placement shall be done by Contractor.		
1.01.09	Steam Generator, mill bunker building, coal handling transfer points, coal conveyor galleries and its supporting trestles shall be supported by Contractor on Foundation through Foundation Bolt assemblies and shear keys installed at the time of first stage concreting.		
1.01.10	All other Structures shall be supported by Contractor on Foundation through Anchor Fasteners. For such Structures, Employer shall provide the Foundation, on which the Contractor shall supply and install, the Anchor Fasteners of requisite capacity to support his Structures.		
1.01.11	Anchor Fasteners shall be used for supporting all such Equipment, where the Static and Dynamic Load due to Equipment is within the safe Load carrying capacity of the Anchor Fasteners. For such Equipment, Employer shall provide the Foundation, on which the Contractor shall supply and install the Anchor Fasteners of requisite capacity to support his Equipment.		
1.01.12	The Employer shall provide the pockets only for those Equipment Foundations where the Load to be transferred is beyond the safe Load carrying capacity of Anchor Fasteners. For such Equipment, subsequent supply and installation of Foundation Bolts including		
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2	PART-B SUB-SECTION-V CIVIL WORKS	Power Sector Marketing PAGE 1 OF 22 New Delhi/49


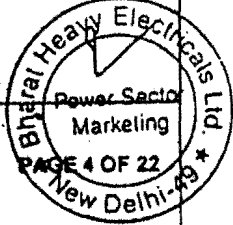
CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<p>of pockets shall be done by Contractor. In case, it is required that Foundation Bolts are required to be embedded during the first stage of concreting, then the Contractor shall make the Bolts available at site (before casting of foundation) for installation by Employer at the time of the concreting stage itself. During concreting, Contractor shall depute his engineers to verify that all foundation bolts/sleeves/embedments etc. are installed correct to layout and levels as per their design drawings. Any modification required on these fixtures subsequent to their placement shall be done by Contractor.</p>	
1.01.13	<p>All inserts and embedments whatsoever required by the Contractor over the Concrete, masonry and other similar surfaces, for supporting their Structures / Equipment etc. shall be installed by the Contractor using Anchors Fasteners. All small size Openings having size (within 150 mm x 150 mm area) which are required on Floors, Walls, Cladding, Roof etc. shall be neatly created and finished by the Contractor using appropriate tools. The Employer shall however provide larger size Openings.</p>	
1.01.14	<p>All Grouting of pockets, Underpinning of Base Plates, filling and finishing of Openings etc. shall be done by the Contractor. The Employer shall do encasement of Base Plates. Anchor Fasteners shall be fixed in position by Contractor as recommended by the manufacturer and approved by the Employer.</p>	
1.01.15	<p>The work shall be carried out according to the Design / Drawings, to be developed by the Contractor and got approved by the Employer. For all Plant, Systems, Facilities, Structures, etc., necessary Layout and details are to be developed by the Contractor keeping in view the statutory and functional requirements and providing enough space and access for Operation, use and Maintenance. The Contractor's work shall cover satisfying the complete requirements as per IS Codes, requirements of various Statutory Bodies, International Standards, best prevailing practices and to the complete satisfaction of the Employer.</p>	
1.01.16	<p>The Contractor shall make the Layout and Levels of all Structures from the general grid of the plot and the nearest GSI Benchmark or other acceptable Benchmark of Government Department, as per the directions of the Employer. The Contractor shall be solely responsible for the correctness of the Layout and Levels and shall also provide necessary instruments, manpower, materials, access to works, etc., to the Employer for general checking of the correctness of the Civil works.</p>	
1.01.17	<p>All the quality standards, tolerances, Welding standards and other technical requirements shall be strictly adhered to.</p>	
1.01.18	<p>The Contractor shall fully appraise himself of the prevailing conditions at the proposed Site, climatic conditions including monsoon pattern, soil conditions, local conditions and Site specific parameters and shall provide for all such conditions and contingent measures, including those which may not have been specifically brought out in the Specifications but required for successful execution of work.</p>	
1.01.19	<p>In case of any conflict between stipulations in various portions of the Specification, most stringent stipulation would be applicable for implementation by the Contractor without any extra cost to the Employer.</p>	
2.00.00	<p>SUBMISSIONS</p>	
2.01.01	<p>Commencement of Fabrication, Erection and Construction shall be done after approval of the relevant Design Documents and Drawings. All Drawings shall be of standard sizes (Metric System) and shall be made under AutoCAD, whereas all Documents shall be made either in MS Excel or in MS Word.</p>	
<p>MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (2x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2</p>	<p>PART-B SUB-SECTION-V CIVIL WORKS</p>





CLAUSE NO.	TECHNICAL REQUIREMENTS		
2.01.02	<p>The Design Documents and Drawings for the following areas shall be submitted for approval of the Employer.</p> <ul style="list-style-type: none"> (a) Steam Generator and Auxiliaries (b) Power Cycle Piping consisting of MS, HRH, CRH and Auxiliary Steam Piping. (c) Mill Reject Handling System. (d) Mill Bunker Building, Transfer points, conveyor galleries and its supporting trestles. 		
2.01.03	<p>The Design Documents and Drawings submitted by the Contractor shall contain at least the following Minimum information :</p> <ul style="list-style-type: none"> (a) General Arrangement for Equipment, Piping / Cables / Ducts. (b) Loading Plans indicating Floor Imposed Loads, Equipment Loads, Piping / Cables / Ducts Loads. (c) Openings in Floor/ Walls / Cladding / Roof. (d) Equipment Mounting Details (where Supporting Structures are provided by the Employer). (e) General Arrangement of Foundations including Loading Data, Bolt Details, Pocket Details, etc. (f) Insert Details, Anchor Fastener Details along with their General Arrangements. (g) Project Design Intent Document covering Design Criteria including Loading assumptions, references, structural idealisation / Mathematical Model, Load Cases, Load Combinations, etc. (h) Analysis and structural Design Calculations. (i) 3-D Analytical Model of Structure. (j) Details of Corrosion Protection Measures. (k) Any other submission, as indicated elsewhere in this Specification and / or as required by the Employer. 		
3.00.00	DESIGN CRITERIA		
3.01.00	General		
3.01.01	The Design criteria given herein are applicable for all Structures.		
3.01.02	Structures shall be Designed for the most critical Combinations of Dead Loads, Imposed Loads, Equipment Loads, Crane Loads (if any), Pipe Loads (Static, Friction and Dynamic), Cable / Ducts Loads, Ash Loads, Dust Loads, Wind Loads, Seismic Loads, Temperature Loads, Erection Loads, Loads due to Differential Settlement, etc.		
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CLAUSE NO.	<div style="text-align: right;"></div> TECHNICAL REQUIREMENTS		
3.02.00	Material Structural Steel (including embedded Steel) shall be straight, sound, free from twists, cracks, flaw, laminations and all other defects.		
3.02.01	Mild Steel <ol style="list-style-type: none"> a) Rolled sections and plates up to and including 20mm thickness shall conform to grade designation E250A semi killed of IS: 2062. Plates beyond 20mm thickness and up to 40mm thickness shall conform to grade designation E250B killed and controlled rolling conforming to IS:2062. Plates beyond 40mm thickness, shall conform to grade designation E250B killed, normalizing rolling as per IS:2062. Plates beyond 40mm shall be ultrasonically tested as per ASTM-A578 level B. b) Pipes shall conform to IS: 1161. c) Hollow (square and rectangular) steel sections shall be hot formed conforming to IS: 4923 and shall be of minimum Grade Yst 240. d) Chequered plate shall conform to IS 3502 and shall be minimum 6 mm thick excluding projection. Steel for chequered plate shall conform to grade E250A semi killed of IS: 2062. 		
3.02.02	Medium and High Tensile Steel <ol style="list-style-type: none"> a) Rolled sections and plates up to and including 20mm thickness shall conform to grade designation E350 semi killed of IS: 2062. Plates beyond 20mm thickness and up to 40mm thickness shall conform to grade designation E350 killed and controlled rolling conforming to IS:2062. Plates beyond 40mm thickness, shall conform to grade designation E350 killed, normalizing rolling as per IS:2062. Plates beyond 40mm shall be ultrasonically tested as per ASTM-A578 level B. 		
3.02.03	All other Materials shall be as per applicable Standards and Codes.		
3.02.04	All Materials brought for incorporation in works shall be of best quality as per IS, unless specified otherwise.		
3.03.00	Loading		
3.03.01	Dead Loads Dead Loads are permanent Loads which shall include the weight of Structure complete with finishes, fixtures, partitions, etc. and shall be taken as per IS:875 (Part-I).		
3.03.02	Imposed Loads <ol style="list-style-type: none"> (a) Imposed Loads in different areas shall include Live Loads, Erection, Operation and Maintenance Loads. (b) Equipment Loads (which constitute all Loads of Equipment to be supported, as given by Equipment Supplier), Pipe Loads (Static, Friction and Dynamic), Cable / Ducts Loads, Ash Loads, Dust Load, wherever applicable, are not included in the Imposed Loads as furnished below and these Loads shall be considered in addition to Imposed Loads. 		
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2	PART-B SUB-SECTION-V CIVIL WORKS	

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(c) For consideration of Imposed Loads on Structures, IS : 875 (Part 2) in general shall be followed. However, for the following areas, minimum imposed loads as indicated below shall be considered for the design. If the actual expected Imposed Load is more than the specified Minimum Imposed Load, then actual Imposed Load shall be considered.

Sl.No.	Description	Minimum specified Imposed Loads (T /Sq. M.)
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1.	Floors	
i)	Operating Floors	1.00
ii)	Separator Floor	1.00
iii)	Elevator Machine Room	1.00
iv)	Maintenance Platforms	1.00
v)	Feeder & Tripper Floor in mill & bunker building, Floors in TPs and any other Floors	0.50
2.	Roof / Penthouse	
i)	Non Accessible (with no Equipment)	0.075
ii)	Accessible	0.150
iii)	Dust Loads	Equivalent to 0.30M of Ash Deposit
3.	Equipment Laydown Loads.	As per Equipment supplier or 1.00, whichever is more.
4.	Lift Structure	As per Equipment supplier with 100 % Impact Factor.
5.	Cable/Pipes/Ducts Supports	0.40 for walkway (in addition to friction loads as applicable)

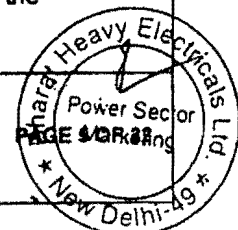
Note : Additionally Load for Cable/Piping/Ducting, shall be considered, as applicable


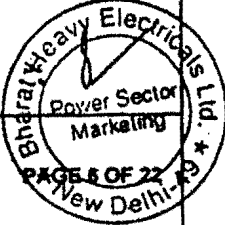
6.	Walkways (in conveyor galleries)	0.30
7.	Conveyor galleries	In addition to the live loads, loads due to cable trays, fire fighting/service water/ coal handling plant pipes shall also be considered @ 250Kgs./m (minimum) on each of the longitudinal girder.

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STEAM GENERATOR PACKAGE

TECHNICAL SPECIFICATION SECTION-VI
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3.03.03	<p>Roof-truss members are to be checked for supporting fire fighting pipes / Service water pipes. Tentative locations and diameter for pipes are shown in Tender Drawing.</p> <p>8. General</p> <ul style="list-style-type: none"> i) Stairs and Landings 0.50 ii) Walkways 0.50 iii) Balconies 0.50 iv) Chequered plate floors. 0.40 		
3.03.04	<p>Equipment, Piping / Cables / Ducts and associated Loads</p> <p>The Equipment, Piping / Cables / Ducts and associated Loads shall be considered as given by the supplier. Equipment Loads, which are of permanent nature, shall be treated as Dead Loads.</p> <p>For mill bunker building, TPs & conveyor galleries tentative loads are indicated in the tender drawings. Detailed load data including equipment loads, belt tension, etc. shall be furnished by the employer during detailed engineering stage.</p>		
3.03.05	<p>Seismic Loads</p> <p>All Structures shall be Designed for Seismic forces adopting the Site Specific Seismic information, as specified in Annexure-V to Sub-Section-II, Part-A of section-VI of Technical specification.</p>		
3.03.06	<p>Wind Loads</p> <p>All Structures shall be Designed for Wind forces adopting the Site Specific Wind parameters, as specified in Annexure-VI to Sub-Section-II, Part-A of section-VI of Technical specification.</p>		
3.03.06	<p>Temperature Loads</p> <p>(a) For temperature Loading, the total temperature variation shall be considered as 2 / 3 of the average maximum annual variation in temperature. The average maximum annual variation in temperature for this purpose shall be taken as the difference between the mean of the daily Minimum ambient temperature during the coldest month of the year and mean of daily maximum ambient temperature during the hottest month of the year. The Structure shall be Designed to withstand Stresses due to 50% of the total temperature variation.</p> <p>(b) Suitable expansion joints shall be provided in the Longitudinal direction wherever necessary with provision of twin columns. The maximum distance of the expansion joint shall be as per the provisions of IS : 800 for Steel Structures.</p> <p>(c) Frictional forces due to temperature variation shall be considered between the Pipes and the supporting Structures along Longitudinal direction.</p>		
MOUDA STPP-4 (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-1 (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2	PART-B SUB-SECTION-V CIVIL WORKS	 PAGE 6 OF 22



CLAUSE NO.

TECHNICAL REQUIREMENTS

3.03.07

Ash Density

(a) Following Ash density shall be considered for the Design :

Sl.No.	Description	Density (Kg/Cu. M.)
a)	Bottom Ash for volume calculations	650
b)	Bottom Ash for Load calculations	1600
c)	Fly Ash for volume calculations	750
d)	Fly Ash for Load calculations	1300
e)	Dry Fly Ash for dry fly ash Pipeline supporting Structures (Pipe to be considered full)	1000

3.03.08

Ash Loads

- (a) Ash Load over Penthouse / Roof of Steam Generator shall be considered.
- (b) Ash Load in the flue gas Duct shall be as per clause no.15.01.02 section VI Part B sub-section-II: M1 of technical specification.

3.03.09

Differential settlement Loads

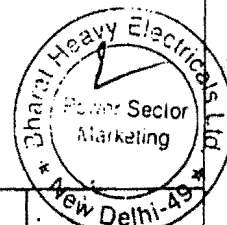
Structures shall be Designed considering an additional Load on account of differential settlement of 1 in 1000 between any two adjacent columns, subject to a maximum differential settlement of 8 mm.

3.03.10

Additional Loads due to Employer Facilities

Following Minimum additional Loads supporting the Employers Facilities shall be considered in the Design of Steam generator Structures, Mill & Bunker Building, Coal handling Transfer points and Trestles for the supporting of the Employers Facilities.

- (a) Cantilever Loads of not less than 500 Kg / M at a distance of 1200 mm from the external face of the columns, on both sides of the Steam Generator, for Cable trays and Walkways.
- (b) Cantilever Loads of not less than 2000 Kg / M at a distance of 2500 mm from the external face of the Mill & Bunker Building columns, CHP transfer point columns/ VGTU columns & conveyor gallery trestles (on one side) for Cable trays and Walkways.
- (c) Dry Fly Ash Piping Loads.
- (d) Ash Water Piping Loads.
- (e) Supply Air and Instrument Air Piping.
- (f) Service Water Piping


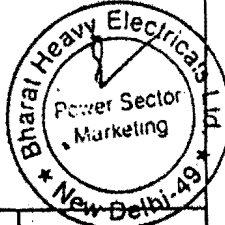


-MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE

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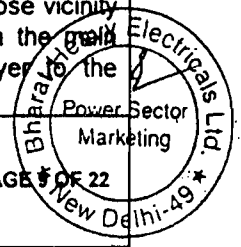
PART-B SUB-SECTION-V CIVIL WORKS


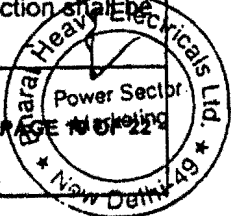
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CLAUSE NO.	TECHNICAL REQUIREMENTS													
3.04.00	(g) Loads associated with Coal Handling Plant equipment Design Concepts													
3.04.01	Individual members of the frame shall be Designed for the worst Combination of forces such as bending moment, axial force, shear force, torsion, etc.													
3.04.02	The different Load Combinations shall be taken as per IS : 875 (Part - 5) and other relevant IS Codes. (a) Wind and Seismic forces shall not be considered to act simultaneously. (b) The Structures shall be Designed for most unfavorable Combination of Dead Loads, Imposed Loads, Equipment Loads, Piping / Cables / Ducts Loads, Wind / Seismic Loads, Temperature Loads, Ash Loads, and other applicable Loads without exceeding the Permissible Stresses. (c) Permissible Stresses for different Load Combinations shall be taken as per IS 800. (d) For checking against uplift / tension case, 75% of Dead Loads with no Imposed Loads shall be considered along with other Loads. (e) In all Loading Combinations, the Loads that have reduction effect on design condition shall not be taken into account in the Combination concerned. (f) Where Wind is the main Load acting on the Structure, no increase in Stresses is to be considered for Design of Structures and Foundation Bolts. (g) Dynamic Piping Loads need not be considered acting simultaneously with Wind or Seismic Loads. Increase in Permissible Stresses shall be allowed in Load Combinations where Dynamic Piping Loads are considered and shall be as permitted under Seismic Load conditions.													
3.04.03	The Design of Steel Structures shall be done by Working Stress Method. Design shall be as per the provisions of IS : 800 and other relevant IS standards. For Design of Hoppers IS : 9178 Parts - I, II & III shall be followed.													
3.04.04	Deflection Criteria The maximum Deflection for various Structures shall not exceed and be limited to the following: <table border="1"> <thead> <tr> <th>Sl. No.</th> <th>Description</th> <th>Maximum value of</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>For all Structures</td> <td>Span / 325 or Height / 325, as the case may be unless noted otherwise.</td> </tr> <tr> <td>2.</td> <td>For all beams directly supporting Equipment, drive machinery</td> <td>Span / 500</td> </tr> <tr> <td>3.</td> <td>For all Purlin, Cladding Runners, Roofing / Cladding Sheets</td> <td>Span / 250</td> </tr> </tbody> </table>	Sl. No.	Description	Maximum value of	1.	For all Structures	Span / 325 or Height / 325, as the case may be unless noted otherwise.	2.	For all beams directly supporting Equipment, drive machinery	Span / 500	3.	For all Purlin, Cladding Runners, Roofing / Cladding Sheets	Span / 250	
Sl. No.	Description	Maximum value of												
1.	For all Structures	Span / 325 or Height / 325, as the case may be unless noted otherwise.												
2.	For all beams directly supporting Equipment, drive machinery	Span / 500												
3.	For all Purlin, Cladding Runners, Roofing / Cladding Sheets	Span / 250												
MOUDA STPP-II (2x860MW) / SOLAPUR STPP (2 x 860MW) / NABINAGAR STPP (3x 860MW) / MEJA TPP-I (2 x 860MW) / RAGHUNATHPUR TPP PHASE-II (2 x 860MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9576/ 9571/ 0370/ 0360/ 9586-102(R)-2	PART-B SUB-SECTION-V CIVIL WORKS	PAGE 8 OF 22											



CLAUSE NO.	TECHNICAL REQUIREMENTS		
	<p>4. For all Grating / Chequered Plates Span / 250</p> <p>5. For Trestles and Transfer Points (Transverse deflection at Conveyor gallery supporting level) Height / 1000 (For Wind load by Peak Wind Speed Method /Seismic Load)</p> <p>6. For Mill Bunker Building# Height / 500 (For Wind load by Gust Factor Method /Seismic Load)</p>		
	<p>(However, the maximum vertical Deflection of Grating / Chequered Plate shall be limited to 6 mm).</p>		
	<p>Note: Stresses under wind load condition for all structures shall be checked for the higher of the forces obtained from gust factor method and peak wind method.</p>		
	<p># - In case this building is integrated with boiler supporting structure, deflection criteria for mill bunker building portion shall be same as that for boiler supporting structure.</p>		
3.04.05	<p>All Structures of the Contractor shall be independent of Employer's Structures. In case any vertical Loads from the Contractor's Structures are required to be transferred to the Employer's Structures, the same shall be through PTFE bearings. In no case shall any horizontal Loads be transferred to the Employer's Structures from the Contractor's Structures.</p>		
3.04.06	<p>Welding shall be used for fabrication and Erection. Site connections shall be with Welding / Bolts. For Bolt connection, IS : 4000, IS : 3757, IS : 6623 and IS : 6649 shall be followed. For Welding of Structures IS : 814, IS : 816, IS : 1024, IS : 4353 and IS : 9595 shall be followed. Other requirements pertaining to welding mentioned elsewhere in the specification shall also be satisfied by the Contractor.</p>		
3.04.07	<p>Fans (ID, FD and PA) shall be supported on spring supported RCC foundation. The steel helical springs and viscous dampers shall be provided by the Contractor. However the RCC deck shall be provided by the Employer. The equipment supplied by Contractor shall be compatible for supporting on steel helical springs and viscous dampers.</p>		
3.04.08	<p>Pipes, Cables and Ducts Supports</p> <p>(a) All Pipes, Cables and Ducts shall generally be routed above ground.</p> <p>(b) A Minimum clearance (clear Headroom) of 8 m shall be kept for all over-ground Pipes / Cables / Ducts for all road / rail crossings. For other areas, the requirement of Minimum clearance shall be as specified elsewhere in the Specifications. All Pipes / Cables / Ducts supports shall be provided with continuous walkway of Minimum 600 mm Width with handrails and toe-guards, all along the length with approach ladders near roads, passageways, etc. Before and after the road / rail crossings, a barrier of suitable Height shall be constructed so as to prevent the approach of Cranes (having Height more than 8 m) etc., upto the Pipes / Cables / Ducts supports.</p> <p>(c) In case any main Steel framed Structure of the Employer is existing in close vicinity of the Contractor's Pipes / Cables / Ducts supports, support only from the main framing Structure of the Employer may be permitted by the Employer.</p>		
<p>MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9576/ 9571/ 0370/ 0360/ 9586-102(R)-2</p>	<p>PART-B SUB-SECTION-V CIVIL WORKS</p>	<p>PAGE 5 OF 22</p>



CLAUSE NO.	TECHNICAL REQUIREMENTS 		
	<p>Contractor, for supporting his Pipes / Cables / Ducts. Levels and detail of such supports shall be finalised by the Contractor in consultation with the Employer during his detailed Engineering stage. The Contractor shall supply and provide all such supports.</p>		
3.04.09	<p>Whenever Contractor is taking any support from any of the Employer's Structures, the Contractor shall ensure that no damage is done, to the Employer's Structures including Painting thereof. In case of any damage to the Employers Structure and / or Painting, then the Contractor shall rectify the same to the complete satisfaction of the Employer.</p>		
3.04.10	<p>Supporting Structures shall be so configured that the temperature of Steel does not exceed 60°C unless specified otherwise.</p>		
3.04.11	<p>The bracing in Structures shall be provided such that under no circumstances normal / convenient access to any points is blocked or obstructed.</p>		
3.04.12	<p>Finished Floor Level of Steam Generator/ESP/ ID fan area/CHP Transfer Points shall be kept 200 mm lower than the finished Floor Level of Main Plant Building. Finished floor level of Mill Bunker building & Chimney (by employer) shall match with the finished floor level of Main Plant Building.</p>		
3.04.13	<p>The Employer proposes to encase all Base Plates. Top of the encasement Concrete shall match with the surrounding finish Paving Level. All stiffeners provided with Base Plate shall also be fully encased and for this purpose the top Level of stiffeners shall be kept by Contractor at least 200 mm below the surrounding finish Paving Level.</p>		
3.04.14	<p>Propping / supporting of any Beam on the bracing members shall not be permitted.</p>		
3.04.15	<p>All Structures close to railway line shall have clearance conforming to Railway norms.</p>		
3.04.16	<p>Penthouse / Roof shall be covered with troughed profile permanently colour coated Sheet. Site Cladding / Canopy shall also be with troughed profile permanently colour coated sheet.</p>		
3.04.17	<p>All Stairs shall have a maximum Riser Height of 180 mm and a Minimum Tread Width of 250 mm. Minimum clear Width of Stairs shall be 1200 mm, unless specified otherwise..</p>		
3.04.18	<p>Minimum headroom (free Height) under all Floors, walkways and Stairs shall be 2.30 M</p>		
3.04.19	<p>All Foundation Bolts shall conform to IS : 5624.</p>		
3.04.20	<p>Design Requirements</p>		
<p>3.04.20.1</p> <p><i>Q</i></p>	<p>Overhead Conveyor Galleries and Trestles</p> <p>Overhead conveyors shall be located in a suitably enclosed gallery of structural steel. The overhead gallery shall consist of two vertical latticed girders having rigid jointed portal frame at both ends. Cross beams at floor level supporting conveyor stringer beams shall be made of rolled steel beam or plate girder. Horizontal bracings are to be provided at top & bottom plan of the gallery (latticed girders shall be braced together in plan at the top and bottom). Common end portal frame shall not be used for adjacent conveyor spans. Roof truss shall be provided at upper node points of latticed girders to form an enclosure. Maximum span of gallery shall preferably be 25M. The gallery should as far as possible be erected as a box section keeping all the vertical and horizontal bracing tied in proper position. The gallery should be checked for all erection stresses that are likely to develop during handling and erection and if required, temporary strengthening of gallery members during erection shall be made.</p>		
<p>MOLDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2</p>	<p>PART-B SUB-SECTION-V CIVIL WORKS</p>	

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For double stream conveyor gallery, two side and one central walkway of clear width 800 mm and 1100 mm respectively shall be provided. The clear width of two side walkways for single stream conveyor gallery shall be 800 mm and 1100 mm respectively. Both sides of central and side walkways shall be provided with pipe handrails all along the conveyor gallery. Hand railing should not be supported on conveyor supporting stringers. The walkways shall be chequered plate construction with anti - skid arrangement. The anti - skid arrangement will consist of welding of 10 mm square steel bars at a maximum spacing of 500 mm along the length of the gallery.

Conveyor gallery shall have permanently colour coated steel sheet covers on roof and both sides. However in roof, a panel of minimum 1.5 m x 1.5 m area at about 6.0 m center shall be provided with translucent sheets of polycarbonate material for natural lighting. A continuous slit opening of 500 mm shall be provided on both sides just below the roof sheeting. Windows of size 1.2mx1.5m shall be provided at a spacing of 25m on each side in staggered pattern. Windows shall be provided with wire mesh.

Conveyor Gallery structure shall be designed considering both conveyors operating simultaneously. All gallery supporting trestles shall be four legged type only. One end of each gallery span shall be hinged to the supporting trestle and the other end shall be slide type. Slide type support shall be with P. T. F. E. bearings to allow both rotation & longitudinal movements.

3.04.21

Transfer Houses

The over ground portion of the transfer house shall be framed structure of structural steel work. The floors shall be of R. C. C. over structural beams. Floor beams are to be designed with no lateral resistant by RCC slab. Plan bracings are to be provided in all floors to transfer horizontal loads to columns. In some areas like MCC floors etc., one brick thick wall cladding shall be provided. Brick wall cladding shall be supported on encased wall beams and suitably anchored to adjoining columns and beams.

Adequate steel doors and windows for proper natural lighting and ventilation shall be provided. In addition to steel windows, panels of suitable size to suit the architectural treatment and made of translucent sheets of polycarbonate material shall also be provided on the side cladding for natural lighting. The size of transfer house shall be 14mx14m (excluding Vertical Gravity Takeup structure) with four corner columns only. Side cladding and roof shall be as specified elsewhere in the specifications.

3.04.22

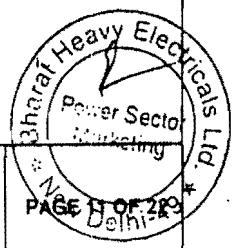
Mill Bunker Building

The mill bunker building shall house coal mills, feeders, coal silo, conveyors, tripper, mono rails etc. The silo shall have a cylindrical top portion with a conical hopper. The cylindrical part shall be constructed from mild steel and conical portion shall be constructed from mild steel plates with stainless steel SS304 grade liner of 4mm thickness for the entire hopper region. The unit weight of coal shall be taken as 1.05 Tonne/Cu.M. and 0.8 Tonne/Cu.M. for Weight/Load calculation and Volume/Capacity calculation respectively.

The live storage capacity of each bunker (one for each mill) shall be maximum of the following:

- a) Total 14 hours coal requirement of the boiler for BMCR duty with worst coal firing, equally distributed over the number of bunkers (i.e. the coal mills) required in service for this duty condition as specified elsewhere.

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MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE

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	<p>b) Total 14 hours coal requirement of the boiler for BMCR duty with design coal firing, equally distributed over the number of bunkers (i.e. the coal mills) required in service for this duty condition as specified elsewhere.</p> <p>c) Total 14 hours coal requirement of the boiler for TMCR duty with worst coal firing, equally distributed over the number of bunkers (i.e. the coal mills) required in service for this duty condition as specified elsewhere.</p> <p>Side cladding and roof shall be as specified elsewhere in the specifications. RCC slab at feeder locations and tripper locations shall be provided (by the employer).</p> <p>Plan bracings are to be provided in all floors to transfer horizontal loads to columns.</p>		
3.05.00	Electrodes		
3.05.01	The electrodes used for welding shall be of suitable type and size depending upon specifications of the parent material, the method of welding, the position of welding and quality of welds desired. Only low hydrogen electrodes shall be used for welding of medium / high tensile steel and for mild steel plate thickness above 20 mm.		
3.05.02	All low hydrogen electrodes shall be baked and stored before use as per manufacturer's recommendation. The electrodes shall be re-baked at 250°C - 300°C for one hour and later on cooled in the same oven to 100°C. It shall be transferred to a holding oven maintained at 60°C - 70°C. The electrodes shall be drawn from this oven for use.		
3.05.03	Where coated electrodes are used they shall meet the requirements of IS: 814 and relevant ASME - Sec. II. Covering shall be heavy to withstand normal conditions of handling and storage.		
3.05.04	Only those electrodes that give radiographic quality welds shall be used for welds, which are subjected to radiographic testing.		
3.05.05	Where bare electrodes are used these shall correspond to specification of the parent material. The type of flux-wire combination for submerged arc welding shall conform to the requirements of F-60 class of AWSA-5-17-69 and IS: 3613. The electrodes shall be stored properly and the flux shall be baked before use in an oven in accordance with the manufacturer's requirements as stipulated.		
3.05.06	The contractor shall take specific approval of the weld for the various electrodes proposed to be used on the works before any welding is started.		
3.06.00	Edge Preparation for Welding		
3.06.01	Suitable edge as per weld joint detail shall be prepared either by machines or by automatic gas cutting. All edges cut by flame shall be ground before they are welded.		
3.07.00	Pre Heating and Post Heating		
3.07.01	Mild steel and medium / high tensile steel plates thicker than 20mm, will require Pre-Heating of the parent plate prior to welding as mentioned in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, however, higher pre heat temperature may be required as per approved welding procedure and it shall be followed. In welding materials of unequal thickness, the thicker part shall be taken for this purpose.		
3.07.02	Base metal shall be preheated, notwithstanding provisions of IS: 9595 to the temperature given in Table - 1 for mild steel and Table - 2 for medium / high tensile steel, prior to welding		
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABHAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2	PART-B SUB-SECTION-V CIVIL WORKS	

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or tack welding. When base metal not otherwise required to be pre heated is at a temperature below 0°C it shall be pre heated to atleast 20°C., prior to tack welding or welding. Pre heating shall bring the surface of the base metal to the specified pre heat temperature and this temperature shall be maintained as minimum inter-pass temperature while welding is in progress.

TABLE - 1

MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MILD STEEL

Thickness of thicker part at Point of welding	Welding Using	
	Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode
Upto and including 20mm	None	None
Over 20mm and up to and including 40mm	20°C	Not allowed
Over 40mm and up to and including 63mm	66°C	Not allowed
Over 63mm	110°C	Not allowed

Note: Type of electrode and the preheating requirements for welding shall be as per approved welding procedure.

TABLE - 2

MINIMUM PREHEAT AND INTERPASS TEMPERATURE FOR WELDING MEDIUM / HIGH TENSILE STEEL

Thickness of thicker part at Point of welding	Welding Using	
	Low hydrogen electrode or submerged arc welding	Other than low hydrogen electrode
Upto and including 20mm	None	Not Allowed
Over 20mm	120°C - 140°C	Not Allowed

Note: Type of electrode and the preheating requirements for welding of medium and high tensile steel shall be as per approved welding procedure.

3.07.03

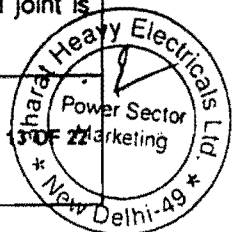
Pre heating may be applied by external flame which is non-carbonizing like LPG, by electric resistance or electric induction process such that uniform heating of the surface extending up to a distance of four times the thickness of the plate on either side of the welded joint is obtained.

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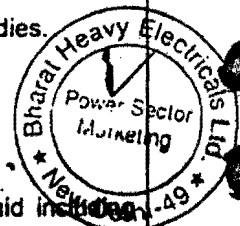


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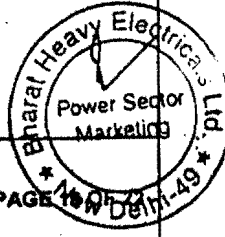
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3.07.04	Thermo-chalk, thermo-couple or other approved methods shall be used for measuring the plate temperature.
3.07.05	All butt welds with plates thicker than 50mm and all site butt welds of main framing beam supporting the bunker shall require post weld heat treatment as per procedure given in AWS D-1.1. Post heating shall be done up to 600°C and rate of application shall be 200°C per hour.
3.07.06	The post heat temperature shall be maintained for 60 minutes per 2.5cm thickness. For maintaining slow and uniform cooling, asbestos pads shall be used for covering the heated areas.
4.00.00	STEEL HELICAL SPRINGS AND VISCOUS DAMPERS
4.01.01	General Requirement
4.01.02	This part of the specification covers the requirement for the manufacturing, testing, supply, transport to site, pre-stressing, erection, supervision of erection, release of pre-stress, alignment, commissioning, etc. of steel helical springs and viscous dampers.
4.01.03	The steel helical springs and viscous dampers supplied should be of proven make. The qualifying requirements for sub-vendor/ supplier for steel helical springs and viscous dampers is specified elsewhere in the specification.
4.01.04	The information about the entire range of spring units, damper units and spring-damper units manufactured by sub vendor shall be furnished to enable the Employer to do the engineering of the foundations along with appropriate type of spring units for different machines. The information to be furnished should include the load carrying capacity, stiffness (vertical & horizontal), damping resistance, dimensions of spring and damper units.
4.02.00	Codes and Standards Some of the relevant applicable Indian standards and codes, etc. applicable to this section of the specification are listed below : DIN : 4024 Machine foundations; Flexible supporting structures for machine with rotating masses. DIN : 2089 Helical compression springs out of round wire and rod : calculation & design. DIN : 2096 Helical compression springs out of round wire and rod; quality requirements for hot formed compression springs. VDI : 2056 Criteria for assessing mechanical vibrations of machine. VDI : 2060 Criteria for assessing the state of balance of rotating rigid bodies.
4.03.00	Material (Design & Supply)
4.03.01	Steel helical springs and viscous dampers shall consist of: (a) Steel helical spring units and viscous dampers along with viscous liquid including associated auxiliaries for installation of the spring units and dampers like steel shirts, adhesive pads, etc.





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	<p>(b) Frames for pre-stressing of spring elements.</p> <p>(c) Suitable hydraulic jack system including electric pumps, high-pressure tubes etc. required for the erection, alignment etc., of the spring units. One set of extra hydraulic jacks, and hand operated pumps shall also be provided.</p> <p>(d) Any other items which may be required for the pre-stressing, erection, release of pre-stress, alignment, and commissioning of the steel helical springs.</p>		
4.03.02	<p>The design of the supporting arrangement for the equipment supported on steel helical springs and viscous dampers shall be done by Employer. The supporting arrangement shall consist of an RCC deck supported on steel helical spring units and viscous dampers which in turn shall be supported on RCC substructure. The RCC deck shall be provided by the Employer.</p>		
4.03.03	<p>The spring units should have stiffness in both vertical and horizontal directions with the horizontal stiffness not less than 50% of vertical stiffness. The stiffness should be such that the vertical natural frequency of any spring unit at its rated load carrying capacity is not more than 3 Hz.</p>		
4.03.04	<p>The damper units or spring-cum-damper units should be of viscous type offering velocity proportional damping. The damper units should be suitable for temperatures ranging from 0 to 50°C. The damping resistance of individual damper units should be such that the designed damping can be provided using reasonable number of Units. Damper Units shall have damping resistance ranging from 40 KN Sec / M to 300 KN Sec / M.</p>		
4.03.05	<p>The sizes of the spring units, damper units and spring-cum-damper units should be such that groups of such units can be accommodated on column heads in case of elevated foundations and on pedestals / walls in case of foundations at ground level.</p>		
4.03.06	<p>The steel helical springs and viscous dampers shall be designed for a minimum operating life of 30 years.</p>		
4.04.00	<p>Manufacturing & Testing</p>		
4.04.01	<p>Complete manufacturing and testing of the steel helical springs and viscous dampers shall be done at the manufacturing shop of the approved sub vendor / supplier. For this purpose the contractor / sub vendor shall submit the detailed programme for approval of employer and take up the manufacturing / testing after approval of such programme. The programme shall include</p> <p>(a) Manufacturing schedule and quality check exercised during manufacturing.</p> <p>(b) Detail of test to be carried out at the manufacturing shop with their schedule.</p> <p>(c) Special requirements, if any, regarding concreting of top deck.</p> <p>(d) Complete step-by-step procedure covering the installation and commissioning of the spring system.</p> <p>(e) Manuals for erection, commissioning, testing and maintenance of the steel helical springs and viscous dampers.</p>		
<p>MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2</p>	<p>PART-B SUB-SECTION-V CIVIL WORKS</p>	<p>Bharat Heavy Electricals Ltd. Power Sector PAGE 15 OF 27</p>

CLAUSE NO.	TECHNICAL REQUIREMENTS	
	<p>(f) A checklist for confirming the readiness of the civil fronts for erection of steel helical springs and viscous dampers.</p> <p>(g) Checklist for equipment required at each stage of erection.</p> <p>(h) Bill of materials (data sheet) of various elements such as spring units, viscous dampers, with their rating, stiffness etc. included in the supply.</p> <p>(i) Bill of material (data sheet) for frames for pre stressing, hydraulic jack including electric pump, high pressure tubes, hand operated pump etc., with their rating and numbers.</p> <p>(j) Any other details which may be necessary to facilitate design and construction of the foundations / structures.</p>	
4.04.02	The Springs shall conform to codes DIN 2089 and DIN 2096. The quality assurance and inspection procedure shall be finalised on the basis of the above codes and the quality plans be drawn accordingly.	
4.05.00	Transportation	
4.05.01	Steel helical springs and viscous dampers shall be suitably protected, coated, covered, boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection.	
4.05.02	The contractor shall be responsible for any loss or damage during transportation, handling and storage.	
4.06.00	Erection and Commissioning	
4.06.01	Complete erection and commissioning of the steel helical springs and viscous dampers including pre-stressing of elements, placing of elements in position, checking clearances on the shuttering of the RCC top deck, releasing of pre-stress in spring elements, making final adjustments and alignments etc. all by a specialist supervisor.	
4.06.02	The scope of work shall be deemed to include all activities, which may not have been explicitly mentioned but are reasonably implied for the successful commissioning of steel helical springs and viscous dampers.	
4.06.03	The contractor shall guarantee the performance of the steel helical springs and viscous dampers for 24 months from the date of commissioning of each machine which shall be termed as "Guarantee Period".	
4.07.00	<p>Supervision</p> <p>The supervision of installation of steel helical springs and viscous dampers including pre-stressing, placing, releasing and alignment of spring units shall be done by a specialist supervisor of sub vendor / supplier, trained for this purpose.</p>	
4.08.00	<p>Realignment of Spring System</p> <p>If any realignment of the steel helical springs and viscous dampers is required to be done for aligning the shaft or for any other reasons during the first one year of operation from the date of commissioning of the machine, the same shall be done by the contractor.</p>	
		
MOUDA STPP-4 (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-1 (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9576/ 9571/ 037W 0360/ 9586-102(R)-2	PART-B SUB-SECTION-V CIVIL WORKS



CLAUSE NO.	TECHNICAL REQUIREMENTS		
4.09.00	<p>Acceptance Criteria</p> <p>Stiffness values shall be checked. The permissible deviations shall be as per DIN 2096.</p> <p>Following acceptance criteria shall be followed:</p> <ol style="list-style-type: none"> General workmanship is being good and as recommended by the manufacturer and approved by the Engineer. Tolerances are within the specified limit. Material test certificate (MTC) is in compliance with the applicable codes/standards. Bought out material is from the approved manufacturer / vendor. Bought out material is matching with the approved sample. 		
5.00.00	<p>MISCELLANEOUS REQUIREMENTS</p>		
5.01.00	<p>Corrosion Protection</p>		
5.01.01	<p>General</p> <ol style="list-style-type: none"> All equipments, pipes, etc. shall be painted as per the requirements specified in the relevant section of the specification. All Steel structures (except those embedded in Concrete) shall be provided with Painting as given below which is designed for a minimum maintenance free life of Ten (10) years (expected life, long range Ten (10) to Twenty (20) years, as per BS : 5493. All Paints shall be of high build constitution. All Painting shall be done as per approved Painting scheme of the Vendors / Manufacturers, which shall be submitted by the Bidder and as approved by the Employer. Painting scheme shall also include Item codification / Description of all Coats of Paints for manufacturer's, from whom the Paint is intended to be procured. 		
5.01.02	<p>Painting of Steel Surfaces embedded in Concrete.</p> <ol style="list-style-type: none"> For the portion of Steel surfaces embedded in Concrete, the surface shall be prepared by Manual Cleaning and provided with Primer Coat of Chlorinated Rubber based Zinc Phosphate Primer of Minimum 50 Micron Dry Film Thickness (DFT). All threaded and other surfaces of foundation bolts and its materials, insulation pins, Anchor channels, sleeves, etc. shall be coated with temporary rust preventive fluid and during execution of civil works, the dried film of coating shall be removed using organic solvents. 		
5.01.03	<p>Painting of Steel Surfaces (other than those embedded in Concrete)</p> <ol style="list-style-type: none"> All Steel surfaces shall be provided with self curing Inorganic Zinc Silicate Primer Coat (Solid by Volume Minimum 60%) of Minimum 75 Micron Dry Film Thickness (DFT) applied over blast cleaned surface to near white metal conforming to Sa 2 1/2 finish of Swedish standard SIS-05-5900. The Primer Coat shall be applied in Shop immediately after blast cleaning by Airless spray technique. 		
<p>MOUDA STPP-II (2x660MW) / SOLARUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9675/ 9571/ 0370/ 0360/ 9586-102(R)-2</p>	<p>PART-B SUB-SECTION-V CIVIL WORKS</p>	<p>PAGE 17 OF 22 Power Sector Marketing Bhat Heavy Electricals Ltd. New Delhi-49</p>

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TECHNICAL REQUIREMENTS



- (b.) Primer Coat shall be followed with the application of Intermediate Coat of Polyamide Cured pigmented Titanium Dioxide (TiO₂) or Micaceous Iron Oxide (MIO) Epoxy based Paint (Solid by Volume Minimum 60%) of Minimum 75 Micron DFT. This Coat shall be applied in Shop after an interval of Minimum overnight (from the application of Primer Coat) by Airless spray technique.
- (c) Intermediate Coat shall be followed with the application of Finish Coat of Polyamide Cured colour pigmented Epoxy based Paint (Solid by Volume Minimum 60%) of Minimum 75 Micron DFT. This Coat shall be applied after an interval of Minimum overnight and maximum indefinite (from the application of Intermediate Coat) either before Erection by Airless spray technique or after Erection by brush and / or spray. Colour and shade of the Coat shall be as approved by the Employer. The Finish Coat thickness of 75 Micron can be built up either in Single application at Shop or in two applications one at Shop and the other at Site.
- (d) Finish Coat shall be followed with the application of Final Finish Coat of Polyurethane based colour pigmented Paint (Solid by Volume Minimum 40%) of Minimum 25 Micron DFT. This Coat shall be applied within Seven (7) days (from the completion of Finish Coat), after Erection by brush and / or spray. Colour and shade of the Coat shall be as approved by the Employer.

5.01.04

Touch-up Painting on damaged areas

- (a) For Coatings damaged up to metal surface

Surface preparation shall be carried out by Manual Cleaning. Minimum 6 inches adjoining area with existing Coating shall be roughened by Wire brushing, emery paper rubbing etc., for best adhesion of patch Primer.

Primer Coat of self-priming Epoxy Touch-up Primer applied by brush immediately after the surface preparation. (Minimum DFT 100 Microns).

Over this Primer Coat, Intermediate Coat, Finish Coat and Final Finish Coat shall be applied as covered above by brush with Intermediate Coat applied within maximum seven (7) days of application of touch up Primer.

- (b) For Coatings damaged upto Intermediate Coatings (i.e. where Primer Coat is intact).

Damaged area including Minimum 6 inches adjoining area with existing Coating should be roughened by wire brushing, emery paper rubbing etc., for best adhesion of patch Primer without damaging the Primer Coat.

Touch-up Primer, Intermediate, Finish and Final Finish Coats shall be applied as specified above for Coatings damaged up to metal surface.

5.01.05

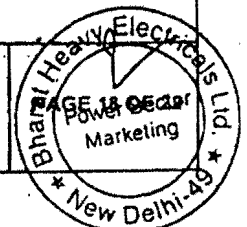
Painting of Welded areas / Painting of areas exposed after removal of temporary supports / Touch-up Painting on damaged areas of Employer's Structures, where inter-connection, Welding / modification etc. has been carried out by the Contractor.

- (a) Clean the surface to remove flux spatters and loose rust, loose Coatings in the adjoining areas of Weld seams by wire brush and emery paper.
- (b) Painting procedure to be followed as mentioned above for Touch-up Painting on damaged areas.

MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / HABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE

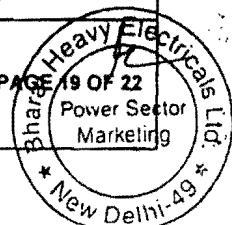
TECHNICAL SPECIFICATION SECTION-VI
 BID DOC NO.: CS-9575/ 9571/ 0370/
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PART-B
 SUB-SECTION-V
 CIVIL WORKS





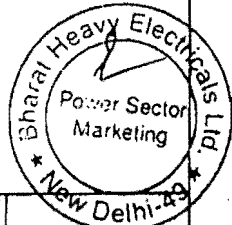
CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.01.06	Dry film thickness of each coat shall be checked and measured as per the procedure specified in paint application standard no. 2 by SSPC: The Society for Protective Coating. The thickness as measured shall not be less than the minimum thickness specified for the coat of paint under relevant clauses of technical specification.		
5.01.07	Coating for Mild Steel parts in contact with Water. <p>(a) All mild Steel parts coming in contact with water or water vapour shall be hot dip galvanised. The Minimum Coating of Zinc shall be 610 Gms / Sq. M. for galvanised Structures and shall comply with IS : 4759 and other relevant Codes. Galvanising shall be checked and tested in accordance with IS : 2629.</p> <p>(b) The galvanising shall be followed by the application of an etching Primer and dipping in black bitumen in accordance with BS : 3416, unless otherwise specified.</p>		
5.01.08	Gratings <p>All gratings shall be blast cleaned to Sa 2 ½ finish of Swedish standard SIS-Q5-5900 and shall be hot dip galvanised at the rate of 610 Gms / Sq. M.</p>		
5.01.09	Hand Railings and Ladders <p>All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS : 4736.</p>		
5.01.10	Sea Worthiness <p>All Steel Sections and fabricated Structures, which are required to be transported on sea, shall be provided with anti corrosive Paint before shipment to take care of sea worthiness.</p>		
5.02.00	Hand Railing		
5.02.01	Minimum 1000 mm high hand railing shall be provided around all Openings, projections / balconies, walkways, platforms, Steel Stairs, etc., All handrails and ladder Pipes shall be 32 mm nominal bore MS Pipes (medium class).		
5.02.02	Handrails shall have top and middle rails at a height of 1000 mm and 500 mm and the vertical post spacing shall not exceed 1.50 M, with provision of kick Plates (100 mm high and 6 mm thick).		
5.03.00	GRATING		
5.03.01	All gratings shall be Electro-forged type. Minimum thickness of the grating shall be 40 mm for in door installation and 32 mm for outdoor installation.		
5.03.02	The Opening size shall not be more than 30 mm X 100 mm. The Minimum thickness of the main bearing bar shall be 5 mm.		
5.03.03	Cutting of gratings shall not be carried out at Site. Any cutting of gratings required to provide passage for Columns / Pipes / Cables / Ducts etc shall be done by the Contractor in Shop and cut edges of Grating shall be suitably reinforced with binding strips.		
5.04.00	FIRE EXITS		
5.04.01	All fire exits shall be Painted with P O Red / signal Red colour shade, which shall not be used anywhere except to indicate the emergency or safety measures. Fire safety norms shall be		
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2	PART-B SUB-SECTION-V CIVIL WORKS	PAGE 19 OF 22 Power Sector Marketing


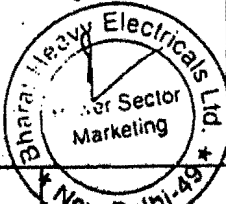


CLAUSE NO.	<p style="text-align: center;">TECHNICAL REQUIREMENTS</p> <div style="text-align: right; border: 1px solid black; padding: 2px;">  </div>		
	<p>followed as per National Building Code and requirements of various statutory bodies shall be followed for providing Fire Exits, Escape Stairs and Fire Fighting Equipment.</p>		
5.05.00	<p>OPENINGS</p>		
5.05.01	<p>Details / Data of all Openings required by the Contractor in Floors / Walls / Cladding / Roof to be provided by the Employer shall be given by the Contractor, who shall also furnish all Foundation Loads to be considered by the Employer for the Design of Foundations to support the Contractor's Structures / Equipment. Accordingly, the same shall be listed in Engineering Information Flow Schedule to be furnished by the Contractor.</p>		
5.05.02	<p>If the details / data of all Openings required by the Contractor in Floors / Walls / Cladding / Roof are not furnished by the Contractor, as per the Engineering Information Flow Schedule then all such required Openings shall be created by the Contractor himself, at a later date in Floors / Walls / Cladding / Roof by using special tools, as required. In this case edge protection to the Openings shall also be provided by the Contractor using Anchor-Fasteners.</p>		
5.05.03	<p>For routing of Pipes / Cables / Ducts, Employer shall only provide suitable passage / Opening in Floors / Walls / Cladding. Any Pipe sleeves or embedments required by the Contractor in these passages / Openings shall be provided by the Contractor himself. These passage / Openings shall be suitably sealed by the Contractor after completion of Erection works.</p>		
5.06.00	<p>GROUTING</p>		
5.06.01	<p>Non-shrink cementitious flowable grout shall be used for Grouting of pockets and underpinning work below Base Plate of columns. Nominal thickness of grout shall be 50 mm. Non-shrink cum plasticizer admixture shall be added in the grout. Crushing Strength of the grout shall generally be one grade higher than that of the base Concrete. Minimum grade of grout shall be M30.</p>		
5.06.02	<p>However, for Equipment Foundations, high Strength (Minimum Characteristic Compressive Strength of 60 N / mm² at 28 days) ready mixed non-shrink, Chloride free, Cement based, free flowing, non-metallic grout as recommended by Equipment manufacturer shall be used. The ready mix grout shall be of reputed make as approved by the Employer.</p>		
5.06.03	<p>The surface to be grouted shall be properly cleaned by using compressed air. Contractor shall provide the required shim plates.</p>		
5.06.04	<p>The top surface of Foundation as constructed by the Employer may vary by + 25 mm. The same shall be suitably corrected by the Bidder by chipping before the Erection of his Structures / Equipment or subsequently during Grouting / Under Pinning, as the case may be.</p>		
5.07.00	<p>ROOFING / CLADDING / DECKING SHEETS</p>		
5.07.01	<p>Galvanised / Zinc Aluminium alloy coated Sheet having Trough Profile and permanently colour Coated shall be used for Roofing / Cladding / Decking.</p>		
5.07.02	<p>Minimum bare metal thickness of Decking Sheet shall be 0.8 mm. These sheets shall be either galvanised at a Minimum rate of 275 Gm / Sq. M. or Coated with Zinc Aluminium alloy (Zincalume) at a Minimum rate of 150 Gm./ Sq. M. Silicon modified polyester Paint having DFT of Minimum 20 Microns or Super Polyester Paint having Minimum DFT of 25 Microns shall be used for permanent Coating on exposed surfaces.</p>		
<p>MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-957B/ 9571/ 0370/ 0360/ 9586-102(R)-2</p>	<p>PART-B SUB-SECTION-V CIVIL WORKS</p>	<p>Bharat Heavy Electricals Ltd. Power Sector Marketing PAGE 20 OF 22 New Delhi-49</p>



CLAUSE NO.	TECHNICAL REQUIREMENTS		
5.07.03	Single Skin Sheeting for Side Cladding / Roofing / Canopy shall have Minimum base metal thickness of 0.5 mm for High Tensile Steel (having Minimum Yield Strength 550 MPa) Coated with Zinc Aluminium alloy (45 % Zn : 55% Al) at the rate of 150 Gms / Sq. M. (Minimum) or Minimum bare metal thickness of 0.6 mm for galvanised Mild Steel Sheets (as per IS : 513) of grade 275 (Minimum) (as per IS : 277). The Sheets shall be finished with Silicon modified Paint (SMP) of Minimum 20 Microns (DFT) on external face and 7 Microns Coating on internal face. Alternately, Sheets can also be finished with Super Polyester quality Paint having total Coating thickness of 35 Microns, comprising of 20 Microns Coating on external face and 5 Microns on inner face over 5 Microns Primer Coat on both faces.		
5.07.04	Moment of Inertia of Sheet, Section Modulus of Sheet, thickness of Sheet and spacing of runners / Purlin shall be compatible to satisfy the specified Deflection criteria.		
5.07.05	The Sheets shall meet the general requirement of IS : 14246 and shall conform to class 3 for the durability.		
5.07.06	Z spacers if required shall be made out of at least 2 mm thick galvanised Steel Sheet of grade 275 as per IS : 277.		
5.07.07	The Sheets shall be fixed by means of Stainless Steel / High performance Steel, fasteners of self-tapping / self drilling type provided with neoprene cap and washer of matching colour. Fasteners shall pass Salt Spray test for 1000 hours (Minimum).		
5.07.08	The Insulation shall be bonded mineral wool conforming to IS : 8183, having a density of 32 Kg / Cu. M. for glass wool or 48 Kg / Cu. M. for rock wool.		
5.07.09	All flashing, 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 Single Skin Sheets.		
5.07.10	Overlap shall be as specified by the manufacturer.		
5.07.11	Steam Generator Roof (Penthouse) / Canopy / Side Cladding shall have Single Skin troughed profile permanently colour coated sheets.		
5.07.12	Cladding for Boiler Elevator enclosure except its Machine Room shall be with Single Skin troughed profile permanently colour coated sheets.		
5.07.13	Side Cladding for Mill Bunker Building, Transfer points and conveyor galleries (including roof) shall have Single Skin troughed profile permanently colour coated sheets. However, roof of Mill Bunker Building and transfer points shall be provided with troughed profile permanently colour coated sheet on outside and plain permanently colour coated sheet on inside with 50mm thick mineral wool insulation in between the two sheets.		
5.08.00	MACHINE ROOM		
5.08.01	Floor / Roof of the machine room shall be of reinforced cement concrete supported on structural steel beams. The side walls shall be of brick work. Civil works including RCC floors, roof slab, door and windows (excluding trap door) flooring etc. shall be in the Employer's scope. However the structural steel members e.g. floor/roof beams, wall beams, etc. shall be supplied and erected by the Contractor.		
5.09.00	NUTS AND BOLTS		
5.09.01	M. S. Nuts and Bolts shall conform to IS:1363, IS:1364, IS:1367.		
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x 660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2	PART-B SUB-SECTION-V CIVIL WORKS	PAGE 21 OF 22



CLAUSE NO.	TECHNICAL REQUIREMENTS 		
5.09.02	High Tensile fixing with Bolts and nuts shall respectively be as per IS:3757 and IS:6623.		
5.09.03	Washers shall conform to IS 5369, IS : 5370, IS : 5372, IS 5374, IS : 6610, IS : 6649, as appropriate.		
6.00.00	STATUTORY REQUIREMENTS		
6.01.00	Contractor shall comply with all the applicable statutory rules pertaining to Factories Act, Fire Safety Rules, Water Act for pollution control, Explosives Acts, etc.		
6.02.00	Provisions of safety, health and welfare according to Factories Act shall be complied with. These shall include railing, fire escape, etc.		
6.03.00	Provisions for Fireproof Doors, number of Staircases, etc. shall be made according to the requirements of Statutory Bodies.		
6.04.00	Statutory clearances and norms of State Pollution Control Board shall be followed.		
7.00.00	PERMISSIBLE TOLERANCES		
7.01.00	All Structural Steel work shall be Shop fabricated outside the Plant area.		
7.01.01	Tolerances on dimensions for fabrication of Steel Structures shall be according to IS : 7215.		
7.01.02	Tolerances on dimensions for Erection of Steel Structures shall be according to IS : 12843.		
7.01.03	Tests on Welds shall be as per ASTM standards, IS : 816 and IS : 9595.		
7.01.04	Dimensional and weight tolerance of Rolled Steel shapes shall be as per IS : 1852.		
8.00.00	LIST OF CODES AND STANDARDS		
8.01.00	<p>All applicable standards, references, Specifications, Codes of practice, etc., shall be the latest edition including all applicable official amendments and revisions. A complete set of all these documents shall be available at Site with Contractor.</p> <p>For Criteria for earthquake resistant design of structures & equipment, site specific design parameters, & horizontal seismic acceleration spectral co-efficients in units 'g' of respective projects, Please refer project information, Sub-section-II, Part-A, section-VI of Technical specification.</p>		
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / RABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9576/ 9571/ 0370/ 0360/ 9586-102(R)-2	PART-B SUB-SECTION-V CIVIL WORKS	 PAGE 22 OF 22

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TITLE:

**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED**

SPECIFICATION NO. PE-TS-385-600-C01

VOLUME - II B

SECTION - D SUB-SECTION-D2

REV.NO. 0

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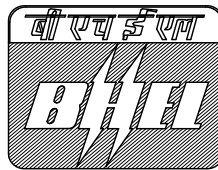
VOLUME: II B

SECTION – D

SUBSECTION-D2

CEMENT CONCRETE (PLAIN & REINFORCED)

SPECIFICATION NO. PE-TS-385-600-C001



Bharat Heavy Electricals Limited

Project Engineering Management

Power Sector, PPEI Building

Noida – 201 301



TITLE:

**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED**

SPECIFICATION NO. PE-TS-385-600-C01

VOLUME - II B

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C O N T E N T

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**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED)**

SPECIFICATION NO. PE-TS-385-600-C01

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SUB-SECTION – D II

CEMENT CONCRETE (PLAIN & REINFORCED)

1.00.00 SCOPE

1.01.00 General

This specification covers all the requirements, described hereinafter for general use of Plain and Reinforced Cement Concrete work in Structures and locations, cast-in-situ or precast, and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work. Special requirements for structures such as reinforced concrete chimney, cooling towers, etc. have been covered under the respective specifications. Those specifications shall be used in conjunction with this specification.

1.02.00 ACI:318 shall form a part of this specification and shall be complied with unless permitted otherwise. For any particular aspect not covered by this Code, appropriate Code, specifications and/or replacement by any International code of practice as may be specified by the Engineer shall be followed. All codes and Standards shall conform to its latest revisions. A list of IS codes and Standards is enclosed hereinafter for reference. However, should the list be not exhaustive and does not cover any aspect of the work, then relevant Indian and, in its absence, relevant International code shall apply.

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 shall include but not be limited to the following

- a) Furnish all labour, supervision, services including facilities as may be required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plants, transportations, etc. required for the work.
- b) Prepare Bar bending Schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.
- c) Prepare working drawings of formworks, scaffolds, supports, etc.
- d) Prepare shop drawings for various inserts, anchors, anchor bolts, pipe sleeves, embedments, hangers, openings, frames etc.
- e) Prepare detailed drawings of supports, templates, hangers, etc. required for



TITLE:

**TECHNICAL SPECIFICATION FOR
CEMENT CONCRETE (PLAIN &
REINFORCED**

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installation of various embedments like inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc.

As decided by the Engineer some or all of the drawings & schedules prepared under item (b) to (e) above will have to be submitted for approval.

- f) Submit for approval detailed schemes of all operations required for executing the work, e.g. material handling, Concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc.
- g) Design and submit for approval concrete mix designs required to be adopted on the job.
- h) Furnish samples and submit for approval results of tests of various properties of the following:
 - i) The various ingredients of concrete
 - ii) Concrete
 - iii) Embedments
 - iv) Joint seals
- i) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings and specifications.
- j) For supply of certain materials normally manufactured by specialist firms, the Contractor may have to produce, if directed by the Engineer, a guarantee in approved Performa for satisfactory performance for a reasonable period as may be specified, binding both the manufacturers and the Contractor, jointly and severally.

2.02.00 Work by others

No work under this specification will be provided by any agency other than the Contractor unless specifically mentioned elsewhere in the contract.

2.03.00 Information to be submitted by the Tenderer

2.03.01 With Tender

The following technical information's are required with the tender:

- a) Source and arrangement of processing of aggregates proposed to be adopted.



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- b) Type of batching plant and equipments to be used for batching, transportation, compaction, ice handling, testing at site & laboratory.
- c) Names of firms with which association is sought for to execute the special items of work in the contract.
- d) Types of formwork proposed to be used.

2.03.02

After Award

The Contractor shall submit the following information and data including samples where necessary, progressively during the execution of the contract.

- a) Programme of Execution

Within 30 days of the award of contract, the Contractor will submit a Master Programme for completion of the work.

This Master Programme may have to be reviewed and updated by the Contractor, quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work.

Detailed day-to-day Programme of every month is to be submitted by the Contractor before the end of the previous month.

- b) Samples

Samples of the following materials and any other materials proposed to be used shall be submitted as directed by the Engineer, in sufficient quantities free of cost, for approval. The Engineer for future reference will preserve approved samples. The approval of the Engineer shall not, in any way, relieve the Contractor of his responsibility of supplying materials of specified qualities:

- i) Coarse and fine aggregates, cement (if supplied by contractor).
- ii) Admixtures.
- iii) Plywood for Formwork.
- iv) Embedded and anchorage materials as may be desired by the Engineer.
- v) Joint sealing strips and other*waterproofing materials.
- vi) Joint filling compounds.



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vii) Foundation quality Rubber Pads.

c) Design Mix

Design mix as per specification giving proportions of the ingredients, sources of aggregates and cement, along with test results of trial mixes as per relevant I.S 10262 (latest), is to be submitted to the Engineer for his approval before it can be used on the works.

d) Bar Bending Schedules

Bar Bending Schedules in accordance with Clause 2.01.00 (b) and 3.16.01 of this specification.

e) Detailed Drawings and Designs of Formworks to be used

Detailed design data and drawings of standard formworks to be used as per clause 2.01.00 (c).

f) Detailed Drawings for Templates & Temporary Supports for embedment
As per Clause 2.01.00 (e).

g) Mill Test Reports for Cement & Reinforcing Steel.

h) Inspection Reports

The Engineer in accordance with Clause 2.04.00 of this specification may desire inspection Reports in respect of Formwork and Reinforcement and any other item of work as.

i) Test Reports

Reports of tests of various materials and concrete as required under Clause 4.0: SAMPLING & TESTING of this specification or as directed by the Engineer.

j) Any other data, which may be required as per this specification or as directed by the Engineer.

2.04.00

Conformity with Design

The Contractor will prepare checklists in approved Form, which will be called "Pour Cards". These Pour Cards will list out all items of work involved. The Contractor will inform the Engineer, sufficiently in advance, whenever any particular pour is ready for concreting. He shall accord all necessary help and assistance to the Engineer for all checking required in the pour. On satisfying himself that all details are in accordance to the drawings



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and specifications, the engineer will give written permission on the same Pour Cards allowing the contractor to commence placement of concrete. Details of all instructions issued by the Engineer and the records of compliance by the Contractor, deviations allowed by the Engineer and any other relevant information will be written on accompanying sheets attached to the Pour Cards. The Pour Cards along with accompaniments will be handed over to the Engineer before starting placement of concrete. One of the mix designs developed by the Contractor as per the I.S. Specifications and established to the satisfaction of the Engineer by trial mixes shall be permitted to be used by the Engineer, the choice being dictated by the requirements of designs and workability. The methods of mixing, conveyance, placement, vibration, finishing, curing, protection and testing of concrete will be as approved or directed by the Engineer.

2.05.00 Materials to be used

2.05.01 General Requirement

All materials whether to be incorporated in the work or used temporarily for the construction shall conform to the relevant IS Specifications unless-stated otherwise and be of best approved quality.

2.05.02 Cement

Ordinary Portland cement of grade-43 as per IS:8112/fly ash based Portland puzzolona cement conforming to IS:1489 (Part-1) shall preferably be used in reinforced/plain cement concrete works for all areas other than for the critical structures identified below. However, other types of cement such as ordinary Portland cement conforming to IS:269, Portland slag cement conforming to IS:455 respectively can be used under special circumstances. Cement used in all concrete mixes shall be in general of grade 33/43 unless design requires a higher grade. Ordinary Portland cement shall be used for following structure.

- a) TG foundation top deck and sub structures including raft.
- b) Spring Supporting decks of all machine foundations.
- c) Structures requiring grade of concrete of M30 and above.

In special cases, Rapid Hardening Portland Cement, Low Heat Cement, Sulphate resistant cement, high strength Ordinary Portland Cement etc. may be permitted or directed to be used by the Engineer.

For Brickwork, plaster, flooring and other finishing works, ordinary Portland cement of 33/43 grade shall be used.

2.05.03 Coarse Aggregate



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Aggregate of sizes ranging between 4.75 mm and 150 mm will be termed as Coarse Aggregate. Coarse aggregate for concrete shall be chemically inert, hard, strong durable against weathering, of limited porosity, and free from deleterious materials. It shall be properly graded. Coarse aggregates shall be either crushed gravel or stone. All aggregates shall meet the requirement of IS:383:1970. Only Coarse Aggregate from, approved quarries and conforming to IS-383 will be allowed to be used on the works. Petrographic test shall be carried out by the contractor free of cost for checking the quality of rock from quarry. This test shall be repeated by the Contractor free of cost for change in quarry or as directed by the Engineer. The results shall be checked for reactivity of silica in aggregate with alkalis of cement.

2.05.04 Fine Aggregate

Aggregate smaller than 4.75 mm and within the grading limits and other requirements set in IS: 383 are termed as Fine Aggregate or Sand. Only Fine Aggregate from approved sources and conforming to the above IS Specification will be allowed to be used in works. Sand shall be hard, durable, clean and free from adherent coatings or organic matter and clay balls or pellets. Sand when used as fine aggregate in concrete shall conform to IS:383. For plaster, it shall conform to IS:1542 and for masonry work to IS:2116.

2.05.05 Water

Water for use in Concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts, or other impurities. Generally, IS: 3550 will be followed for routine tests. Acceptance of water shall be as per IS: 456.

2.05.06 Admixture

Only admixtures of approved quality will be used when directed or permitted by the Engineer. The different types of admixtures, which may be necessary to satisfy the concrete mix and the design requirement, shall be as per IS-9103 and may be one of the followings:

- a) Accelerating admixture
- b) Retarding admixture
- c) Water reducing admixture
- d) Air entraining admixture

The contractor shall inform the Engineer about the type of admixture which he is planning to use in different areas within the scope of work for the approval of the Engineer. The admixture shall be of proven make and from a reputed manufacturer. It should not have any adverse effect on strength, durability of



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concrete and reinforcement. Super plasticizers conforming to IS: 9103 or ASTM C-494 shall only be used as admixture having the above properties either individually or in a combination as per the direction of the Engineer.

2.05.07 Reinforcement

Reinforcement shall be as per relevant IS Specification as mentioned in the Contract/Drawing/Instructions. All bars above 10 mm dia. shall be of tested quality.

2.06.00 Storage of Materials

2.06.01 General

All materials shall be so stored as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged or is otherwise considered defective by the Engineer, shall not be used for concrete and shall be removed from site immediately, failing which, the Engineer shall be at liberty to get the materials removed and the cost incurred thereof shall be realised from the Contractor's dues. The Contractor shall maintain upto-date accounts of receipt, issue and balance (stack wise) of all materials. Storage of materials shall conform to IS: 4082.

2.06.02 Cement

Sufficient space for storage, with open passages between stacks, shall be arranged by the Contractor to the satisfaction of the Engineer.

Cement shall be stored off the ground in dry, leak proof, well-ventilated warehouses at the works in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter.

Cement shall be stored in easily countable stacks with consignment identification marks. Consignments shall be used in the order of their receipts at site. Sub-standard or partly set cement shall not be used and shall be removed from the site, with the knowledge of the Engineer, as soon as it is detected.

2.06.03 Aggregates

Aggregates shall be stored on raised surface constructed by providing planks or steel plates or on concrete or brick masonry pavement. Each size shall be kept separated with wooden or steel or concrete or masonry bulkheads or in separate stacks and sufficient care shall be taken to prevent the material at the edges of the stock piles from getting intermixed. Stacks of fine and coarse aggregates shall be kept sufficiently apart with proper arrangement of drainage. The aggregates shall be stored in easily measurable stacks of



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suitable depths as may be directed by the Engineer.

2.06.04 Reinforcement

Reinforcing steel shall be stored consignment-wise and size-wise off the ground and under cover, if desired by the Engineer. It shall be protected from rusting, oil, grease, and distortions.

If necessary, the reinforcing steel may be coated with cement wash before stacking to prevent scale and rust at no extra cost to the Owner. The stacks shall be easily measurable. Steel needed for immediate use shall only be removed from storage.

2.07.00 Quality Control

Contractor shall establish and maintain quality control for different items of work and materials as may be directed by the Engineer to assure compliance with contract requirements and maintain and submit to the Engineer records of the same. The quality control operation shall include but not be limited to the following items of work:

- a) Admixture: Type, quantity, physical, and chemical properties that affects strength, workability, and durability of concrete.
- For air entraining admixtures, dosage to be adjusted to maintain air contents within desirable limits.
- b) Aggregate: Physical, chemical and mineralogical qualities. Grading, moisture content and impurities.
- c) Water: Impurities tests.
- d) Cement: Tests to satisfy relevant IS Specifications.
- e) Formwork: Material, shapes, dimensions, lines, elevations, surface finish, adequacy of form, ties, bracing and shoring and coating.
- f) Reinforcement: Shapes, dimensions, length of splices, clearances, ties and supports. Quality and requirement of welded splices.
- Material tests or Certificates to satisfy relevant IS Specification.



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- g) Grades of Concrete: Usage and mix design, testing of all properties.
- h) Batching & Mixing: Types and capacity of plant, concrete mixers and transportation equipment.
- i) Joints: Locations of joints, water stops and filler materials. Dimension of joints, quality, and shape of joint material and splices.
- j) Embedded and Anchorage Items: Material, shape, location, setting.
- k) Placing: Preparation, rate of pouring, weather limitations, time intervals between mixing and placing and between two successive lifts, covering over dry or wet surfaces, cleaning and preparation of surfaces on which concrete is to be placed, application of mortar/slurry for proper bond, prevention of cold joint, types of chutes or conveyors.
- l) Compaction: Number of vibrators, their prime mover, frequency and amplitude of vibration, diameter and weight of vibrators, duration of vibration, hand-spreading, rodding and tamping.
- m) Setting of base & Bearing plates: Lines, elevations, and bedding mortar.
- n) Concrete Finishes: Repairs of surface defects, screening, floating, steel trowelling and brooming, special finishes.
- o) Curing: Methods and length of time.

Copies of records and tests for the items noted above, as well as, records of corrective action taken shall be submitted to the Engineer for approval as may be desired.

3.00.00

INSTALLATION

All installation requirements shall be in accordance with IS: 456 and as supplemented or modified herein or by other best possible standards where the specific requirements mentioned in this section of the specification do not cover all the aspects to the full satisfaction of the Engineer.



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3.01.00 Washing and Screening of Aggregates

Washing and screening of coarse and fine aggregates to remove fines, dirt, or other deleterious materials shall be carried out by approved means as desired by the Engineer.

3.02.00 Admixture

All concrete shall be designed for normal rate of setting and hardening at normal temperature. Variations in temperature and humidity under different climatic conditions will affect the rate of setting and hardening, which will, in turn, affect the workability and quality of the concrete. Admixtures including plasticisers of approved make may be used with the Engineer's approval in accordance with IS-456 to modify the rate of hardening, to improve workability or as an aid to control concrete quality. The Engineer reserves the right to require laboratory test or use test data, or owner satisfactory reference before granting approval. The admixture shall be used strictly in accordance with the manufacturer's directions and/or as directed by the Engineer.

3.03.00 Grades of Concrete

Concrete shall be in one of the grades designated in IS: 456. Grade of concrete to be used in different parts of work shall be as shown on the drawing. In case of liquid retaining structures, IS: 3370 will be followed. Minimum cement content shall be as per IS: 456.

3.04.00 Proportioning and Works Control

3.04.01 General

“Design Mix Concrete” and “Nominal Mix Design” is defined as follows for use in this specification:

- a) Proportioning of ingredients of concrete made with preliminary tests by designing the concrete mix. Such concrete shall be called "Design Mix Concrete".
- b) Proportioning of ingredients of concrete made without preliminary tests adopting nominal concrete mix. Such concrete shall be called "Nominal Mix Concrete".

As far as possible, design mix concrete shall be used on all concrete works. Nominal mix concrete, in grades M-15 or lower only may be used if shown on drawings or approved by the Engineer. In all cases the Proportioning of ingredients and works control shall be in accordance with IS: 456 and shall be adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.



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3.04.02

Mix Design Criteria

Concrete mixes will be designed by the Contractor to achieve the strength, durability, and workability necessary for the job, by the most economical use of the various ingredients. In general, the design will keep in view the following considerations

- a) Consistent with the various other requirements of the mix, the quantity of water should be kept at the lowest possible level.
- b) The nominal maximum size of coarse aggregate shall be as large as possible within the limits specified.
- c) The various fractions of coarse and fine aggregates should be mixed in such a proportion as to produce the best possible combined internal grading giving the densest and most workable mix.
- d) The finished concrete should have adequate durability in all condition, to withstand satisfactorily the weather and other destruction agencies, which it is expected to be subjected to in actual service.
- e) The mix design shall have required workability and characteristic strength as per IS: 456. The quantity of cement, aggregates, and admixtures shall be determined by mass.

The requirement of adequate structural strength is catered for by the choice of proper grade of concrete in structural design. The Contractor will strictly abide by the same in his design of concrete mix installation. Various trials shall be given by the contractor with specific cement content on each trial. In some cases, plasticizers and other admixtures may be necessary to achieve the desired results.

3.05.00

Strength Requirements

The strength requirements of both design mix and nominal mix concrete where ordinary Portland Cement or Portland Blast furnace slag cement is used, shall be as per IS: 456. All other relevant clauses of IS: 456 shall also apply.

3.06.00

Minimum Cement Content

The minimum cement content for each grade of concrete shall be as per IS: 456. Contractor has to consider actual environmental exposure condition at



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site. Based on various tests results and as per Engineer, the environment condition shall be adopted for which minimum cement content shall be considered. No extra payment shall be made on account of any variation in environment condition.

- a) Sufficient number of trial mixes (to be decided by the Engineer) will be taken at the laboratory for the various designs and graphs of w/c ratio Vs crushing strengths at various ages will be plotted.
- b) All tests will be done in presence of the Engineer who shall be the final authority to decide upon the adoption of any revised minimum cement content. The Contractor will always be responsible to produce quality concrete of the required grade as per the acceptance criteria of IS: 456.
- c) The Engineer will always have the unquestionable right to revise the minimum cement content as decided above, if, in his opinion, there is any chance of deterioration of quality on account of use of lower cement content or any other reason.

3.07.00 Water-Cement Ratio

The choice of water-cement ratio in designing a concrete mix will depend on:-

- a) The requirement of strength.
- b) The requirement of durability.

3.07.01 Strength Requirement

In case of "Design Mix Concrete" the water-cement ratio of such value as to give acceptable test results as per IS: 456, will be selected by trial and error. The values of water-cement ratios for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary tests in the laboratory to the satisfaction of the Engineer. Frequent checks on test will have to be carried out and the water-cement ratios will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above the Contractor's responsibility to produce satisfactory test results and to bear all the consequences in case of default remains unaltered.

In case of nominal mix concrete, the maximum water-cement ratio for different grades of concrete is specified in Table-5 of IS: 456 and no tests are necessary. The acceptance test criterion for nominal mix concrete shall be as per IS: 456.

3.07.02 Durability Requirement



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Tables 4 & 5 of IS: 456 give the maximum water-cement ratio permissible from the point of view of durability of concrete subjected to adverse exposure to weather, sulphate attacks, and contact with harmful chemicals. Impermeability may also be an important consideration.

Whenever the water-cement ratio dictated by Durability consideration is lower than that required from strength criteria, the former should be adopted.

In general the water cement ratio between 0.4 and 0.45 will be desirable to satisfy the durability requirement and from the consideration of impermeability of concrete. The contractor may propose lower water cement ratio as mentioned above by addition of a suitable plasticizer/super-plasticizer. Trial mix shall be carried out accordingly. However, the contractor has to propose specifically along with field trials in the event of lower cement content if found suitable along with a plasticizer.

3.08.00 Workability

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedments and to give the required surface finish shall depend*on the type and nature of structure and shall be based on experience and tests. The usual limits of consistency for various types of structures are given below:

TABLE-V

LIMITS OF CONSISTENCY

Degree of workability	Slump in mm with Standard Cone as per IS: 1199		Use for which concrete is suitable
	Min.	Max.	
Very low	0	25	Large Mass concrete structure with heavy compaction equipments, roads
Low	25	50	Uncongested wide and shallow R.C.C. structures
Medium	50	100	Deep but wide R.C.C. structures with congestion of reinforcement and inserts
High	100	150	Very narrow and deep R.C.C. structures with congestion due to



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reinforcement and inserts.

Note: Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer.

With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. No extra payment will be made for this additional cement.

The workability of concrete shall be checked at frequent intervals by slump tests.

3.09.00 Size of coarse Aggregates

The maximum size of coarse aggregates for different locations shall be as follows unless otherwise directed by the Engineer

Very narrow space	- 12 mm
Reinforced concrete Except foundation	- 20 mm
Ordinary Plain concrete and Reinforced concrete foundations	- 40 mm
Mass concrete	- 80 mm
Lean concrete	- 40 mm

Grading of coarse aggregates for a particular size shall conform to relevant I.S. Codes and shall also be such as to produce a dense concrete of the specified proportions, strength and consistency that will work readily into position without segregation.

Coarse aggregate will normally be separated into the following sizes and stacked separately in properly designed stockpiles

80 mm to 40 mm, 40 mm to 20 mm and 20 mm to 5 mm. In certain cases it may be necessary to further split the 20 mm to 5 mm fraction into 20 mm to 10 mm and 10 mm to 5 mm fractions.

This separation of aggregates in different size fractions is necessary so that they may be remixed in the desired proportion to arrive at a correct internal grading to produce the best mix.



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3.09.01

Temperature control of concrete in top decks of machine foundations (i.e. of TGs, BFPs, Fans and Mills):

The temperature of fresh concrete shall not exceed 25°C when placed. A suitable measuring device for measuring the temperature of concrete as approved by the Engineer shall be used. For maintaining the limiting temperature of the 25°C, crushed ice shall be used as mixing water. The ice shall be formed of water conforming IS: 456. The Contractor shall establish the quantity of crushed ice to be mixed in order to achieve the limiting temperature of 25°C.

3.09.02

Base raft of Turbo Generator foundations and top decks of all machine foundations shall be cast in a continuous operation without any construction joint.

3.10.00

Mixing of Concrete

Ingredients of the concrete mix shall be measured by weight. Concrete shall always be mixed in mechanical mixer. Water shall not normally be charged into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency, but in no case shall mixing be done for less than 2 (two) minutes and at least 40 (forty) revolutions after all the materials and water are in the drum. When absorbent Aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.

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

Regular checks on mixer efficiency shall be carried out as directed by the Engineer as per IS: 4634 on all mixers employed at site only those mixers whose efficiencies are within the tolerances specified in IS: 1791 will be allowed to be employed.

Batching Plant shall conform to IS: 4925. The measuring gauges of batching plant shall be periodically calibrated for which the contractor shall provide standard weights. The accuracy of all gauges shall be within limits prescribed by the Engineer.

When hand mixing is permitted by the Engineer, for unimportant out of the



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way locations in small quantities, it shall be carried out on a water-tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand-mixing, 10% extra cement shall be added to each batch at no extra cost to the owner.

3.11.00 Conveying Concrete

Concrete shall be handled and conveyed from the place of mixing to the place of laying as rapidly as practicable by approved means and placed and compacted in the final position before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation or loss of any of the ingredients. For long distance haulage, agitator cars of approved design will be used. If, in spite of all precautions, segregations does occur during transport, the concrete shall be properly re-mixed before placement. During very hot or cold weather, if directed by the Engineer, concrete shall be transported in deep containers, which will reduce the rate of loss of water, by evaporation or loss of heat. If necessary, the container may have to be covered and insulated. Conveying equipments for concrete shall be well maintained and thoroughly cleaned before, commencement of concrete mixing. Such equipments shall be kept free from set concrete.

3.12.00 Placing and Compacting Concrete

Where specifically covered, the relevant I.S. Code will be followed for the procedure of surface preparation, placement, consolidation, curing, finishes, repairs and maintenance of concrete. If, however, there is no specific provision in relevant I.S. code for any particular aspect of work, any other standard code of practice, as may be specified by the Engineer, will be adopted. Concrete may have to be placed against the following types of surfaces:

- a) Earth foundation
- b) Rock foundation
- c) Formwork
- d) Construction joint in concrete or masonry

The surface on or against which concrete is to be placed has to be cleaned thoroughly. Rock or old construction joint has to be roughened by wire brushing, chipping, sand blasting or any other approved means for proper bond. All cuttings, dirt, oil, foreign and deleterious material, laitance, etc. are to be removed by air water jetting or water at high pressure. Earth foundation on which direct placement of concrete is allowed, will be consolidated as directed by the Engineer such that it does not crumble and get mixed up with the concrete during or after placement, before it has sufficiently set and



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hardened.

Formwork, reinforcement, preparation of surface, embedments, joint seals etc., shall be approved in writing by the Engineer before concrete is placed. As far as possible, concrete shall be placed in the formwork by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 1500 mm shall have to be approved by the Engineer.

Rock foundation or construction joint will be kept moist for at least 72 hours prior to placement. Concrete will be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the Engineer will have to be adopted.

Formwork will be cleaned thoroughly and smeared lightly with form oil or grease of approved quality just prior to placement.

A layer of mortar of thickness 12 mm of the same or less w/c ratio and the same proportion as that of the concrete being placed or cement slurry will be spread thoroughly on the rock Foundation or construction joint just prior to placement of concrete.

After concrete has been placed, it shall be spread, if necessary & thoroughly compacted by approved mechanical vibration to maximum, subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced workmen and the work carried out as per relevant IS Code of Practice: In thin members with heavy congestion of reinforcement or other embedments, where effective use of internal vibrator is, in the opinion of the Engineer, doubtful, in addition to immersion vibrators the contractor may have to employ form vibrators conforming to IS: 4656. For slabs and other similar structures, the contractor will additionally employ screed vibrator as per IS: 2506. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures, reinforcement, and formwork are not displaced or distorted during placing & consolidation of concrete.

The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green Concrete, which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended.



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No accumulation of water shall be permitted on or around freshly laid concrete.

Slabs, beams, and similar members shall be poured in one operation, unless otherwise instructed by the Engineer. Mouldings, throating, drip course, etc., shall be poured as shown on the drawings or as directed by the Engineer. Holes shall be provided and bolts, sleeves, anchors, fastenings, or other fixtures shall be embedded in concrete as shown on the drawings or as directed by the Engineer. Any deviation there from shall be set right by the Contractor at his own expense as instructed by the Engineer.

In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Engineer may direct to remove the portion and reconstruct or repair the same -at the Contractor's expense.

The Engineer shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement.

Once the concrete is deposited, consolidated and finished in its final position, it shall not be distributed.

3.13.00 Construction Joints and Cold Joints

3.13.01 Construction Joints

It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete certain predetermined stages. These joints will be formed in a manner specified in the drawings/Instruction.

Vertical construction joints will be made with rigid stop-board forms having slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint as per clause 3.12.

Where the location of the joints are not specified, it will be in accordance with the following:

- a) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it.
- b) Concrete in a beam shall preferably be placed without a joint, but if



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Provision of a joint is unavoidable, the joint shall be vertical and at the middle of the span.

- c) A joint in a suspended floor slab shall be vertical and at the middle of the span and at right angles to the principal reinforcement.
- d) Feather-edges in concrete shall be avoided while forming a joint.
- e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress.
- f) In case the Contractor proposes to have a construction joint anywhere to facilitate his work, the proposal should be submitted well in advance to the Engineer for study and approval without which no construction joint will be allowed.

3.13.02 Cold Joint

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The Contractor should always remain vigilant to avoid cold joints.

If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it:

- a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated.
- b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 mm in thickness, will be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.
- c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not raise inspite of extensive vibration, the joint, will be left to harden for at least 12 - 24 hrs. It Will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under clause 3.12.



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3.14.00 Repairs, Finishes, and Treatment of Concrete surfaces

3.14.01

Adequate and sound concrete surfaces, whether formed or unformed, can be obtained by employing a concrete mix of proper design, competent formwork, appropriate methods of handling, placing, and consolidation by experienced workmen.

Unsound concrete resulting from improper mix design, incompetent methods, equipment and formwork, poor workmanship and protection will not be accepted and will have to be dismantled, removed and replaced by sound concrete at the Contractor's cost. The Engineer may, at his sole discretion, allow to retain concrete with minor defects provided the Contractor is able to repair it by approved methods at no extra cost to the Owner. All concrete work shall be inspected by the Contractor immediately after the forms are removed & he will promptly report occurrence of any defects to the Engineer. All repair works will be carried out as per the instructions and in the presence of the Engineer or his representative. Generally, repair work will consist of any or all of the following operations:

- a) Sack rubbing with mortar and stoning with carborundum stone.
- b) Cutting away the defective concrete to the required depth shape.
- c) Cleaning of reinforcement & embedments. It may be necessary to provide an anti-corrosive coating on the reinforcement.
- d) Roughening by sand blasting or chipping.
- e) Installing additional reinforcement/welded mesh fabric.
- f) Dry packing with stiff mortar.
- 9) Plastering, guniting, shotcreting etc.
- h) Placing and compacting concrete in the void left by cutting out defective concrete.
- i) Grouting with cement sand slurry of 1:1 mix.
- j) Repairing with a suitable mortar either cement or resin modified mortars.
- k) Polymer modified patching and adhesive repair & mortar for beams & columns.

3.14.02 Finishing unformed Surface



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The contractor shall provide normal finishes in unformed surfaces which can be achieved by screeding, floating, trowelling etc. A few typical and common cases of treatment of concrete surface are cited below

a) Floor

Whenever a non-integral floor finish is indicated, the surface of reinforced concrete slab shall be struck off at the specified levels and slopes and shall be finished with a wooden float fairly smooth removing all laitance. No over trowelling, to obtain a very smooth surface, shall be done, as it will prevent adequate bond with the subsequent finish. If desired by the Engineer, the surface shall be scored and marked to provide better bond.

Where monolithic finish is specified or required, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type and then floated with a wooden float. Steel trowelling is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done will flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes, ripples, and trowel marks.

A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water can be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface.

To provide a better grip the Engineer may instruct marking the floor in a regular geometric pattern after initial trowelling.

b) Beams, Columns & Walls

If on such or any other concrete structure it is intended to apply plaster or such concrete surfaces against which brickwork or other allied works are to be built, the Contractor shall hack the surface adequately as soon as the form is stripped off so that proper bond can develop. Pattern, adequacy, and details of such hacking shall meet with the approval of the Engineer, who shall be informed to inspect such surfaces before they are covered up.

3.15.00

Protection and Curing of concrete

Newly placed concrete shall be protected by approved means from rain, sun, and wind. Concrete placed below the ground level shall be protected against contamination from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be protected from contact with



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such ground, or with water draining from such ground, during placing of concrete and for a period of at least three days, or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pumping out or other adequate means of drainage to prevent floatation or flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage by debris, excessive Loadings, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently, it shall be covered either with sand, hessian, canvas, or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water will be allowed if the Engineer is satisfied with the adequacy of the arrangements made by the Contractor. Quality of water for curing shall be as per IS: 456.

If permitted by the Engineer, liquid curing compound may be used for prevention of premature water loss in concrete and thereby effecting curing of concrete. This type of curing compound shall be sprayed on newly laid concrete surfaces to form a thin film barrier against premature water loss without disturbances to normal setting action. The curing compound shall be emulsified paraffin based and shall comply with ASTM requirements for acceptance.

The curing compound shall be applied following the final finishing operation and immediately after disappearance of water from concrete surface. It is important not to apply the curing compound when standing water is still present on concrete.

The contractor shall arrange for the manufacturer's supervision at no extra cost.

The Contractor shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. The Engineer's decision regarding the adequacy of curing is final. In case the Engineer notices any lapse on the part of the Contractor, he will inform the Contractor or his supervisor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the Contractor within 3 (three) hours of issuance of such instruction, the Engineer will be at liberty either to employ sufficient means through any agency to make good the deficiency and recover the cost thereof from the Contractor, or deduct certain amount from contractor's payment for the part where inadequate curing was noticed entirely at the discretion of the Engineer.

3.16.00

Reinforcement

Mild steel round bars, TMT bars, Hot rolled deformed bars or cold twisted



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deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc, will be used as reinforcement as per drawings and directions. In an aggressive environment an anti-corrosive coating on the reinforcement may be provided as per IS: 9077, as shown on the drawing or as directed by the Engineer.

3.16.01 Bar Bending Schedules

The Contractor shall prepare Bar Bending Schedules showing clearly the arrangements proposed by the Contractor to match available stock of reinforcing steel, progressively, starting within one week of receipt of approval on corresponding design of RCC structure. As decided by the Engineer, some or all the detailed drawings and schedules will have to be submitted for approval. Approval of such detailed drawings by the Engineer shall not relieve the Contractor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the contract. The contractor for record and distribution shall submit six prints of the final drawings & schedules with one reproducible print.

3.16.02 Cleaning

All steel for reinforcement shall be free from loose scales, oil, grease, paint or other harmful matters immediately before placing the concrete.

3.16.03 Bending

Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in IS: 2502 or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions corresponding with the final Bar Bending Schedules. Bar Bending Schedules shall be rechecked by the Contractor before any cutting, bending is done.

No reinforcement shall be bent when already in position in the work, without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Rebending can be done only if approved by the Engineer. Reinforcing bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat (not exceeding 845°C) may be allowed under very exceptional circumstances except for bars whose strength depends on cold working. Bars bent hot shall not be cooled by quenching.

3.16.04 Placing in Position

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings by such approved and adequate means like mild steel chairs and/or concrete spacer blocks. Bars intended to be in contact at crossing



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points, shall be securely tied together at all such points by No. 20 G annealed soft iron wire or by tack welding in case of Bar larger than 25 mm dia., as may be directed by the Engineer. Binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be spaced such that the main bars do not sag perceptibly between adjacent spacers. Before actual placing, the Contractor shall study the drawings thoroughly and inform the Engineer in case he feels that placement of certain bars is not possible due to congestion. In such cases he should not start placing any bar before obtaining clearance from the Engineer.

3.16.05 Welding

Lapping shall normally do splicing of reinforcement. For M.S. reinforcement bars, butt-welding may be done, if permitted by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards for welding of mild steel bars used in reinforced concrete construction as per IS: 2751 and IS: 456. Welded mesh fabrics conforming to IS: 1566 may also be used if specified in the Drawings. Welding of cold twisted High yield strength deformed bar shall not be allowed.

3.16.06 Control

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS: 456, unless otherwise specified. The laps shall be staggered as far as practicable and as directed by the Engineer. Arrangements for placing concrete shall be such that reinforcement in position does not have to bear extra load and get disturbed. The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Engineer. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar not leaner than 1 (one) part cement to 2 (two) parts sand by –volume and cured in a pond for at least 14 (fourteen) days. The type, shape, size and location of the concrete blocks shall be as approved by the Engineer.

3.17.00 Cold Weather Concreting

When conditions are such that the ambient temperature may be expected to be 5°C or below during the placing and curing period, the work shall conform to the requirement of IS: 456 and IS: 7861.



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3.18.00 Hot Weather Concreting

When depositing concrete in very hot weather, the Contractor shall take all precautions as per IS: 7861 and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 38°C while placing. Positive temperature control by precooling, post cooling or any other method, if required, will have to be done by the contractor at no extra cost.

3.19.00 Concreting under water

When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of IS: 456.

3.20.00 Form Work

3.20.01 General

If it is so desired by the Engineer, the contractor shall prepare, before commencement of actual work, designs and working drawings for formwork and centring and get them approved by the Engineer. The formwork shall conform to the shape, grade, lines, levels and dimensions as shown on the drawings.

Materials used for the formwork inclusive of the supports and centring shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Engineer.

The centring shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Rakers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight and horizontal pressure of the concrete as a liquid as well as the working load. In case the contractor wishes to adopt any other design criteria, he has to convince the Engineer about its acceptability before adopting it. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel and concrete of adequate strength shall be used. Bolts passing completely through



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liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified as directed by him.

For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion-resistant devices. Rigid care shall be exercised in ensuring that all column forms are in true plumb and thoroughly cross-braced to keep them so. All floor and beam centring shall be crowned not less than 8 mm in all directions for every 5 metres span. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed when required, during pouring operations without leaving any mark on the concrete.

3.20.02 Cleaning and Treatment of Forms

All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, sawdust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil or other compound before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork. The oiling of the formwork will be inspected just prior to placement of concrete and redone wherever necessary.

3.20.03 Design

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns, and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork.

Removing any props or reproping shall not be done except with the specific approval of the Engineer. If formwork for column is erected for the full height



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of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.

3.20.04 Inspection of Forms

Casting of Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In case of delay beyond three days, a fresh approval from the Engineer shall be obtained.

3.20.05 Removal of Forms

Formwork shall be kept in position after casting of concrete for a minimum period as mentioned in IS: 456, however the period of retaining form in position can be extended as per drawing, instruction of Engineer or as required for satisfactory completion of work without any extra cost. Before removing any formwork, the Contractor must notify the Engineer well in advance to enable him to inspect the concrete if the Engineer so desires.

The Contractor shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed there from and have this record checked and countersigned by the Engineer regularly. The Contractor shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him without any extra cost to the Owner, The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

If any other type of cement other than ordinary Portland cement and Rapid hardening cement is used, the time of removal of forms shall be revised such that the strength of this cement at the time of removal of forms match with strength of Portland cement at the time of removal of form.

3.20.06 Tolerance

The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances unless otherwise specified in this specification or drawings or directed by the Engineer:-

- For - a) Sectional dimension - ± 5 mm
b) Plumb - 1 in 1000 of height



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- c) Levels - ± 3 mm before any deflection has taken place

The tolerance given above are specified for local aberrations in the finished concrete surface & should not be taken as tolerances for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Any error, within the above tolerance limits or any other as may be specially set up by the Engineer, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

3.20.07 Re-use of Forms

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as specified hereinbefore. Formwork shall not be used/re-used if declared unfit or unserviceable by the Engineer.

3.20.08 Classification

Generally, the "ordinary" class formwork shall be used unless otherwise specified.

- a) **Ordinary:** These shall be used in places where ordinary surface finish is required and shall be composed of steel and/or approved good quality partially seasoned timber.
- b) **Plywood:** These shall be used in exposed surfaces, where specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilization of used plywood for the "ordinary" class, if it is still in good condition.
- c) **Ornamental:** These shall be used where ornamental and curved surface are required and shall be made of selected best quality well seasoned timbers or of plywood, which can be shaped correctly.

3.21.00 Opening, Chases, Grooves, Rebates, Blockouts etc.

The Contractor shall leave all openings, grooves, chases, etc. in concrete work as shown on the drawings or as specified by the Engineer.

3.22.00 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and other misc. Embedded Fixtures



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The Contractor shall build into concrete work all the items noted below and shall embed them partly or fully as shown on drawings and secure the same as may be required. The materials shall be as specified and be of best quality available according to relevant Indian Standards of approved manufacture and to the satisfaction of the Engineer. Exposed surfaces of embedded materials are to paint with one coat of approved anti- corrosive paint and/or bituminous paint without any extra cost to the Owner. If welding is to be done subsequently on the exposed surface of embedded material, the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, jigs, fixtures, supports etc. shall be used as may be required or directed by the Engineer.

Items to be embedded

- a) Inserts, hangers, anchors, frame around openings, manhole covers, frames, floor clips, sleeves conduits and pipes.
- b) Anchor bolts and plates for machinery, equipment and for structural steel work.
- c) Steel structurals to be left embedded for future extension, special connection etc.
- d) Dowel bars, etc. for concrete work falling under the scope of other contractors.
- e) Lugs or plugs for door and window frames occurring in concrete work.
- f) Flashing and jointing in concrete work.
- g) Any misc. embedments and fixture as may be required.

Correct location and alignment, as per drawings/instruction of all these embedded items shall be entirely the responsibility of the Contractor.

3.23.00 Expansion and Isolation Joints

3.23.01 General

Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified hereinafter. In case of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids



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as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufacturers and must have the approval of the Engineer. Where it is the responsibility of the Contractor to supply the material, the Engineer may demand test certificates for the materials and/or instruct the Contractor to get them tested in an approved laboratory free of cost to the Owner. Joints shall be formed true to line, level, shape, dimension, and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the Engineer before starting the work.

3.23.02

Bitumen Board/ Expanded Polystyrene Board

a) Bitumen Board

Bitumen impregnated fibreboard of approved manufacturer as per IS: 1838 may be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the joint and not prepared by cutting to size smaller pieces from larger boards at site. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

b) Expanded Polystyrene Boards

If required, commercial quality of expanded polystyrene products commonly used for thermal insulations may also be used as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installations will be similar to that recommended by the manufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board against which concrete will be placed.

3.23.03

Joint sealing strips

Joint sealing strips may be provided at the construction, expansion, and isolation joints as a continuous diaphragm to contain the filler material and/or to exclude passage of water or any other material into or out of the structure. The sealing strips will be either metallic like G.I., Aluminums, or Copper, or non-metallic like rubber or P.V.C.

Sealing strips will not have any longitudinal joint and will be procured and installed in largest practicable lengths having a minimum number of transverse joints. The material is to be procured from reputed manufacturers



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having proven records of satisfactory supply of joint strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Engineer. The Contractor is to supply all labour and material for installation -including the material and tools required for jointing, testing, protection, etc. If desired by the Engineer, joints in rubber seals may have to be vulcanized.

a) Metal Sealing Strips

Metal sealing strips shall be either G.I., Aluminium or Copper and formed straight, U shaped, Z shaped or any other shape and of thickness as indicated in the drawing. The transverse joints will be gas welded using brass rods and approved flux and will be tested by an approved method to establish that it is leak proof. If required, longer lap lengths and different method of brazing which will render it leak proof, will be adopted by the Contractor. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

i) G.I. Strips

G.I. strips shall be minimum 1.5 mm thick and 150 mm in width unless specified otherwise. The standard of Galvanizing shall be as per relevant Indian Standards for heavy-duty work. At the joints, the overlapping should be for a minimum length of 50 mm.

ii) Aluminium Strips

Aluminium strips shall be minimum 18 SWG thick and 300 mm wide unless specified otherwise and shall conform to IS: 737 of 19000 grades or 31000 grade (Designation as per IS: 6051). A minimum lap of 50 mm length is required at the joints.

iii) Copper Strips

The Copper strips shall be minimum 18 SWC in thickness and 300 mm width unless specified otherwise and shall conform to the relevant Indian Standards. It should be cleaned thoroughly before use to expose fresh surface, without any reduction in gauge. A minimum lap of 50 mm in length is required at the joints.

b) Non-metallic Sealing Strips

These will be normally in Rubber or P.V.C. Rubber or P.V.C. joint seals can be of shape having any combination of the following features:

i) Plain



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- ii) Central bulb
- iii) Dumb-bell or flattened ends
- iv) Ribbed and Corrugated Wings
- v) V shaped

As these types of seals can be easily handled in very large lengths unlike metal strips, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer. The method of forming these joints, laps etc. shall be as specified by the Manufacturer and/or as approved by the Engineer taking particular care to match the central bulbs & the edges accurately.

c) Rubber Sealing Strips

The minimum thickness of Rubber sealing strips shall be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion, and tear and also to attacks from the acids, alkalis and chemicals normally encountered in service. The physical properties will be generally as follows. The actual requirements may be slightly different as decided by the Engineer:

Specific Gravity	:	1.1 to 1.15
Shore Hardness	:	65A to 75A
Tensile Strength	:	25 - 30 N/Sq.mm
Maximum Safe Continuous Temperature	:	75°C
Ultimate Elongation	:	Not less than 350%

b) P.V.C., Sealing Strips

The minimum thickness of P.V.C. sealing strips will be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings or as directed by the Engineer. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion, and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows. The actual requirements, which will be directed by the Engineer, may vary slightly

Specific Gravity	:	1.3 to 1.35
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Shore Hardness	:	60A to SOA
Tensile Strength	:	10 - 15 N/Sq.mm
Maximum Safe Continuous Temperature	:	70 Deg.C
Ultimate Elongation	:	Not less than 275%

3.23.04 Bitumen Compound

When shown in drawing or directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS: 1834.

3.23.05 Isolation Joints

Strong and tough alkathene sheet or equivalent, about 1 mm in thickness and as approved by the Engineer shall be used in isolation joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set concrete to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

3.23.06 Pad

Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings. The rubber shall have a unit weight of 1500 Kg/Cu.m, a shore hardness - 65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.

3.24.00 Grouting under Machinery or Structural Steel Bases

If required, grouting under base plates of machines or structural steel etc. shall be carried out by the Contractor. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6 mm down stone chips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If specified on drawings, admixtures like Aluminium powder, "Ironite" etc. may have to be added with the grout in required proportions. Premixed non-shrink grout of



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approved manufacture having proper strength shall be used with Engineer's approval for important machineries.

3.25.00 Precast Concrete

The Specification for precast concrete will be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose. This yard shall be dry, properly levelled and having a hard and even surface. If the ground is to be used as a soffit former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer, casting will have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 7 (seven) days of curing and can be removed for erection after 28 (twenty-eight) days of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal. The yard shall preferably be fenced.

Lifting hooks, where necessary or as directed by the Engineer, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection.

Precast concrete units, when ready, shall be transported to site by suitable means approved by the Engineer. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, leveling, and plumbing shall be done as per instructions of the Engineer. The Contractor shall render all help with instruments, materials, and men to the Engineer for checking the proper erection of the precast units.

After erection and alignment, the joints shall be filled with grout or concrete as per drawings. If centrings have to be used for supporting the precast units, they shall not be removed until the joints have attained sufficient strength and in no case before 14 (fourteen) days. The joint between precast roof planks shall be pointed with 1:2 cement: sand mortar where called for in the drawings.

3.26.00 Waterproofing of Concrete Structure

3.26.01 General

Where required, waterproofing of concrete structures shall be ensured internally by suitable design of the concrete mix, addition of suitable admixtures in the concrete or mortar at the time of mixing and/or installing water bars at the joints. In addition to the above measures, the structures shall be made watertight by adopting "structural waterproofing" as per



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specification. The design, material, and workmanship shall conform to the relevant I.S. Codes where applicable. The Engineer's approval of the materials shall be obtained by the Contractor before procurement. If desired by the Engineer, test certificates for the materials and samples shall be submitted by the Contractor free of charge. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

3.26.02

Water Bar/Seal/Special Treatment of Construction Joint

Water bearing structures and underground structures may have water bar/seals installed at the joints. They may be metallic, rubber, or P.V.C. The materials and installation will be as described under Clause 3.23.3. Construction joint shall be provided as per clause 3.13.1 with or without water bar/seal as shown on the drawing. In case of water bars being used at the construction joint, fixing of the same has to be done carefully, so that the water bar is not disturbed during concreting. The construction joint shall also be treated by any one of the following methods.

Method 1: A surface retarder in the form of a thixotropic gel shall be applied on the joint surface of the previous pour in case of joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm just before pouring the next stage of concreting. In case of walls, the above bonding agent will be mixed with water, which will be used for making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer's specification. In case of floor joint, however, after washing of retarder a solvent free two-component epoxy resin-bonding agent will be used at the joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days

Compressive strength	-	55 to 60 N/Sq.mm
Flexural strength	-	5 to 30 N/sq.mm
Tensile strength	-	15 N/Sq.mm (approx.)
Bonding strength to concrete	-	3 N/Sq.mm (approx.)
Bonding strength to steel	-	20 N/Sq.m (approx.)

The whole operation shall be done as per manufacturers specification. The



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contractor shall provide manufacturer's supervision at no extra cost to the owner.

Method 2: One row of threaded nozzles at regular intervals not exceeding 1.5 m centre to centre shall be placed in concrete along the construction joint during casting. Injection of cement water together with a suitable waterproof expanding grouting admixture of approved quality shall be done through the nozzles after the concrete has set to seal the voids in concrete near the construction joint in walls and slabs. The injection shall be done under pressure of approximately 2 to 4 kg/sq.cm. The nozzles shall be sealed off with suitable admixture after the injection is over. The whole operation shall be carried out as per manufacturer's specification and supervision. The cost of such manufacturer's supervision shall be borne by the contractor.

3.26.03 Waterproofing Admixtures

The waterproofing admixture for concrete and cement mortar/plaster shall conform to IS: 2645. The admixture shall not cause decrease of strength of concrete/plaster at any stage and it shall be free from chlorides and sulphates. The admixture shall not affect the setting time by more than 5%. The maximum permissible dosage of admixture will be 3% (three percent) by weight of cement, but a lower dosage will always be preferred. The product shall be stored in strong moisture proof packings. However, in case of important structures where M25 or higher grade concrete is specified, the use of melamine based, high range water reducing concrete admixture shall be used to provide a waterproof concrete, For achieving high strength concrete having cement content around 400 kg/cu.m. a melamine based super plasticizer will be preferable.

- a) In concrete: The admixtures shall be procured from reliable and reputed manufacturers and approved by the Engineer. The method of application and other details shall conform to the manufacturer's specification and/or as instructed by the Engineer. The Contractor shall have the services of the manufacturer's supervisor at no extra cost to supervise the work, if desired by the Engineer.
- b) In Plaster: The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture and laid in appropriate thickness and in layers not exceeding 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the Engineer. If desired by the Engineer, the Contractor shall have the work supervised by the manufacturer's supervisor at no extra cost. On completion, the Plastered surface shall be cured continuously for a minimum period of 14 days like concrete.



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3.26.04 Structural waterproofing

a) Nozzles spaced as required after the concrete is completed shall be drilled into surfaces to be rendered watertight. Non-shrink cement grout with waterproofing compound as per manufacturers specifications shall be injected under pressure to seal all voids. Special care shall be taken at joints by providing additional nozzles. The pressure grouting shall be done on the internal surface.

b) External Treatment

Two layers of (1 : 4) plaster of 12 mm thick each with waterproofing compound as per manufacturer's specification shall be provided on outer surface of concrete underground structures.

3.26.05 Protective coating on Inside Surface.

Two coats of cement based two components polymer modified flexible protective and waterproofing slurry having 1 mm thick for each coat shall be applied on the walls/floor after proper surface preparation as mentioned above. The slurry shall be applied by brush.

3.26.06 Bitumen Felt: Application for Tanking

This specification shall cover laying the waterproof course on the outside and inside of the walls and bases of structures.

The materials shall conform to IS: 1322, and the workmanship to IS: 1609. The bitumen felt should be hessian base and/or fibre base as specified in Drawing. If required by the Engineer, tests as specified in relevant IS Codes shall be arranged by the Contractor without charging any extra to the Owner.

The Contractor shall execute this work in direct collaboration with one of the well known specialized firm approved by the Engineer.

Cleaning the surface, keeping it dry, providing, necessary corner fillets and cement rendering and cutting chases, etc. shall be done as per drawings and/or instructions. If any protective brickwork on/against concrete sub-bases or walls are required, the same shall be provided. A twenty (20) years guarantee for satisfactory performances shall be given by the Contractor as well as his specialist sub-contractor jointly and severally, for this work. Free rectification of any defects noted in the work within this guarantee period will be carried out by the Contractor even if it is beyond the specified maintenance period of the contract as a whole.

3.26.07 Polyethylene Films: Application in Walls or base of structures



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Waterproof treatment shall be applied as outlined and as per sequence given hereunder

- i) the concrete surface shall be made smooth with 12 mm cement plaster 1:6.
- ii) apply hot bitumen 80/100 grade (IS: 73-1961) at the rate of 1.0 Kg/Sq.m minimum
- iii) lay black polyethylene film 250-micron (IS: 2508-1977) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed, taking care not to puncture the film.

Alternatively, the overlaps shall be heat sealed by an electric iron having three parallel sealing bars. A long piece of plywood is to be placed below the polyethylene film to be heat-sealed. On the plywood a rubber gasket is to be laid to provide a cushion for better welding of the film. On the rubber padding, a cellophane tape is to be spread and on this the LDPE film, with 100 mm overlap, is to be stretched. On the overlapped film another cellophane tape is to be placed to prevent the heat sealer from sticking to the LDPE film. After this, the electric iron is to be pressed on the overlap joint for sufficient time so as to allow perfect welding. The operation is to be repeated for subsequent lengths of joints. After heat-sealing, the cellophane tape is to be removed and the joints are to be tested for leaks.

- iv) Lay 100 gm brown craft paper laminated with a layer of straight run bitumen,
- v) Lay hot bitumen 80/100 grade (IS: 73-1961) at 1.0 Kg/Sq.m minimum.
- vi) Lay 250-micron polyethylene film as second layer similar to
- vii) above.
- viii) Lay second layer of 100 gm. brown craft paper laminated similar to (iv) above.
- ix) Apply hot bitumen (straight run grade) to IS: 73-1961 at 1.0 Kg/Sq.m dusted with fine sand.
- x) Protecting with a layer of 75 mm plain cement concrete M-10, or a layer of brick laid in cement mortar 1:6 in case of wall apply a 12 mm thick plaster as shown on the drawing or a protective brick wall in 1:6 cement mortar as shown on the drawing.

3.27.00 Protective Coating on Concrete Surface

3.27.01 On Foundation



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The outside faces of foundation of important structures will be protected from adverse effect of soil/underground water, if shown on drawing by using rubber/bitumen emulsion protective coating of approved manufacturer.

4.00.00 SAMPLING AND TESTING

4.01.00 General

The Contractor shall carry out all sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost unless otherwise specified in this specification. 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.

4.02.00 Cement

Representative samples will be taken from each consignment of cement received from the manufacturer/supplier for carrying out the tests for fineness (by hand sieving), setting time and compressive strengths as per guidelines of IS: 269. Soundness Tests may also be required to be carried out if required by the Engineer. The Contractor shall carry out the tests without any expense to BHEL. No cement from a particular consignment/batch will be used on the works unless satisfactory 3 (three) days and 7 (seven) days test results for compressive strength are known. The Engineer and Contractor will jointly associate themselves with the tests irrespective of whether they are carried out by the BHEL or the Contractor. These tests are of great importance, as their results will have a bearing on the acceptance of concrete or otherwise as per the terms and conditions of the Contract.

4.03.00 Aggregates

The contractor shall carry out any or all the tests on aggregates as may be required by the Engineer in accordance with IS: 2386 PARTS-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant Indian Standards.

4.04.00 Water

Sampling and Testing of water being used for concrete works as per IS: 3550 will be carried out by the Contractor at regular intervals and whenever directed by the Engineer. The acceptance criteria will be as per IS: 456.

4.05.00 Admixture

4.05.01 Air Entraining Agents



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Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cylinder cube crushing strength vis-a-vis quantity of A.E.A. used for all types of concrete will be established by the Contractor by carrying out sufficiently large number of tests. After that, at regular intervals and whenever directed by the Engineer, the Contractor will check up the actual percentages of air entrained and corresponding crushing strengths to correlate with the earlier test results.

4.05.02 Other Admixtures

Tests for establishing the various properties of any other admixtures, which may be required to be added, shall be carried out by the Contractor.

4.06.00 Concrete

The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be in accordance with IS: 516 and IS: 1199, the size of specimen being 15 cm cubes. Normally, only compression tests shall be performed but under special circumstances the Engineer may require other tests to be performed in accordance with IS: 516. Sampling procedure, frequency of sampling and test specimen shall conform to IS: 456. To control the consistency of concrete from every mixing plant, slump tests shall be carried out by the Contractor every two hours or as directed by the Engineer. Slumps corresponding to the test specimens shall be recorded for reference. The acceptance criteria of concrete shall be in accordance with IS: 456. Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the Contractor at his own cost. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good, free of charge by the Contractor, to the satisfaction of the Engineer.

5.00.00 ACCEPTANCE CRITERIA

5.01.00 Standard Deviation

Standard deviation shall be based on test results and determination of Standard deviation shall conform to IS: 456.

5.02.00 Acceptance Criteria

The strength requirements and acceptance criteria shall conform to IS: 456.

5.03.00 Inspection and Core Tests

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to IS: 456.



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5.04.00 Load Test

Load tests of structural members as per IS:456 may be required by the Engineer, when the strength of test specimen results falls below the required strength.

If the member shows evident failure, the Contractor shall make the structure adequately strong free of cost to BHEL.

The entire cost of load testing shall be borne by the Contractor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification. The entire cost of dismantling and replacement and restoration of the site being borne by the Contractor.

If, in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same will be made good, free of charge by the Contractor to the satisfaction of the Engineer.

6.00.00 RATES AND MEASUREMENTS

6.01.00 Cast-in-situ Concrete

6.01.01 Rates

- a) The unit rates shall include the cost of labour, materials, equipment, handling, transporting, botching, mixing, placing in position, vibrating, compacting, finishing, curing, testing, etc. at all elevations. This shall also include the cost of using curing compound, whenever used.
- b) The unit rates shall include for all working conditions including in or under water, liquid, mud, in or under foul positions, under tides, and extreme weather conditions.
- c) The unit rates for exposed concrete works (including machine foundations) shall include all incidentals, rendering, smoothening with carborandum stone, finishing with a paste of cement sand mortar, curing, etc.
- d) The unit rates shall include for maintaining stability of structure during execution.
- e) Nothing extra shall be payable for the handling/mixing of extra cement on account of any reason or pouring of second stage concrete.
- f) Nothing shall be payable to the Contractor on account of facilities and arrangement provided by him for conducting ultrasonic pulse velocity tests or other relevant tests to ascertain grade and quality, etc. of the concrete, if required. In case of any defects, the Contractor shall rectify the same by



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cement/epoxy grout at his own cost.

- g) The unit rates for controlling of the temperature of concrete shall include storing and mixing of ice, water, cooling of aggregate etc.
- h) The quoted rate shall include the cost of making additional trial mixes, using the superplasticizer and mixing in concrete etc.

6.01.02 Measurements

- a) Actual volume of concrete work as executed or as per drawings issued, whichever is less shall be measured in cubic metres.
- b) No deductions shall be made for the following:
 - i) Opening upto 0.1 sq.m.
 - ii) Volume occupied by reinforcement, sleeves, anchor bolts, and similar items.
 - iii) Volume occupied by pipes, conduits, sheathing, etc. not exceeding 100 sq.cm. each in cross sectional area.
- c) The concrete works of different grades; below and above ground floor finished level shall be measured separately, unless otherwise specified in the schedule of items. Accordingly rates shall be applied for concrete in foundation for concrete below ground floor finished level and concrete in superstructure for concrete above ground floor finished level.
- d) For temperature control measures, measurement shall be done in terms of quantity of concrete in cum. in concreting of which the ice have been used or cooling of aggregates has been done to keep the temperature of freshly laid concrete to less than 25⁰C.

6.02.00 Reinforcement

6.02.01 Rates

- a) The unit rates shall include for cover block, providing binding wire, welding, separator pieces between two or more layers of reinforcement required for keeping the steel in position, etc. at all elevations.
- b) No extra will be paid for transportation from stores, cleaning, straightening of steel, cutting, bending, binding with annealed wire, welding, tack welding, placing the reinforcement modification of already embedded reinforcement, if required, due to faulty fabrication or placement and other



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cost of tools and plants, materials, labours, return of unused steel to the store, etc.

- c) No extra shall be paid for preparing and getting approved bar bending schedules (including all revisions).
- d) Generally members are straight and have straight edges. However, for bending, binding, placing of reinforcement in any curved member in length or cross section or both, no extra payment shall be made.

6.02.02 Measurements

- a) Bar or any other type of reinforcement used like hard drawn steel wire fabric etc. for reinforced concrete shall be measured by weight in tonnes. The weight shall be arrived at by multiplying the actual or theoretical length measured alongwith standard hooks, cranks, bends, authorized laps, etc. whichever is less by the sectional weights. Claims for payment for this item shall be submitted with supporting documents giving the schedule of bars with sketches. The sectional weight to be adopted shall be IS Section weight. Nothing extra will be payable to the Contractor on account of, difference in weight, if any, due to different methods adopted for issue and measurement.
- b) Standard hooks, cranks, bends, authorised laps, supports, hangers and chairs which are covered in approved bar bending schedule shall be measured in tonnes.

6.03.00 Formwork and Staging

6.03.01 Rates

- a) The unit rates shall be inclusive of all staging, scaffolding, making the formwork watertight, etc. for all elevations and in all types of works.
- b) No separate payment shall be made for providing fillets, for rounding or chamfering at junctions, comers, etc.
- c) The unit rates shall include the cost of labour, materials etc. and the extra time, which shall be required for the removal of shuttering/ support for satisfactory completion of work.
- d) No extra payment shall be made on account of difficulty, wastage etc. for placement/removal of formwork between the network of closely placed steel beams or for the lacing/bracing portions and ribbed slab constructions.
- e) Payment for curved shuttering shall be made for curved members/wall whose centerline radius in plan is less than 6m.



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- f) If the contact surface area in pockets is less than or equal to 0.1 sq.m. in each case, payment shall be done under item for providing formwork in pockets.

6.03.02 Measurements

- a) Formwork for different classes (types) shall be measured separately as the actual surface in contact with the concrete and paid on area basis unless included in the rate for concrete. The unit of measurement shall be in sq.m.
- b) Openings upto 0.1 sq.m or boxing left for inserts etc. for facility of Contractor's work, shall be neglected as if nonexistent for the purpose of formwork measurement of surface in which the openings occur.

For suspended floor, no deduction shall be made for flange area of secondary steel beams.

- c) No measurement shall be taken for the formwork in pockets, openings, chases, blockouts, etc. in concrete, the contact surface area is less than or equal to 0.1 sq.m. in each case.
- d) For pockets, if the contact surface area is less than or equal to 0.1 sq.m. in each case, measurement shall be done under item for providing formwork in pockets.
- e) Formwork, if required, for joints shown on drawing or instructed by the Engineer, shall be paid for the 'leading side' only.

6.04.00 Embedded Parts

6.04.01 Rates

- a) The unit rate for erection of embedded steel parts, supplied by Engineer shall include transportation from Owner's store to the place of work, erection & installation including setting material in concrete, etc. complete.
- b) The unit rate for MS pipe embedments and PVC pipe embedments shall include cutting, welding, fabrication, erection, embedding, and transportation to site. Unit rate shall also include the cost of the pipes.
- c) Rate for expansion fasteners shall include cost of fasteners, installation, and fixing including cost of washers and nuts.

6.04.02 Measurements



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- a) The measurement of the embedded steel parts fabricated and installed by the Contractor shall be based on the calculated weight of steel sections in tonne corrected to second place of decimal.
- b) Embedded steel parts supplied by Owner and installed by Contractor Measurement shall be done for the net weight of the embedments installed in tonnes correct to second place of decimal.
- c) For PVC pipes/conduits, measurements shall be in quintals correct to second place of decimal for the net weight.
- d) For mild steel pipes, measurement shall be in quintals, correct to second place of decimal, for the net weight of the steel pipe supplied, fabricated, and installed.
- e) The lugs shall be measured in Kg. correct to second place decimal for the net weight.
- f) The expansion fasteners shall be measured in number according to tension capacity.
- g) The rails shall not be treated as embedded steel part and the track shall be measured in running metres along the centre line and paid for under separate item of work as specified in schedule of items. Other related civil items associated with the laying of track shall be measured separately and paid under respective items of works.

6.05.00 Groutings

6.05.01 Rates

Rate shall include the cost of surface preparation, admixtures, and curing.

6.05.02 Measurements:

- a) Measurement shall be in cubic decimeters.
- b) Measurement for grouting shall be by volume of the block out, pockets or bolt hole upto the top surface of foundation concrete and shall be calculated from the dimensions shown on the drawings.
- c) Measurement for underpinning shall be by volume between the top surface of the foundation concrete and the underside of the base plate, the plan dimensions being as indicated on the drawings.
- d) No deduction shall be made for shims, bolts, shear keys and such other embedments.



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6.06.00 Joints

6.06.01 Rates

The unit rate shall include all the activities described in the schedule of items.

6.06.02 Measurements

a) Bitumen Board/Expanded polystyrene.

The measurement for bitumen board shall be based on actual finished surface area in square meters nearest to second decimal, for the specified thickness.

b) Water Stops

The measurement for water stops shall be in running metres of actual length of the joint covered, for specified thickness, width, and shapes. No separate measurement shall be made for laps/splices for cross-joints and mitered joints.

c) Metal Cover Strips

The measurement for Metal Cover Strips shall be based on actual finished surface area in square metres for the specified thickness.

d) Vibration Damping Resilient Pads

The measurement for this item shall be in square metres for the specified thickness, measured correct to the second place of decimal, of the actual finished surface area.

6.07.00 Dismantling/Demolishing Work – RCC and PCC and Chipping of Concrete

6.07.01 Rates

The unit rates shall include the cost of all necessary propping, shoring, underpinning scaffolding, safety measures, temporary enclosures, disposal/stacking of serviceable/unserviceable materials, etc. for all types of work and for all grades of concrete.

In the case of dismantling/demolishing work, the cutting of reinforcement shall also be included in the rate.

In the case of chipping work, the cutting of reinforcement shall be paid



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separately.

6.07.02 Measurements

- a) Dismantling of PCC and RCC work shall be measured in cu.m separately. Measurement of all work, except hidden work shall be taken before execution of work and no allowance for increase in bulk shall be allowed. Specifications for deductions of voids, openings etc, shall be on the same basis as that employed for construction work.
- b) Chipping of concrete, making holes/pockets etc. shall be measured in cubic decimeters (i.e. 0.001 cu.m.).
- c) Cutting of reinforcement in chipping work for making of pockets and openings shall be measured in sq. cm. of cross-sectional area.

6.08.00 Precast Concrete

This clause shall be read in conjunction with relevant provisions specified elsewhere for cast in-situ Concrete.

6.08.01 Rates

- a) The unit rate shall include cost of preparation of casting yard, formwork, concrete and its casting, finishing as specified, setting filling of gaps between adjacent pre-cast concrete units with concrete, or cement mortar, curing, handling, erection, grouting, welding, preparation of supporting surface, etc.

6.08.02 Measurements

The measurement of pre-cast concrete members shall be on the basis of volume of concrete in cubic metres nearest to second place of decimal. No deduction shall be made for volume occupied by reinforcement/inserts/sleeves and for openings up to 0.1 sq.m. The setting of element with cement mortar shall not be measured separately The filling of concrete cement mortar between the gaps of adjacent precast units shall be considered while computing the volume of pre-cast concrete work and shall be paid for under this item itself.



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LIST OF IS CODES AND STANDARDS FOR REFERENCE

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 Specifications and Codes of Practice. In case any particular aspect of work is not specifically covered by Indian standard Specifications, any other standard practice, as may be specified by the Engineer, shall be followed:-

- IS: 73 - Indian Standard Specification for Paving Bitumen
- IS: 216 - Indian Standard Specification for Coal Tar Pitch
- IS: 383 - Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete
- IS: 432 - Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement
- IS: 455 - Indian Standard Specification for Slag Cement
- IS: 456 - Indian Standard Code of Practice for Plain and Reinforced Concrete
- IS: 457 - Indian Standard Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive Structures
- IS: 516 - Indian Standard Specification for Methods of Test for Strength of Concrete
- IS: 702 - Indian Standard specification for industrial bitumen.
- IS: 1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete



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- IS: 1322 - Indian Standard Specification for Bitumen Felts for Waterproofing and Damp-proofing
- IS: 1489 - Indian Standard Specification for Portland Pozzolona Cement
- IS: 1566 - Indian Standard Specification for hard drawn steel wire fabric for concrete reinforcement.
- IS: 1609 - Code of Practice for Laying Damp-proof Treatment using Bitumen Felts
- IS: 1786 - Indian Standard Specification for High Strength Deformed Steel Bars and Wires for Concrete Reinforcement.
- IS: 1791 - Indian Standard Specification for Batch Type Concrete Mixers.
- IS: 1838 - Indian Standard Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).
- IS: 2185 - Indian Standard Specification for Hollow Cement Concrete Blocks
- IS: 2210 - Indian Standard Specification for Design of Reinforced Concrete shell Structures and Folded Plates
- IS: 2386 - Indian Standard Specification for Methods of Test for Aggregates for Concrete - Part-I to VIII
- IS: 2502 - Indian Standard Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement
- IS: 2505 - Indian Standard Specification for Concrete Vibrators, Immersion Type
- IS: 2506 - Indian Standard Specification for Screed Board Concrete Vibrators
- IS: 2514 - Indian Standard Specification for Concrete Vibrating Tables
- IS: 2571 - Code of practice for laying in-situ cement concrete floors.
- IS: 2645 - Integral cement water proofing compound
- IS: 2722 - Indian Standard Specification for Portable Swing Weigh Batchers for Concrete (Single and Double Bucket type)



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- IS: 2750 - Indian Standard Specification for steel scaffoldings.
- IS: 2751 - Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete Construction
- IS: 2770 - Indian Standard Specification for Method of Testing Bond in Reinforced Concrete
- IS: 3025 - Indian Standard specification for Methods of Sampling and Test (Physical and Chemical) for Water used in Industry
- IS: 3067 - Code of practice for general design details and preparatory work for damp proofing and water proofing of building.
- IS: 3201 - Indian Standard Specification for Design and Construction of Precast Concrete Trusses
- IS: 3370 - Indian Standard Specification for Code of Practice for Concrete Structures for Storage of Liquids
- IS: 3414 - Code of practice for design and installation of joints in buildings.
- IS: 3550 - Indian Standard Specification for Method of Test for Routine Control for Water used in Industry
- IS: 3558 - Code of Practice for use of Immersion vibrators for Consolidating Concrete
- IS: 3696 - Safety Code for Scaffolding and Ladders
- IS: 3812 - Indian Standard Specification for Fly Ash for Use as Admixture for Concrete
- IS: 4014 - Code of practice for steel tubular scaffolding.
- IS: 4031 - Indian Standard Specification for Method of Tests for Hydraulic Cement
- IS: 4082 - Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials at site
- IS: 4090 - Indian Standard Specification for Design of Reinforced Concrete Arches
- IS: 4634 - Indian Standard Specification for Method of Testing



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- IS: 4656 - Indian Standard Specification for Form Vibrators for Concrete
- IS: 4925 - Indian Standard Specification for Concrete Batching and Mixing Plant
- IS: 4926 - Indian Standard Specification for Ready Mixed Concrete
- IS: 4990 - Indian Standard Specification for Plywood for Concrete Shuttering work
- IS: 4991 - Indian Standard Specification for Blast Resistant Design of structure for Explosion above ground
- IS: 4995 - Indian Standard Specification for Design of Reinforced Part-I & II Reinforced Concrete Bins for the Storage of Granular and Powdery Materials
- IS: 4998 - Indian Standard Specification for Design of Reinforced Concrete Chimneys.
- IS: 5256 - Code of practice for sealing joints in concrete lining on canals.
- IS: 5512 - Indian Standard Specification for Flow Table for use in Tests of Cement and Pozzolanic materials
- IS: 5513 - Indian Standard Specification for vacate Apparatus.
- IS: 5515 - Indian Standard Specification for Compaction Factor Apparatus.
- IS: 5525 - Recommendation for detailing of reinforcement in reinforced concrete works.
- IS: 5624 - Indian Standard Specification for foundation bolts.
- IS: 5751 - Indian Standard Specification for Precast Concrete Coping Blocks.
- IS: 5816 - Indian Standard Specification for Method of Test for Splitting Tensile strength of Concrete Cylinders.
- IS: 5891 - Indian Standard Specification for Hand operated Concrete Mixers.
- IS: 5892 - Indian Standard Specification for transit mixer and agitators.



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- IS: 6452 - Indian Standard Specification for High Alumina Cement for Structural Use
- IS: 6909 - Indian Standard Specification for Super sulphated Cement
- IS: 6923 - Indian Standard Specification for Method of Test for Performance of Screed Board Concrete Vibrators.
- IS: 6925 - Indian Standard Specification for Method of Test for Determination of Water Soluble Chloride in Concrete Admixtures.
- IS: 7242 - Indian Standard Specification for Concrete Spreaders.
- IS: 7246 - Indian Standard Specification for Table Vibrators for Consolidating Concrete.
- IS: 7251 - Indian Standard Specification for Concrete Finishers.
- IS: 7293 - Safety code for working with construction machinery.
- IS: 7320 - Indian Standard Specification for Concrete Slump Test Apparatus.
- IS: 7861 - Indian Standard Specification for Recommended Practice Part-I&II for Extreme Weather Concreting.
- IS: 7969 - Safety Code for Storage and Handling of Building Materials.
- IS: 8041 - Indian Standard Specification for Rapid Hardening Portland cement.
- IS: 8112 - Indian Standard Specification for high strength Ordinary Portland Cement.
- IS: 8142 - Indian Standard Specification for Determining Setting time of concrete by Penetration Resistance.
- IS: 8989 - Safety Code for Erection of Concrete Framed Structures.
- IS: 9012 - Recommended method for shortcreting.
- IS: 9013 - Indian Standard Specification for Method of Making, Curing, and determining compressive Strength of Accelerated-cured Concrete Test Specimens.



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- IS: 9077 - Code of Practice for Corrosion Protection of Steel Reinforcement in RB and RCC Construction.
- IS: 9103 - Indian Standard Specification for Admixtures for Concrete.
- IS: 10262 - Recommended Guidelines for Concrete Mix Design.
- IS: 13311 - Non-destructive testing of concrete.
- SP: 34 - Handbook of concrete, reinforcement and detailing.



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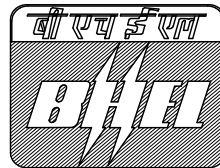
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Bharat Heavy Electricals Limited

**Project Engineering Management
Power Sector, BHEL House
Asian Games Village Complex
Siri Fort, New Delhi-110049**



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METAL DOORS, WINDOWS, VENTILATORS, LOUVERS ETC.

1.00.00 SCOPE

This section covers supplying and/or erecting and installing of all metal doors, windows, ventilators, louvers, translucent sheets of polycarbonate, glazed partitions, etc. The scope of work shall also include the assembly and erection of all doors, windows, ventilators, glazing with polycarbonate sheets, louvers, glazed partitions, etc. Supplying and/or fixing of all door and window accessories and hardware are also included in the scope.

2.00.00 INSTALLATION

2.01.00 Materials

Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS: 1038 and IS: 1361 or as specified.

Steel sheets for frames, shutters, louver blades etc. shall be of gauge mentioned in drawings and schedules.

Aluminium sections for fabricating doors, windows, partitions etc. shall be extruded sections conforming to IS:733 or IS:1285 or as manufactured by Indian Aluminium Company Limited or approved equivalent. Aluminium door, windows and ventilator shall be fabricated as per IS:1948 and IS:1949. The alloy used shall conform to IS Designation HE 9-WP of IS: 733.

Hardware and fixtures shall be as specified and the best quality from approved manufacturers shall only be used. The tenderer shall specifically state the particular manufacturer's materials he proposes to use. Improper alignment or faulty operation due to inadequate strength of hardware or fixture shall entirely be the Contractor's responsibility.

All hardware and fixtures shall be able to withstand repeated use. Door closures shall conform to IS: 3564 and shall be suitable for doors weighing 61-80 Kg. unless otherwise stated. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or shall be replaced free of charge. Concealed door closers shall be either floor mounted or transom mounted, suitable for installation with metal doors. It shall conform to the performance Requirements and endurance test stated in IS: 3564 - Appendix-A. The Contractor shall submit samples of each type of hardware to the Engineer. The approved samples shall be retained by the Engineer for comparison of bulk supply. The samples shall be returned to the Contractor towards end for incorporation in the job. The mastic for caulking shall be of best quality from a manufacturer approved by, the Engineer. In general, mastic for fixing of metals frames shall be as per IS:



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1081 or as approved by the Engineer.

2.02.00 Fabrication

2.02.01 Steel Doors, Windows, Ventilators, louvers etc.

a) Door Frames

Frames shall be fabricated from 16 gauge (G) sheets. They shall, be mortised, reinforced, drilled, and tapped for hinge lock and bolt strikes. Where necessary, frames shall be reinforced for door closers. Welded construction with mitered Corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose "T" masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be installed. Frames shall be brought to site with floor ties/weather bars installed in, place.

b) Double or Single Plate Flush Door Shutters

Door shutters shall be 45 mm thick, completely flush design and shall comprise of two outer sheets of 18 G steel sheets, rigidly connected and reinforced inside with continuous vertical 20 G stiffeners, spot welded in position at not more than 150 mm on centres including void filled with mineral wool (64kg/cum density).

Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally as shown on drawing by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and heads, shall have proper level on lock stiles and rails to operate without binding, and shall be reinforced at corners to prevent sagging or twisting. Pairs of double doors shall have meeting-stile edges bevelled or rebated. Where shown in drawings, or called for in the schedule of items. The doors shall be sound deadened by filling the inside voids with mineral wool or other suitable approved materials.

Doors shall be mortised, reinforced, drilled, and tapped in shop for hinges, locks, and bolts. They shall also be reinforced for closers, push-plates, and other surface hardwares where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown in drawings, provision shall be made for fixing glazing, vision panels, louvers etc. glazing mouldings shall be of 18 G steel or extruded aluminium sections and suitable for fixing 6 mm. glass. Louvers blades shall be V or Z shaped and made out of 18G sheets.



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c) Single or Double Sheet Door Shutters

Single sheet doors shall be made from best quality 18 G (mild) steel sheets, and shall present a flush surface on the outside. The inside shall be stiffened with semi tubular edge and central stiffening rail, which shall convey the lock and other fixture. The frames shall be made from best quality, 16 G mild steel sheets.

Wherever required, provisions for fixing glass panes, louvers etc. shall be made.

The manufacturing shall be done as specified in 2.02.01 (b) “Double Plate Flush Door Shutters.”

d) Sliding Door

Sliding doors shall be either double plate or single plate Construction made out of 18 gauge steel sheets with adequate stiffeners. The contractor shall specify the weight of the door in his shop drawings and submit the manufacturer's catalogue of the sliding gear proposed to use. Where called for the Contractor shall make provision for openings to the door for monorail beams. Doors shall close positively to exclude rainwater from seeping in. When called for, sliding doors shall withstand specified wind loads without buckling or jamming. The door shall slide freely under all ambient conditions.

e) Door Threshold

Door threshold shall be provided. Doors without threshold shall have bottom tie of approved type.

f) Steel Windows, Sashes, and Ventilators etc.

These shall conform in all respects to IS: 1038 and IS: 1361, IS: 7452 latest editions. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, and pivot arrangements for ventilators, etc. or as called for. All welds shall be dressed flush on all exposed and contact surfaces. Where composite unit openings are required the individual window units shall be joined together with requisite transoms and mullions. All windows shall be outside glazed, fixed with putty or metal glazing beads as specified. Where aluminium glazing beads are specified, they shall be extruded aluminium channel 9.5 mm x 9.5 mm x 1.6 mm (Indal Section No. 2209) /hindalco /jindal unless otherwise shown on drawings. Aluminium beads shall be given one coat of zinc chromate primer before fixing to windows.



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Extruded sections shall have a minimum 3 mm wall thickness. All sections shall be approved by the Engineer before fabrication is taken up. Doors frames, mullions, transom etc. shall be anodized in a bath of sulphuric acid to provide a clear coating and electro color coating of required shade as per IS 1868 (minimum anodized coating of grade AC15)of minimum 15 micron thickness. The anodized materials shall then be sealed by immersing in boiling water for 15 minutes. A protective transparent Coating shall be applied to the sections before shipment from the factory.

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce an uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

2.03.00 Shop Coat or Paint

The shop Paint for steel doors, windows etc. shall be best lead or zinc chromate primer paint from, approved manufacturer. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. that will be inaccessible after assembly of units shall be given an extra coat of paint before assembly.

Where called for, all steel doors, windows, etc. shall be hot dip galvanized to give a coating weight of 1½ - 2 oz. per sqft. One coat zinc chromate primer coat shall then be applied as shop paint.

Portions of aluminium frame, which come in contact with masonry construction shall be (before shipment from workshop) protected with a heavy coat of alkali resistant paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer.

2.04.00 Handling & Storage of Fabricated Material

All metal doors, windows, etc. shall be packed and crated properly before dispatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.

When taking delivery of items supplied by Owner, the Contractor shall satisfy himself that the items supplied are up to the specified standard. Any defect



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detected shall promptly be brought to the notice of the Engineer.

All metal doors, windows etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust, mortar etc.

2.05.00 Assembly & Erection at Site

In general, the fixing of steel doors, windows, ventilators, louvers, etc. shall conform to IS: 1081. The Contractor shall assemble and install all steel doors, windows, sashes, fixed metal louvers, etc. including transoms and mullions for composite units in respective places, keening proper "Lines and levels", and in approved workmanlike manner, to give trouble free and leak-proof installations. Installation shall be done according to instructions of the manufacturer, and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. The Contractor shall take all precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the Contractor and made good again as per original, after installation, without any extra charge.

After installation of steel doors, windows, etc. all abrasions to shop-coat of paint shall be retouched and made good the same quality of paint used in shop coat.

All coupling mullions, transoms, frames, etc. in contact with adjacent steel and other members, shall be well bedded in mastic. The Contractor shall bring to the site the cement in original sealed containers of manufacturer and shall apply it as per the instruction. For all frames supplied by either the owner or the Contractor, mastic shall be supplied by the Contractor and caulking done properly as per drawings, specifications and as per instructions of the Engineer.

Door shutters, partitions hardware fixtures etc. shall be fixed only after major equipments have been installed in rooms.

Wherever required, nylon cords of approved quality shall be supplied along with pivoted sashes and shall be of adequate length to terminate one metres from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer.

2.06.0 Fire proof Door

Fire proof doors shall be provided at all fire exit points as specified and also to restrict the spread of fire within buildings whether from internal fire or from external fire. The construction details of door shall conform to the requirements stipulated in IS:3614(Part-1). Doors shall comply with the



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testing requirement mentioned in IS:3614 (Part-2). The doors shall be approved by Tariff Advisory Committee(TAC) and shall have minimum 2 hrs. fire rating.

Metal covered (on both sides) Doors having insulating core filled up with mineral wool shall be used at all fire exit points and shall open out side.

All necessary accessories and hardware ,panic bars shall also be supplied along with doors. Fire proof door shall be provided with zinc silicate primer (minimum DFT 75 micron) after blast cleaning the surface to near white metal surface and shall be finished painted with epoxy based painting.

3.00.00 ACCEPTANCE CRITERIA

3.01.00 For fabricated Items

- a) Overall dimensions shall be within ± 1.5 mm of the size shown on drawings.
- b) Mullions, transoms etc. shall be in one length and permissible deviations from straightness shall be limited to ± 1.5 mm from the axis of the member.
- c) Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm for double leaf doors; the gap at the meeting stiles shall not be more than 1.5 mm.
- d) Door leaves shall be undercut where shown on drawings.
- e) Doors, windows, frames, etc. shall be on a true plane, free from warp or buckle.
- f) All welds shall be dressed flush on exposed and contact surfaces.
- g) Correctness of location and smoothness of operations of all shop installed hardware and fixtures
- h) Provision for hardware and fixtures to be installed at site.
- i) Glazing beads shall be cut with mitered corners.
- j) Glazing clips, fixing devices etc. shall be supplied in adequate numbers.
- k) Shop coats shall be properly applied.
- l) Exposed aluminum surfaces shall be free from scratches, stains, and discoloration. Anodized surfaces shall present a uniform and pleasing look.



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3.02.00

For installed Items

- a) Installations shall be at correct location, elevation and in general, on a true vertical plane.
- b) Fixing details shall be strictly as shown in drawings.
- c) Assembly of composite units shall be strictly, as per drawings with mastic caulking of transoms and mullions, gaskets, weather strips etc. complete.
- d) All frames on external walls shall be mastic caulked to prevent leakage through joint between frames and masonry.
- e) All open able section shall operate smoothly without jamming.
- f) Locks, fasteners etc. shall be engage positively. Key shall, be non-interchangeable.
- g) Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.
- h) Aluminium doors, windows, etc. shall be free from scratches stain or discoloration.

4.00.00

INFORMATION TO BE SUBMITTED

4.01.00

With Tender

- a) Names of manufacturers for Doors, windows etc.
- b) Manufacturer's catalogue for all hardware and fixtures proposed to be used.

4.02.00

After Award

- a) Before starting fabrication of all metal doors, windows, etc. the Contractor shall submit detailed fabrication drawings to the Engineer for approval. The fabrication shall be started only after approval of drawings.
- b) He shall submit a programme of work to be done for the approval of the Engineer.
- c) Before bulk supply, he shall submit for the approval of the Engineer samples of all bought out items and samples of each type of fabricated items. The samples shall be retained by the Engineer for comparison of bulk supply and returned to the Contractor towards the end for final incorporation in the job.



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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.

Specification for Wrought Aluminium and Aluminium Alloy bars, rods and sections (for general engineering purpose)	-	IS: 733
Specification for Wrought Aluminium and Aluminium Alloy, extruded round tube, hollow Section (for general engineering purpose)	-	IS: 1285
Steel doors, windows, and ventilators	-	IS: 1038
Steel windows for industrial, building	-	IS: 1361
Aluminium doors windows, and ventilators	-	IS: 1948
Aluminium windows for industrial buildings	-	IS: 1949
Steel doorframes	-	IS: 4351
Code of practice for fixing and glazing of Metal (steel and aluminium) doors, windows and Ventilators.	-	IS: 1081
Specification for Fire-check Doors – Part 1: Plate, Metal covered and Rolling type	-	IS: 3614
Hot Rolled Steel Sections for Doors, Windows and Ventilators – Specification	-	IS: 7452

6.00.00 RATES AND MEASUREMENT

6.01.00 Rates

Rates shall be applicable of all elevation. Rates shall include preparation of working drawings (if required), supply of material, fixtures, gaskets, erection of unit, caulking and jamming of frames, including cutting/drilling/welding, grouting, grinding, making good of the structure for installing the unit etc. complete as per "Schedule of Items".



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Rates shall also include cost of surface preparation, application of primer, enamel painting or anodizing as applicable.

Rate for fire proof door is inclusive of providing insulation core, primer, shop painting (epoxy based), all hardware as specified in Schedule of items.

6.02.00 Measurement

Supply and installation of doors, windows, and ventilators shall be measured in Sqm in net outer to outer (excluding frame) area of doors, windows, and ventilators of each type used as described in "Schedule of Items". Frame for steel or aluminium shall be measured in Kgs. Wooden frames shall be measured in Cum. Measurement for aluminium partition shall be from net outer to outer area of frames i.e., frames are part of partition.

Measurement for fire proof door shall be in SqM in net area outer to outer of the door.



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ANNEXURE-A

SCHEDULE OF FIXTURES

A. TIMBER DOORS

1. For single leaf panel/flush doors

- i) 100 mm brass butt hinges with screws - 3 Nos.
- ii) 150 mm brass tower bolts with screws - 1 No.
- iii) 100 mm x 225 mm clear plastic push Plate with counter sunk brass screws - 1 No.
- iv) 30 mm brass ring pull handle with Plates and screws - 1 No.
- v) 150 mm brass coat hook with screws - 1 No.

vi) Heavy duty, cylinder looks on active leaf - for flush door. For door-closure, see "Door Schedule".

B. ALUMINIUM DOORS

1. For double leaf door

- i) Concealed hanging arrangement for door leaves.
- ii) Concealed two points bolt encasing simultaneously at head and threshold on inactive leaf, operable from inside.
- iii) Heavy duty, cylinder look on active leaf.
- iv) Pull handle of approved design on both leaves.
- v) Doors stoppers for both leaves.
- vi) Overhead hydraulic door closure for both leaves.
- vii) Floor mounted hydraulic door closer



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ANNEXURE-A

C. STEEL DOORS AND WINDOWS

1. Doors

a) Double leaf doors

- i) 100 mm butt hinges - 3 Nos. on each leaf.
- ii) 300 mm aluminium tower bolt - 2 Nos. (top and bottom)
On inside of inactive
Leaf. 1. No. (Top only)
On inside active leaf.
- iii) 200 mm anodized aluminium Pull handle - 1 No. of each leaf.
- iv) Door stopper of approved design - 1 No. of each leaf.

NOTE: For locks, door closure and threshold, see "Door Schedule".

b) Single leaf doors

- i) 100 mm butt hinges - 3 Nos.
- ii) 300 mm aluminium tower bolt - 2 Nos. top & bottom of
Inside face
- iii) 200mm anodised aluminium Pull handle - 1 No.
- iv) Door stopper of approved design - 1 No.

NOTE: For locks, door closures and threshold, sec "Door Schedule".

2. Windows, Ventilators, etc.

a) Side Hung Windows

- i) Hinges - As per standard Practice of the
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Hinges Per leaf.
- ii) 12" peg stays - 1 No. per leaf



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ANNEXURE-A

- iii) 2 point handles - 1 No. per leaf
- b) Top Hung Ventilators (Projecting Out)
 - i) Hinges - As per standard Practice of the Manufacturer, but minimum two Hinges Per leaf.
 - ii) Adjustable sliding fabrication Assembles - 2 Nos. per leaf.
 - iii) 2 point handles - 1 No. per leaf.
- c) Bottom Hung Ventilators (Projecting in)
 - i) Hinges - As per standard Practice of the Manufacturer, but minimum two Hinges Per leaf.
 - ii) Concealed side arms for Opening adjustment. - 2 Nos. per leaf.
 - iii) Spring Catch - 1 No. per leaf.



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ANNEXURE-A

D. ALUMINIUM WINDOW, VENTILATORS, ETC.

(As per I.S-1948 latest editions)

a) Side Hung Windows

- i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
- ii) 300 mm peg stays - 1 No per leaf
- iii) 2 point handles - 1 No per leaf

b) Top Hung Ventilators (Projecting out)

- i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
- ii) Adjustable sliding fabrication assemblies - 2 Nos. per leaf
- iii) 2 Point handles - 1 No. per leaf

c) Bottom Hung Ventilation&(Projecting In)

- i) Hinges - As per standard Practice of the Manufacturer, but minimum two hinges Per leaf.
- ii) Concealed side arms for opening adjustment - 2 Nos. per leaf
- iii) Spring Catch - 1 No. per leaf



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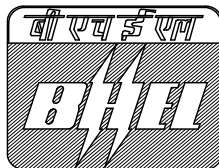
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Project Engineering Management
Power Sector, PPEI Building
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GLASS AND GLAZING

1.00.00 SCOPE

This section covers supplying and fixing of all glass and glazing & glazing with polycarbonate sheets including all clips, putty, mastic cement etc. wherever required as per specifications.

2.00.00 INSTALLATION

2.01.00 General

The Contractor shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louvers, miscellaneous glazing and partitions, from approved manufacturer like Hindustan Pilkinton or equivalent, having uniform refractive index and free from flaws, specks, and bubbles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site.

Materials

- a) Glare reducing or heat absorbing glass shall be "Calorex" of Hindustan Pilkinton or approved equivalent and special care shall be taken to grind smooth and round off the edges before fixing.
- b) Clear glass shall be flat draw sheet glass and shall be at least 4 mm thick. Sheet glass for doors shall be minimum 5.5 mm thick.
- c) Wired glass shall be thick- rolled glass with centrally embedded 42g wire mesh of Georgian type. This may be of clear or coloured glass, as required.
- d) Obscure glasses shall have a cast surface in one side.
- e) Coloured and figured glass shall be as per approved sample.
- f) In general, the putty shall conform to IS: 400 and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing.
- g) Neoprene gaskets with snap-fit glazing beads shall be fixed as per manufacturer's instructions and shall sit snugly against glass to give a leak proof installation.
- h) Polycarbonate sheet multi (twin) wall fire retardant and ultra violet resistant with sealed open edges. as per IS: 14443.



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i) Patterned, figured or rolled glass :-It is a decorative and translucent glass with figures or patterns on one face. In addition to diffusing light and obstructing visibility from the outside, the figures soften the interior lighting. This type of glass is usually more fragile and less convenient to clean

j) Ground Glass :- Ground glass surface has been ground to produce a flat but rough (matte) finish. Glass surface has been ground or etched to create a roughened non transparent surface. this are similar as figured glass, obstructing visibility from the outside.

k) heat-reflecting type float glass:

A metallic coating is applied to one side of the glass in order to significantly increase the amount of reflection by the glass of both the visible and infra-red (light and heat) range of the electromagnetic spectrum. This metallic coating can be applied to clear or body tinted glass. The reflective glass imparts a mirror like appearance to the exterior of buildings under most daytime conditions. Due to the coating of metal oxides on the glass, they are widely applied in buildings for its highly reflective surface and its wide palette of colours. It reduces heat gain and glare from the exterior and allows optimum visible light transmission to the interior. An exceptional property of solar reflective glass is that the coating of metal oxides on the glass can be achieved without affecting the transparency of the glass.

Density : 2.4 – 2.5 g/cm³

l) Laminated glass:

Laminated glass is composed of two or more layers of glass with one or more layers of a transparent/ pigmented and specially treated plastic Polyvinyl Butyral [PVB] sandwiched between the glass layers. The glass panes (layers) can be either normal glass or tempered glass. When the glass is broken, fragments tend to adhere to the plastic [PVB] interlayer thereby reducing the risk of injury and helping to resist further damage by weather.

Laminated glass retains its colour and strength for the life of the building and is as easily cleaned as any conventional glass.

When exposed to heat, laminated glass breaks but stays in place longer. The risk of thermal breakage is avoided only when heat strengthened / tempered laminated glass is used.

Density (approximate) : 2.42 – 2.52 g/cm³

Tensile strength : 32 N/sq. M

Compressive strength : 1000 N /mm²

Modulus of elasticity : 70 GPa

Coefficient of linear expansion: 9×10^{-6} m / mK

U value : 2.84 W/sq. m. K for 3 mm thick clear to 5.96 W/sq. m. K



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for 6 mm thick clear

UV transmittance : 30% for bronze 6 mm thick to 80% for 6 mm thick clear.

Shading co-efficient : 0.5% for 6 mm thick gray to 0.9% for 6mm thick clear.

Visible light transmittance : 25% for 6mm thick bronze to 90% for 6mm thick clear

(product specific information to be referred)

2.03.00 Glazing, Setting, and Finish

All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the Contractor.

All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in relevant I.S. Codes, four glazing chips shall be provided per glass pane, except for large panes where six or more clips shall be used as per engineer's instructions. All holes that may be necessary for holding the clips glazing heads and all other attachments shall be drilled by, the Contractor.

Glass panes shall be set without springing, and shall be bedded in putty and back puttied, except where mouldings or gasket are specified, putty, mastic cement etc. shall be smoothly finished to the even line and figured glass shall be set with smooth side out.

Where owner will supply glass, the Contractor shall cut it to size and fix them in the same as specified above.

The Contractor shall supply necessary glazing clips, putty, mastic cement etc.

After completion of glazing, the Contractor shall remove all dirt stains, excess putty etc. clean glass panes and leave the work in perfectly acceptable condition. All broken cracked or damaged glass shall be replaced by new ones at the contractor's own cost.

3.00.00 ACCEPTANCE CRITERIA

- a) All installation shall be free from cracked, broken, or damaged glass. Edges of large panes of thicker glass and heat absorbing glass shall be inspected carefully for chipped, cracked, or underground edges.
- b) Glazing shall be carefully done to avoid direct contact with metal frames.
- c) All glass shall be embedded in mastic or fixed by neoprene gaskets to give



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a leak proof installation.

- d) At completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the Engineer.

4.00.00

I.S. CODES

Following are some of the important I.S.Codes relevant to this Section:

IS: 3548 - Code of practice for glazing in building.

IS: 1081 - Code of practice' for fixing and glazing metal doors, windows ventilators.

IS: 2553 PART-I- Code of practice for safety glass, toughened or laminated glass.

IS: 2835 – 1987-Code of practice for sheet glass, flat transparent sheet glass.

IS: 14443-Code of practice for polycarbonate sheet specification.

IS: 5437- Code of practice for figured rolled and wired glass.



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5.00.00

RATES

Rates of glass and glazing are included in respective items for supply and installation of window, ventilator, and partitions. No separate payment shall be made for glazing clips, mastic cement, putty, screws; rails, etc. nor for drilling holes in frames for inserting glazing clips.



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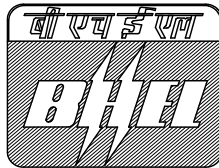
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ROLLING STEEL SHUTTERS AND GRILLS

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ROLLING STEEL SHUTTERS AND GRILLS**1.00.00 SCOPE**

This Section covers the design and supply of materials, fabrication, delivery and erection of Rolling Shutters/Grills with motor drive and/or manual operation including all accessories as hereinafter specified.

2.00.00 INSTALLATION**2.01.00 Components**

- a) Slats for rolling shutters shall be made from tested bright hot rolled double dipped galvanised steel lath section of 18 swg tested mild steel strips at 75 mm rolling centers, interlocking with each other. The profile will be such as to prevent excessive deflection under specified wind load.
- b) Rolling grills shall be constructed out of 6mm rods at 35 mm on centers running horizontally flexible connected with vertical links spaced not more than 200 centers. Alternatively, rolling grills shall be made from perforated slats of approved design reinforced with 6mm dia rods.
- c) End locks shall be heavy type M.C.I./C.I. and shall be provided at each end of alternate slats unless specified otherwise.
- d) Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. When shown on drawings, a flexible weather strip shall be applied to make tight contact with the floor. Bottom lath shall be coupled to a lock plate fabricated from 3mm thick galvanized steel plate and securely riveted with stiffening angles.
- e) Guides shall be of such depth as to retain the shutter under a wind pressure of 100 Kg/Sq.m.
- f) Shafts shall be of steel pipe of sufficient size to carry the tensional load with a maximum deflection of 1/360th of span. Grease packed ball bearings or bushings shall be provided for smooth trouble free operation.
- g) Hoods shall be formed of not less than 20 gauge steel, suitable reinforced to prevent sag.
- h) Locks shall be slide bolt and hasp, or cylinder lock operable from one or both sides. Provision securing hand chain with pad-lock, provision for removable handle for hand cranks etc. shall be made as prescribed by the Engineer.
- i) Power unit shall be suitable for 3 phase, 50 cycles, 400-volt A.C. power



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supply and be either floor or wall mounted unit. The motor shall be of sufficient capacity, to move the shutter in either direction at a speed of 0.3 metres per second. In addition to the gear motor each standard power unit shall include a magnetic brake, a reversing starter with built-in overload protection, a geared limit switch and one push button station located inside the building unless otherwise stated in drawing.

It is desirable that the bottom bar of motor operated doors shall be provided with a sensitive edge, electrically connected to stop the travel of the door on meeting an obstruction.

- j) Operating chains shall be of tested quality, heavily galvanized and with all ends rounded to assure smooth operation and hand protection.
- k) Reduction gears shall be high strength grey cast iron, machine moulded from machine out patterns.

2.02.00 Manually Operated Shutters/Grills (self coiling type or push pull down)

Self-coiling type rolling shutters shall be raised or lowered manually by means of a puffing hook applied to the pulling handles fixed on the bottom lock plate. The length of the pulling hook shall be adequate to push the bottom lock plate to the topmost position with ease. Manually operated shutters shall be easily operable by one person. The speed of operation shall be about 1.3 metres per second. In general, manually operated shutters shall be push pull type for opening up to 8 Sq. metres in area. It shall be used up to a maximum of about 8 m² clear area without ball bearings and up to a clear area of about 12 m² with ball bearings, as per IS 6248. Larger shutters shall, be either chain or gear operated or crank and gear operated. The crank handle shall be removable. All shutters shall be lockable from one or both sides as desired by the Engineer.

2.03.00 Mechanically or Gear Operated Shutters/Grills

It shall be fitted with ball bearings. It shall be used up to 'a maximum of about 25 m² clear area, if the rolling shutter is operated by a bevel gear-box and crank handle and up to a maximum of about 35 m² clear area, as per IS 6248. All shutters shall be lockable from one or both sides as desired by the Engineer. Gear-operated type rolling shutters ordinarily employ a worm drive arrangement, the worm driving the worm wheel attached to one end of the roller. Worm drive is preferred in view of its irreversible nature, which provides a safeguard against any accidental downward descent of the curtain due to failure of the springs.

2.04.00 Power operated Shutters/Grills



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Electrically operated rolling shutters shall be operated by an electric motor operating on 400/440 V, 3 phase, 50 cycles ac supply. The electric motor shall drive the worm shaft by chain or Vee-belt drive or through a reduction gear box. The reduction gear box shall have a control lever within easy reach from the floor so that the motor may be disengaged and the auxiliary chain gear operating mechanism may be engaged instantly in the event of power failure. The motor unit shall be so mounted that the motor may be completely removed without interfering with the operation of the rolling shutter or the auxiliary drive. The electric drive shall be so designed as to limit the speed of movement of the curtain in either direction to not more than about 10 cm/s. The controls provided for the electric motor shall include push button control. The controls provided for the electric motor shall include push button control through the medium of a 3-phase reversing starter with Interlocking contractors and overload protection. The reversing starter shall be wall-mounted and fitted adjacent to the shutter in a convenient position. A minimum of 3 phase buttons marked 'Forward', 'Reverse & 'Stop' or 'Up', 'Down', 'Stop' shall be provided with a mechanical locking arrangement to prevent unauthorized or irregular operation of the push buttons. Limit switches shall be provided to cut off current to the motor when the rolling shutter reaches the limit of its travel in the 'Up' and 'Down' directions. Arrangement shall also be provided for emergency mechanical Operation of the rolling shutter in the event of failure of electricity or electrical equipment. The emergency mechanical operation shall be by an auxiliary chain wheel and hand chain drive on the worm shaft.

2.05.00 Shop Coat

Shutters shall be painted with one coat of red lead or zinc chromate primer. Where specified, shutters shall be galvanized and subsequently painted one coat of zinc chromate for adhesion of field coat and shop paint as per specification.

2.06.00 Erection

Shutters shall be installed by the manufacturer or his authorized representative and all work shall be as per manufacturer's instructions. Any drilling or cutting to concrete, masonry etc. shall be made good after erection of shutters and all abrasion to shop coat shall be touched up. All electrical work shall be in strict accordance with the latest Indian Electricity Rules.

3.00.00 ACCEPTANCE CRITERIA AND GUARANTEE



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3.01.00 Shop Inspection

After completing the manufacture of the different components of the rolling shutter, an arrangement for shop inspection by the Engineer shall be made to check the conformity with approved shop drawings.

3.02.00 Field Inspection

After installing the shutters, the Contractor shall test the performance of the shutter in the presence of the Engineer. The shutters shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault free performance.

3.03.00 Guarantee

The Contractor shall give one year's guarantee for the successful operation of the shutters. This shall be supported by a separate and unilateral guarantee from the manufacturer of the shutters.

4.00.00 I.S. CODE

IS: 6248 - Metal rolling shutters and rolling grills.

5.00.00 RATES AND MEASUREMENT

5.01.00 Rates

Rates for rolling shutters and grill shall include the cost of the locks, guide channels, cost of drive as specified. In case of electrically operated rolling shutters, the rate shall also include the mounting of controls, wire and wiring from the nearest junction box, conduit and other electrical connections and cost of electric motor.

5.02.00 Measurement

Supply and installation of rolling shutter and grill shall be measured in Sqm in net outer to outer (including frame) area of each type used as described in "Schedule of Items".



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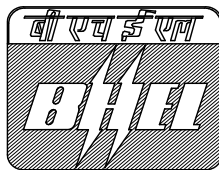
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MISCELLANEOUS METAL**1.00.00 SCOPE**

This section covers supply, fabrication and erection of miscellaneous metal items of light nature in gates, balcony and stair hand rails, structural works, ladders, hangers, masonry anchors, anchor bolts, fasteners, chain link fencing, barbed wire fencing etc. as specified or shown on drawing or as instructed by the Engineer. The above items shall be of fabricated or cast of mild steel, aluminium, brass, cast iron, M.S.& galvanized M.S. sheets, aluminium sheets, expanded metal, wire mesh as shown on drawings or specified.

2.00.00 INSTALLATION**2.01.00 Fabrication/casting****2.01.01 General**

All work shall be done according to approved shop drawings. All workmanship shall be equal to the best practice in modern structural or foundry shop.

2.01.02 Shop Connections

- a) All shop connections shall be riveted or welded except when noted otherwise on drawings.
- b) Welding of steel shall be done in accordance with IS: 816.
- c) Welding of aluminium shall be done accordance with IS: 2812, "Arc welding of Aluminium and Alloys." Special care shall be taken to grind smooth all welded surface that shall remain exposed to view. Welds shall be electrically continuous if so required by the Engineer.

2.01.03 Shop Coat

Before leaving the shop, all metal work shall be thoroughly cleaned by effective means of all loose mill seals, rust and foreign matter. Except where encased in concrete, all steelwork shall be given one coat of approved metal protective paint, applied by brush thoroughly and evenly, well worked into joints and other open spaces. All paint shall be applied to dry surfaces. When specified steel work shall be galvanised or painted with a coat of zinc chromate primer. Aluminium surfaces, which shall come in contact with masonry, shall be given one coat of bituminous paint.



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2.02.00 Erection

2.02.01 Bracing

The Contractor shall provide all necessary temporary guys and braces to ensure alignment and stability of the members and to take care of all loads to which the structure may be subjected, including erection of equipment and operation of the same.

2.02.02 Temporary Bolting-Up

As erection proceeds the Contractor shall plum up and level all members and shall securely bolt up to take care of all dead load, wind load and erection stresses. Wherever erection equipment or other loads are carried by members during erection, proper provision shall be made to take care of the stresses resulting from the same.

2.02.03 Turned Bolt

For field connections where bolting is specified, holes for the turned bolts may be reamed in the field, if required. All drilling or reaming for turned bolts shall be done after the parts to be connected are assembled.

2.02.04 Welding

Where specified on drawings, welding shall be done in accordance with IS: 816 for steel and IS: 2812 for Aluminium & Alloys.

2.02.05 Cutting and Fitting

No cutting of sections, flanges, webs of angles shall be done without the approval of the Engineer. Where indicated on the drawings, holes, cuttings, etc. shall be provided as required for installation, to the work by the other Contractors. No additional holes or cuttings, than those shown on drawings, shall be made without the approval of the Engineer.

2.02.06 Drifting

Correction minor misfits and a reasonable amount of reaming and cutting of excess stock from rivets may be permitted. For this, light drifting may be allowed to draw holes together. Twist drills shall be used to enlarge as necessary to make connections, reaming that weakens the members or make 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 or a moderate amount of reaming and slight



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chipping and cutting shall immediately be called to the attention of the Engineer-and approval of the method of correction obtained. The use of cutting torches to enlarge or alter rivet holes shall not be permitted.

2.02.07 Spot Painting

All field rivets and bolts and also any serious abrasion to shop paint shall be spot painted with the same materials and used for the shop paint or equivalent.

2.02.08 Good

All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer.

2.02.09 Grouting

All bearing plates, lintels and beams, etc. shall be set to proper grade and level by the Contractor and the Engineer's approval obtained before proceeding with the grouting. Grouting shall be done in 1:1:2 concrete with 6 mm down stone chips or as specified in schedule of items.

2.02.10 Anchor Fasteners

The anchor fasteners shall be of two type viz. for masonry works and for concrete works. The expansion sleeves are different for masonry type anchor fastner and concrete type anchor fastener. Depending upon the safe tensile load capacity of each fastener, size of anchor fastener varies. The Contractor shall submit the Manufacture's literature showing the average pull out and average shear value for anchor of various sizes. Anchors shall be fixed in position strictly as per the manufacturer's instructions and as approved by the Engineer.

Anchor fastener is considered as light duty for carrying safe tensile load up to 0.5MT per fastener and as heavy duty for carrying safe tensile load above 0.50MT per fastener.

Heavy Duty Anchor Fasteners

The safe tensile load carrying capacity of the anchors shall be arrived by providing the minimum factor of capacity of 2.5 for the characteristic load of the anchor. Minimum size of anchor shall be M8 (8mm). All anchors shall be from the approved manufacturers like HILTI or equivalent.

- a) Anchor fasteners shall be supplied and fixed in position by the contractor. Anchor fasteners can be of mechanical bonding or chemical bonding.
- b) Capacity of the anchor shall be established after considering the effect of concrete grade, embedment depth, concrete thickness, anchor spacing and edge distance from the concrete edge.



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- c) The selection for the particular type of bonding for the anchors shall be made after considering the concrete grade, available embedment depth, load to be transferred, space available for installing anchors.
- d) The mechanical bonding anchor are torque controlled anchors made from carbon steel of grade 8.8 as per IS:1367 part 3. Anchors in bolt as well as nut version are acceptable. The bolt version anchors consist of bolt washer, sleeves, plastic section, expansion sleeves and a cone. Nuts version anchor consists of nuts, threaded rod, washer, sleeves, plastic section, expansion sleeves and a cone. All steel component of anchor shall be electro galvanised to minimum 5 micron coating thickness. The plastic section shall be of polyacetal Derlin 100 or equivalent.
- e) Chemical bonding anchor shall consist of foil capsule and threaded rod. The foil capsule shall contain the resin and hardener. The threaded rod shall have chiselled tip. The behaviour of anchors under fire shall conform the heating curves as per ISO:834. Anchors of size M8 to M24 shall conform to grade 5.8 and anchors of size M27 to M39 shall conform to grade 8.8 as per IS:1367 part 3. All steel components of the anchors shall be electro-galvanised to minimum 5 micron thickness.

Light Duty Anchors

This anchor shall comprise of stud, nut, washers, and expansion sleeve. The one end of the stud shall have thread and the other end shall have cold formed conical head. All steel components of the anchors shall be electro-galvanised to minimum 5 micron thickness. The expansion sleeve shall preferably be of stainless steel of SS316. The anchors shall conform to minimum grade 5.8 as per IS:1367 part 3.

2.02.11 Pipe Joints

MS pipes or GI pipes shall be joined by threaded sockets or by welding. Cast iron pipes shall be socket and spigot joined and caulked with hemp and molten head.

2.03.0 FENCING

2.03.01 Galvanised Chain Link Fencing

The material requirement shall conform to IS: 2721 latest edition. The galvanised chain link fencing shall be woven from 3.15mm dia. wire with mesh size of 50mm unless otherwise specified. The mesh wire shall not vary from specified dia. by more than ± 0.05 mm. All steel wire shall be hot dipped galvanised wire. The dia shall be measured over the galvanised coating. The line wire shall be 4.0mm dia. GI wire. The stirrup wire for securing the line wire to the intermediate post (RCC/structural steel) shall be GI wire 2.5 mm diameter. The tying wire for securing the chain link fencing to the line wire shall be 1.6mm diameter GI wire. Hair pin chain staples for fastening down



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the bottom of galvanised chain line fencing to the concrete sill shall be 3.15mm wire. The ends shall be bent outwards for securing anchorage.

Cleat for eye bolts shall be of uniform size and shall consist of mild steel angle of 75 x 50 x 8 mm. The eye bolts strainer shall consist of bolt with welded eye sufficiently threaded and fitted with a nut and washer. Two-way eye bolt strainer shall have suitable ring nuts fitted after the wires have been strained on one side. Stretcher bar shall consist of GI flats 25 x 4.75 mm. They shall be secured to the cleats by steel bolts.

The chain link fencing shall be strained between each pair of straining posts and secured to each straining posts by means of a stretcher bar. One of top line wire shall be threaded through appropriate adjacent row of mesh, care being taken that no meshes in the row are bypassed by the line wire except where deviation is necessary at the straining posts. The second top line wire shall be strained in front of the fencing. The fencing shall be attached to the top and bottom line wire by wire ties spaced at 150mm apart and to the other middle line wire by wire ties spaced at 450mm apart.

The bottom of fencing shall be treated as follows:

Hair pin staples shall be threaded through the bottom row of mesh at 750mm c/c and set in the sill 25mm below the chain link fencing to a depth of 150mm.

2.03.02 PVC coated Galvanised Chain Link Fencing

The PVC coated galvanized chain link fencing shall be woven from minimum 8 gauge PVC coated wire (including PVC coating) with mesh size of 75mmX75mm. The diameter of the hot dip galvanized steel wire for chain link fencing excluding PVC coating shall not be less than 12 gauge. The mesh wire shall not vary from specified dia. by more than +0.05mm. Other fixing details shall be as provided under sub head Galvanised **Chain Link Fencing** above.

2.03.03 Barbed Wire Fencing

The barbed wire shall be conform to IS: 278 latest edition. The barbed wire shall be galvanised and galvanising shall conform to the requirement laid down for 'light-coated wire' of IS:4826 and it shall be smooth and relatively free of lumps etc. Wire with excessive roughness blisters, salammoniac spots shall be rejected. The barbed wire shall be made from two line wires and two point wires. The barbs shall have four points and shall be formed by twisting two point wires, each two turns, tightly around both or one line wire (Type A - around both line wire, Type B - around one line wire) making altogether four complete turns. The barbs shall be so finished that four points are set and located or locked as far as possible at right angle to each other.

Straining posts shall be provided at all ends and corners of fences or at changes in direction or acute variation in level and at intervals not exceeding



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66 M on straight lengths of fence. Intermediate posts shall be spaced at regular intervals not exceeding 3.0m. Struts shall be fitted to all straining posts behind the chain link fabric in the direction of line of fence. There shall be four evenly spaced row of line wire in all. The top line wire shall be doubled, making five line wire in all. The bottom wire shall be closed to the ground. Each line wire shall be strained tightly by means of eyebolts strainers or winders at each straining points. Each line wire shall be secured to each intermediate post by a wire stirrup passed through a hold in the post and secured to the line wire by three complete turns on each sides of the post. The barbed wire shall be fitted with one dropper at the centre of each bay, secured to the wire so that they could not be bunched together. Droppers for barbed wire shall be of mild steel of not less than 25 x 4.75 mm thick with 38 x 4.85 mm half round staples for fastening the barbed wire to them. Bracing for the rows of barbed wire shall be approved by the Engineer.

2.03.04 Concertina Fencing

Concertina shall be from high tensile serrated galvanized wire (HTSW) made with wire diameter of 2.5 mm which will be stretched to 6m and attached on two strands of galvanized HTSSW (high tensile spring steel wire) of 2.5mm dia by means of clips at 1m interval. These two HTSSW strands will be attached to the fence posts/ angles with 12mm security fasteners.

3.00.00 ACCEPTANCE CRITERIA

- a) All items shall be correct shape, size, weight etc. shown on drawings and schedule of items.
- b) For installed items, the tolerances shall be as follows
 - i) Permissible deviation from, straightness – 1 in 1000.
 - ii) Seats, stiffener connections etc. shall be as per approved drawings and shall not interfere with architectural clearances.
- c) All castings shall be free from blowholes, cracks, and other blemishes.
- d) All MS wire fencing shall be in true vertical plain, and shall not bulge.

4.00.00 IS CODES

- IS:278 Specification for Galvanised Steel Barbed wire for fencing.
- IS:816 Code of practice for use of Metal Arc welding for general construction in mild steel.



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IS:1367 Industrial Fasteners – Threaded steel fasteners - Technical supply condition.

IS:2721 Specification for Galvanised Steel Chain Link fence fabric.

IS:2812 Arc welding of Aluminum and Alloy

5.00.00 RATES AND MEASUREMENTS

5.01.0 Rates

Rates shall include supply, fabrication and installation for misc. metals works as required for completion of works like gates, fencing, handrails, ladders, hangers, anchors etc., unless otherwise specified in Schedule of Items.

Rate for fencing shall also include excavation, concreting and supply, erection & fabrication of post (post made of either structural steel or reinforced cement concrete), unless any specific item is excluded in the schedule of items.

5.02.0 Measurements

Measurement for MS gates shall be in MT.

Measurement for fencing shall be in Sqm unless otherwise specified in schedule of item.

Measurement for Anchors shall be in nos. for the type as specified in schedule of items.

Measurement of other misc. metals shall be done in MT unless otherwise specified in schedule of items.



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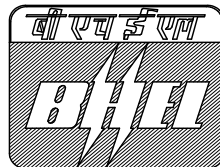
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PAINTING, WHITE WASHING, POLISHING, ETC.

1.00.00 SCOPE

This section covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces of wood work, masonry, concrete plastering, plaster of paris, false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items.

Copper, bronze, chromium plate, Nickel, stainless steel and aluminium shall generally not be painted or finished except if otherwise specified.

Before commencing painting, the Contractor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage; disfiguration or staining to work of other trades or other installations.

2.00.00 Installation

2.00.01 Materials

Materials shall be highest grade products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible and paint of one shade is obtained from the same manufacturing batch. Each and every supply of primer, finish paint etc. shall be accompanied by manufacturer's test certificate. All paint shall be subject to analysis from random samples taken at site from painters bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finished coats to be applied.

All unspecified materials such as snellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognized manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are required, they shall be executed in advance with the specified materials for the approval of the Engineer.



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a) White Wash/Colour Wash

Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the engineer, and shall conform to IS: 712 latest editions. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 grams of gum to 6 litres of white wash water and a little of indigo or synthetic ultramarine blue shall be added to the lime. Mineral colour not affected by lime shall be added to white wash to get the required tint/shade approved by the Engineer.

b) Dry distemper

Shall be made from suitable pigments, extenders, lime proof tinters, water-soluble binders etc. and shall conform to IS: 427. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for a day's work shall be prepared.

c) Oil Bound Washable Distemper

Shall be of oil emulsion type containing suitable preservatives and shall conform to IS: 428. The distemper shall be diluted with prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for a day's work shall be prepared.

d) Waterproof Cement Paint

Shall be made from best quality white cement and lime resistant colours with accelerators, waterproofing agents and fungicides. The paint shall conform to IS: 5410.

e) Acrylic based weather coat paint

Providing and applying two or more coats of **Acrylic based weather coat paint** of approved brand and manufacture and required shade over one coat of primer after necessary cleaning/ washing, preparing the surface using coir brush/ wire brush, sand paper, including filling of cracks with putty wherever required etc. all complete to give smooth, hard, durable & glossy finish over a coat of primer over prepared plaster surface as per manufacturers guidelines. The final finished coating shall be fungus resistant, UV resistant, water repellent and extremely durable with colour fastness as per specification.



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f) Acrylic Emulsion Paint

Shall be water-based acrylic copolymer emulsion with rutile titanium dioxide and other selected pigments and fungicide conforming to IS: 5411 (Part-1). It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, shall be able to withstand washing with mild soap and water without any deterioration in colour, or without showing flaking, blistering, or peeling.

g) Acrylic Distemper

Two or more coats of **acrylic distemper** of approved brand and manufacture to give an even shade including a priming coat with distemper primer complete.

h) Acid/Alkali Resistant Paint

Providing and applying 2 or more coats of **acid/alkali resistant paint** of approved brand and colour to floors, walls and ceiling including preparation of surface to receive paint, providing and applying bitumen primer conforming to IS 158 complete all as per manufacturer's recommendations and as approved by engineer, at all heights above or below grade level, complete as per specifications.

i) Fire Resistant Transparent Paint

Two or more coats of **fire resistant transparent paint** as per IS 162 on all woodwork over French polish as per IS 348 or flat oil paint as per IS 137 of approved grade and manufacture to give an even shade as per specifications.

j) Anti-Corrosive Bitumastic paint

Two or more coats of black **anti-corrosive bitumastic** painting of approved brand and manufacture to give an even shade complete.

Bitumen paint (black bituminous anti-corrosive paint)

Bitumen based anti-corrosive paint conforming to IS: 158 shall be used.

k) Resin Bonded Granular Textured

Providing and applying **resin bonded granular textured finish, for external applications** shall consist of crushed stone/quartz chips of .5 mm to 2.5 mm size and of approved natural colour/shade and bonded with synthetic resins, adhesives and additives altogether in a single pack mix, applied on cured and dried plaster surface with a dry film thickness of minimum 2 mm. The final



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finish shall have UV resistance, fungus, bacterial resistance properties all complete with grooves filled with poly sulphide sealant of matching colour and shade as per specification/drawing/approval of engineer in charge.

l) Epoxy Paint

Providing and applying ready made **Epoxy Paint** over areas other than steel structure with suitable pigments of approved shade as per specification and direction of Engineer. The epoxy paint shall be a two pack material and shall be resistant to water, splash, spillage & acidic environment. The epoxy paint coating shall be of 150micron thickness over epoxy primer.

m) Synthetic plaster for external applications

Providing and applying **Synthetic plaster for external applications** composed of synthetic fibre and petroleum based chemical similar to RENOVO or equivalent and of approved natural color/shade applied on cured and dried plaster surface. The final finish Paint shall have UV resistance, fungus, bacterial resistance properties all complete with grooves filled with poly sulphide sealant of matching color and shade as per specification/drawing/approval of engineer in charge.

n) Synthetic Enamel Paint

Shall be made from synthetic resins and drying oil with rutile titanium dioxide and other selected pigments to give a smooth, hard, durable and glossy finish to all exterior and resist interior surfaces. White and pastel shades shall not yellowing and darkening with aging. The paint shall conform to IS: 2932 and IS: 2933.

o) Aluminium Paint

Shall be in two pack containers and shall resist weathering. The paint shall conform to IS: 2339.

p) Varnishing

Shall be best quality alkyd varnish suitable for brushing over the tint of paint or light natural wood and shall not darken or yellow with age.

q) French Polish

Shall be made from best quality shellac, denatured spirit and other suitable alcohol soluble ingredients and made by a well known approved manufacturer. The material shall conform to IS: 348.

French polish shall not be used on bare wood it shall only be used as



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finishing coat on wood after the woods pretreated with a liquid wood filler conforming to IS: 345 is applied and rubbed out.

2.00.02 Storage

The Contractor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement, & stains. Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the contractor to prevent fire.

2.01.00 Preparation of surface

Before starting the work the Contractor shall obtain the approval of the Engineer regarding the soundness & readiness of the surface to be painted on.

2.01.02 Wood

All surfaces shall be free from, dirt and loose or peeling paints. The surface shall be rubbed down smooth. All nails & screws shall be sunk below the surface and filled with putty after applying an under coat. Small knots that do not justify cutting and sap streaks shall be covered with minimum 2 coats of pure shellace coating applied thinly & extended 25 mm beyond the area. All large, loose, or resinous knots shall be removed and filled with sound wood. All work shall be done as per IS: 2338.

2.01.02 Masonry, Concrete, and Plastered Surface

Surface shall be free from all oil, grease, efflorescence, mildew, loose paint, or other foreign and loose materials. Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of resurfacing may lead to the finishing paint being different in shade from, the original surfaces, the resurfaces area shall be treated with minimum one coat of cement primer, which should be continued to the surrounding area for a distance of minimum 100 mm.

Surface with **Mildew or Efflorescence** shall be treated as below:

All mildewed surfaces shall be treated with an approved fungicide such as ammoniacal wash consisting of 7g of copper carbonate dissolved in 80ml liquor ammonia and diluted to water, or 2.5 percent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied.

2.01.03 Metal

The surface preparation shall be done in accordance with IS:1477(Part-1) 'Code of practice for painting of ferrous metals in building' and as directed by



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Engineer. All metal surfaces shall be absolutely clean, dry, and free from rust, scales, weld slag, flux deposit, wax, grease, dried soap films, foreign matters like cement mortar etc and free from existing loose red oxide zinc chromate primer and should be removed by means of wire brushes, hand scrappers, sand paper, emery cloth, emery papers, or by mechanical power tools etc. or as directed by Engineer. For exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanized iron surfaces shall be pretreated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat. The actual painting work should be commenced only after obtaining clearance from the Engineer regarding proper cleaning of the surface.

2.02.00 Application

2.02.01 General

The method of application shall be as recommended by the manufacturer. In case of selection of special shades and colour (not available in standard shades) the Contractor shall mix different shades and prepare test panels of minimum size 1 meter square as per instruction of the Engineer and obtain his approval prior of application of finishing paints.

Proper tools and implements shall be used. Scaffoldings used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor notes.

Painting shall be done by skilled labours in a workmanlike manner. All materials shall be evenly applied so as to free of sags, runs, crawls, or other defects. All coats shall be of proper consistency. In case of application by brush, no brush marks shall be visible. The brushes shall be clean and in good condition before application of paint.

All priming undercoat for painting shall be applied by brush only, and rollers spray equipments etc. shall not be used.

No work shall be done under conditions that are unsuitable production of good results. No painting shall be done when plastering is in progress or is drying. Application of paint, which seals the surfaces to moisture shall only be done after the moisture on and below the surface has dried out.

All coats shall be thoroughly dry before succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface is not covered property by applying the specified number of coats, further coats shall be applied by the Contractor when so desired by the Engineer.



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All primers and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.

Painting on ferrous metal surface shall, be done as per IS: 1477 (Part I & 2). The total dry thickness of film should not be less than 120 Micron.

2.02.02 White Washing

The surface where white washing is to be applied shall be cleared of all loose materials and dirt. All holes and irregularities of the surface shall be filled up with lime putty and shall be allowed to dry up before white washing.

One coat of whitewash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat shall be applied and in case the Engineer feels that one or more coats are required the Contractor shall do so without any extra cost to the Owner. No brush marks shall show on the finished surface.

2.02.03 Dry Distemper

New plastered surface shall be allowed to dry for at least two months. New lime or lime cement plastered surface shall be washed with a solution of 1 part Vinegar to 12 parts water or 1:50 sulphuric acid solution and for 24 hours after which the wall shall be thoroughly washed with clean water. For cement-plastered surface, the surface shall be washed with solution of 100 gms. of zinc sulphate to 1 litre of water and allowed to dry.

Dry distemping shall be done as per manufacturers instruction. In applying the distempers the brush, should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long, otherwise brush marks may result.

2.02.04 Oil bound washable distemper

The distemper shall be applied after surface is primed with an alkali resistant primer, and followed by minimum two coats of oil bound washable distemper all as per manufacturer's instruction.

2.02.05 Waterproof Cement Paint

Surface to be coated with cement paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and



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prevent cracking. After the first coat has dried (24 to 48 hours) the second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

2.02.06 Acrylic Emulsion Paint

Paint shall be applied after providing one coat of cement primer solvent of approved quality and primer shall be conform to IS: 109. Lime gauged cement plastered surfaces shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer. Painting shall be done strictly as per manufacturer's specification.

2.02.07 Synthetic Enamel Paint

Shall be applied on properly primed surface. Subsequential coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coats.

2.02.08 Aluminium Paint

The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacturer's direction. When more than one coat of paint is required or indicated, the next coat shall only be applied after the previous coat become hard dry.

2.02.09 Clear Synthetic Varnish

The Varnish shall be applied on wood surface after (a) filling, (b) staining & (c) sealing operations are carried out. The application of a combination of filler and stain shall not be permitted.

For the finishing coats of varnish, the surface shall be allowed to dry and be rubbed down lightly, wiped off and allowed to dry. Careful attention to cleanliness is required for varnishing. All dust and dirt shall be removed from the surface as well as from the neighbourhood. Damp atmosphere and draughts shall be avoided, and exposure to extreme heat or cold & dampness shall not be allowed.

The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with light strokes to avoid frothing. It shall be allowed to flow on white the next section is being laid on excess varnish shall then be scrapped off the brush and the first section be crossed, recrossed and then laid off lightly. The varnish once it has begun to set shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh.

The varnish shall be minimum of two coats, with the first coat being a flatting



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varnish. This shall be allowed to dry hard and be flatted down, before applying the next coat. Sufficient time must be allowed between coats to get a hard dry surface before next coat is applied. All work shall be as per relevant IS Code.

2.02.10 French polish

All unevenness of the surface shall be rubbed down to smoothness with sand paper and the surface shall well dusted .The pores in the shall be filled up with a paste of whitening in water or methylated spirit with a suitable pigment like burnt siemme or umber.

After application of the filler paste, the French polish shall be applied with a pad of woollen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles so that the polish is sparingly but uniformly applied over the entire area to give an even surface. A trace of linseed oil may be used on the pad for case of application. The surface shall be allowed to dry before further coats are applied in the same manner. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly dampened with methylated spirit, and rubbed lightly and quickly with circular motions to leave the finished surface with a uniform texture and high gloss.

2.02.11 Chemical Resistant Paint

For chemical resistant paints, epoxy, chlorinated rubber, or vinyl butryl paint system shall be used. Manufacturer's recommendation shall be followed regarding the paint system, exposed to moderately to severe corrosive condition and subject to acid/alkali spillage & fumes, shall be followed.

2.03.00 Protection

Furniture and other movable objects, equipment, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipment shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.

2.04.00 Cleaning up

In addition to provisions in general conditions the Contractor shall, upon completion of painting etc. remove all marks and make good surfaces, where paint has been splashed or splattered, including all equipment, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.



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3.00.00**ACCEPTANCE CRITERIA AND TESTING**

- a) All painted surfaces shall be uniform and pleasing in appearance.
- b) All varnished surfaces shall be of uniform texture and high glossy finish.
- c) The colour, texture etc. shall match exactly with those of approved samples.
- d) All stains, splashes, and splatters of paints and varnishes shall be removed from surrounding surfaces.

Testing

- a) As, each part of the work is under progress, i.e. preparation of surface, providing primer, providing different coats of finishing paints, it shall be passed by the Engineer. Variation from the drawings or specification or standard etc. shall not be accepted. The Contractor shall ascertain from the Engineer as to which parts will be inspected and passed from time to time. The Contractor shall provide all necessary arrangement for inspection of the painting work during its different working phase. The Contractor shall provide necessary scaffolding, approach for inspection of the above as per direction and satisfaction of the Engineer. All the necessary cost for scaffolding, approach, platform, lighting arrangement testing and inspection shall be borne by the Contractor. Such inspection and testing will not, however, exonerate the Contractor from his responsibilities for proper workmanship, material etc.
- b) The Contractor shall carry out all sampling and necessary testing in accordance with the relevant Indian Standards and shall conduct such tests as called for by the Engineer. Where no specific testing procedure is mentioned in the relevant codes, the tests shall be carried out as per the prevalent accepted Engineering practice as per the direction of the Engineer. Tests shall be done in a laboratory, approved by the Engineer, and cost of testing shall be borne by the contractor.
- c) Material/workmanship unsuitable for acceptance shall be removed and replaced by the Contractor. The work shall be redone as per Specification of the contract and direction of the Engineer without extra cost to owner.

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



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standard practice, as may be specified by the Engineer, shall be followed.

IS: 348 Specification for French polish

IS: 427 Specification for Distemper, dry colour as required.

IS: 428 Specification for Distemper oil emulsion, colour as required.

IS: 1477 Code of Practice for painting of ferrous metal
(I & II) in buildings.

IS: 2338 Code of Practice for finishing of wood and
(I & II) wood based materials.

IS: 2339 Specification for Aluminium, Paints for general purposes in
dual containers.

IS: 2395 Code of Practice for painting concrete, masonry, and Plaster
surface.

IS: 2932 Specification for enamel, exterior type-1.

IS: 5410 Specification for cement paint, colour as required.

5.00.00 RATES AND MEASUREMENT**5.01.00 Rates**

Rates shall be unit rates for complete items described in the "Schedule of Items".

Rate shall include cleaning, preparation of surface, supply and application of primer, painting and providing all protection and scaffolding required at site.

5.02.00 Measurements

Painting over the concrete/masonry/wooden surface shall be measured net (on the surface area on which it is applied) in Sqm.

No deduction shall be made for opening not exceeding 0.5 Sqm and ends of beams, joints, etc. also no payment shall be made for reveals, jams, soffits, sill of these openings.

50% deduction shall be made for opening exceeding 0.5 Sqm but not exceeding 3.0 Sqm each and no addition shall be made for reveals, jams, soffits, sills etc.

In case of opening exceeding 3.0 Sqm each, deduction shall be made for



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opening but jams, soffits, and reveals shall be measured and paid for.

Corrugated surfaces shall be measured flat and measured area shall be increased by 15%.

Painting of structural steel works shall be measured in M.T. unless specified otherwise.



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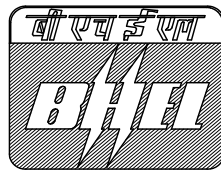
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Project Engineering Management

Power Sector, PPEI Building

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SHEET WORK IN ROOF AND SIDING

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.



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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) having minimum base metal thickness of 0.5 mm for high tensile steel sheet having minimum yield strength of 550 Mpa, coated with Zinc Aluminium alloy(45 % Zn : 55% Al) at the rate of 150 Gms/Sq. M (Minimum) or Minimum bare metal thickness of 0.6 mm for galvanised Mild Steel sheets (as per IS:513) of grade 275(Minimum) (as per IS:277).

The exposed face shall be permanently colour coated with silicon modified polyester paint(SMP) of DFT 20 microns (minimum) over primer. Inner face of external sheet shall be provided with SMP coating of minimum 7 microns. The weight of coating shall not be less than 275 gm/sqm, Alternately, Sheets can also be finished with Super Polyester quality Paint having total Coating thickness of 35 Microns, comprising of 20 Microns Coating on external face and 5 Microns on inner face over 5 Microns Primer Coat on both faces.

- i. The permanent colour coated sheet shall meet the general requirements of IS:14246 and shall conform to class 3 for the durability.
- ii. Plain permanently colour coated 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.
- iii. 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 275 gm/sq.m M.S. sheets having 0.6 mm minimum thickness (or High tensile steel sheet having minimum yield strength of 550 Mpa of 0.5mm minimum thickness) shall be



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used for the cladding system. The outer side (exposed face) shall be permanently colour coated with Silicon Modified paint(SMP) of minimum DFT 20 microns over primer and the inner side (internal face) shall be coated with same paint of minimum DFT 7 microns over primer. Alternately, Sheets can also be finished with Super Polyester quality Paint having total Coating thickness of 35 Microns, comprising of 20 Microns Coating on external face and 5 Microns on inner face over 5 Microns Primer Coat on both faces. 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.



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IS: 277 : Specification for galvanized steel sheets (plain and corrugated).

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 in sheeting works.



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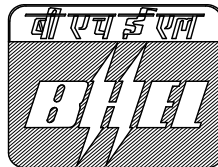
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DRAINAGE AND SANITATION

SPECIFICATION NO. PE-TS-385-600-C001



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Project Engineering Management
Power Sector, PPEI Building
Noida – 201 301**



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**STANDARD TECHNICAL SPECIFICATION
FOR
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1.0.0 SCOPE

1.1.0 This section covers the layout and construction of drains for roof water, surface water and sewage together with all fittings and fixtures and inclusive of ancillary works, such as connections, manholes and inspection chambers used within the building and from the building to the connection to a public sewer or to treatment work, septic tank and soak pit dispersion trenches.

2.0.0 INSTALLATION

2.0.1 General

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 pipe lines, fittings and fixtures shall be installed leakproof. 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.

2.1.0 Rainwater Downcomers

Rainwater downcomers shall be standard Cast Iron Pipes. In case where specifically desired, M.S, UPVC, GI and HDPE pipes may also be used. M.S. pipes shall be painted outside with two coats of anticorrosive paints under a coat of primer.

Rainwater downcomers shall run along and be secured to walls, columns etc. 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.



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2.2.0

Gutters

The gutters shall be made of G.I. All gutters shall be supplied by reputable specialised firms. 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 reflection 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 rivetting, 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.

2.3.0

Soil and Drainage Pipes

2.3.1

Gradients

If not specified the minimum gradients of soil and drainage pipe line shall be as follows :

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

2.3.2

Relation with water supply pipe lines

Unless specifically cleared by the Engineer, under no circumstances shall special drainage and soil pipes be allowed to come close to water supply pipelines.

2.3.3

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.



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2.3.4

Support and Protection on 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.
- 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.

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.

2.3.5

Entry into structures



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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 pipe lines, locations and sizes shall be marked and checked by the Engineer. After laying of the pipeline the openings and chases shall be mended.

2.3.6 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.

2.3.7 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-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.

2.3.8 Manhole and Inspection Chambers

The maximum distance between manholes shall be 30 meter unless specially permitted otherwise. In addition, at every change of alignment gradient or diameter there shall be a manhole or inspection chamber. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 metres unless desired otherwise.

Manhole shall be constructed so as to be watertight under test. The bending at the sides 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.

Manholes shall be provided with standard C.I. covers. The covers shall be close fittings so as to prevent gases from coming out. Suitable heavy duty covers shall be used where necessary as decided by the Engineer.

2.3.9 Cutting of Pipes



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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.

2.3.10

Jointing

Jointing of laid 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 water-tight 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 centered in the socket of the next pipe by tightly caulking in sufficient 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 leakproof by inserting approved type of rubber gaskets. The bolts shall be secured in stages to avoid uneven strain.

b) Concrete Pipes

Care shall be taken to place the collar centrally over the joint.



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2.4.0

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 handpacking 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 minimise inconvenience of traffic where applicable.

2.5.0

Fixtures

The Tenderer shall mention in his bid the type and make of the fixtures he intends to use enclosing manufacturer's current catalogues. In the absence of any such agreement, the Engineer shall be at liberty to choose any type and make.

All fixtures and fittings shall be of approved quality and type manufactured by well known manufacturers. All items brought to the site must bear identification marks of the type of the manufacturer. Procurements shall be made well in advance and inspected and approved immediately by the Engineer. All fixtures shall be adequately protected, covered and plugged till handed over.



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All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated. The connecting lead pipes and bends shall weigh at least 3 kg. per 25 mm dia per meter length. Where PVC or similar pipes are allowed the Contractor shall produce the test reports and convince the Engineer about their durability.

Unless specified in the contract the fixtures shall be as specified hereinafter.

2.5.1 Water closet

a) Raised type

It shall include glazed vitreous china basin with siphon, open front solid plastic seat and plastic cover, low level 12.5 litre PVC flushing cistern (same colour of wc) with valveless fittings, supply connections and necessary fittings. All fittings shall be chromium plated. Colour of basin, wc, cistern, seat and cover shall be as desired by the Engineer.

b) Squatting type

It shall include glazed vitreous china pan with foot rests and low level 12.5 litre PVC flushing cistern with valveless fittings, supply connections and necessary fittings. All fittings shall be chromium plated. The foot rests shall be made of white glazed vitreous china with chequered surface. Colour of basin, wc, cistern, shall be as desired by the Engineer.

2.5.2 Urinals

It shall consist of wall type glazed vitreous china urinals, photo voltaic control flushing cistern complete with supply connections, flush pipe, lead pipes, gratings, traps and all other necessary fittings. All fittings shall be chrome plated.

2.5.3 Wash basin

It shall be made of glazed vitreous china. The basin shall be flat back, wall hung by painted cast iron brackets and complete with pattern with hot and cold brass faucets with nylon washers, waste chain, waste washers, lead waste pipes with traps, perforated waste complete with necessary fittings. All fittings including faucets shall be chromium plated. Colour of wash basin shall be as desired by the Engineer.

2.5.4 Sink



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It shall be made of vitreous china. It shall be wall hung by painted cast iron brackets and complete with one brass faucet with nylon washers, waste chain, waste washers, lead waste pipes with traps, perforated waste with necessary fittings. All fittings including faucets shall be chromium plated.

2.5.5 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.

2.5.6 Glass shelves

Glass shelves shall consist of 6 mm thick clear glass with guard rails and shall be wall mounted with brackets. All brackets, guard rails and screws shall be chromium plated.

2.5.7 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.

2.5.8 Soap holder

It shall be made of chromium plated strong members. The holders shall be wall mounted with chromium plated screws.

2.5.9 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.

2.5.10 Toilet roll holder

It shall be made of glazed vitreous china with suitable cover cum cutter. Wall mounting screws shall be chromium plated.

2.5.11 Installation

All plumbing fittings and fixtures shall be installed in most workmanlike manner by skilled workers. These shall be perfect in level, plumb, plane, location and symmetry. All items shall be securely anchored to walls and floors. All cuttings in walls and floors shall be made good by the Contractor.

2.6.0 Septic tank & effluent disposal

2.6.1 Septic tank

Septic tank shall consist of the tank itself with inlet and outlets therefrom 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



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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.

2.6.2 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 CI pipes laid in a trench filled with broken bricks.

2.6.3 Soak pit / Chlorination Chamber

The soak pit shall be complete as shown on drawing. 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 brick bats. Inlet pipe shall be taken down to a depth of 900 mm from the top as an anti-mosquito measure.

2.6.4 Joining C.I. Pipes / dispersion trenches

Minimum dia of the CI pipe shall be 150 mm nominal. The trench for laying the pipes shall be minimum 600 x 600 mm pipes. The joints of the pipes shall be made with lead. The entire length of the pipe within the trench shall be buried in a 250 mm layer gravel or crushed stone of uniform size. On top of gravel/crushed stone layer is a 150 mm bed of well graded coarse aggregate. Ordinary soil is used for filling the top of trench.

2.6.5 Commissioning septic tank and Soak pit/Chlorination Chamber

After the septic tank has been proved watertight and the sewage system is checked the tank shall be filled with water to its outlet level before the sewage is let into the tank. It shall be seeded with well digested sludge obtained from septic tank or sludge digestion tank. In the absence of digested sludge a small quantity of decaying organic matter such as digested cow-dung may be introduced.

3.0.0 TESTING AND ACCEPTANCE

3.1.0 Inspection before installation

All pipes, fittings and fixtures shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes shall again be inspected on site before laying by sounding to disclose cracks. All defective items shall be clearly marked and forthwith removed from the site.

3.2.0 Testing of Pipelines

Comprehensive tests of all pipe lines shall be made by simulating conditions of use. 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.



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General guidance for the tests are given below :

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 tar paper or similar material in the combustion chamber of a smoke machine. Chemical smokes are not satisfactory.

b) **Water test**

For pipes other than Cast Iron

Glazed ware and concrete 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 centimeter of diameter per kilometer 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 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.

For cast iron pipes



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Cast iron sewers and drains shall be tested as for glazedware and concrete pipes. The drain plug shall be suitably strutted to prevent their being forced out of the pipe during the test.

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 end 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 pipe line is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipe line is not straight.

3.3.0 Testing Septic Tank

The septic tank shall be tested for watertightness. 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.

3.4.0 Fixtures etc.

All fixtures and fittings shall be connected by watertight joints. No dripping shall be accepted.

4.0.0 CODES AND STANDARDS

Some of the important Codes and Standards relevant to this specification shall be followed : Latest editions shall always be consulted.

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:1239 - Mild Steel Tubes and Mild Steel Tubulars and other wrought steel pipe fittings.

IS:1536 - Centrifugally cast (Spun) iron pressure pipes for water gas and sewage.

IS:1537 - Vertically cast iron pressure pipe for water, gas & sewage.

IS:3486 - Cast Iron spigot & socket drain pipes.

IS:1742 - Code of Practice for building drainage.



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- IS:5329 - Code of Practice for sanitary pipe work above ground for buildings.
- IS:2470 - Code of Practice for designs and construction of septic tank for small and large installations.
- IS:3076 - Low density polythelene pipes for potable water supplies.
- IS:4984 - High density polythelene pipes for potable water supplies.
- IS:1537 - Vertically cast iron pressure pipes for water, gas and sewage.
- IS:1538 - Cast Iron fittings for pressure pipes for water, gas & sewage.
- IS:1230 - Cast Iron rain water pipes and fittings.
- IS:3889 - Centrifugally cast (spun) iron spigot & socket soil waste and ventilating pipes, fittings and accessories.
- IS:1729 - Sand cast iron spigot & socket soil, waste and ventilating pipes and accessories.
- IS:1626 - Asbestos cement building pipes, gutters and fittings (spigot & socket types).
- IS:458 - Concrete pipes (with and without reinforcement)
- IS:783 - Code of Practice for laying of concrete pipes.
- IS:784 - Prestressed concrete pipes.
- IS:651 - Salt glazed stoneware pipes & fittings.
- IS:4127 - Code of practice for laying of glazed stoneware pipes.
- IS:1726 - Cast Iron manhole covers and frames intended for use in drainage works.
- IS:5961 - Cast Iron gratings for drainage purposes.
- IS:5219 - 'P' & 'S' traps.
(Part-I)
- IS:771 - Glazed earthen-ware sanitary appliance.
- IS:772 - General requirements of enamelled cast iron sanitary appliances.
- IS:774 - Flushing cistern for water closets & urinals (valveless siphonic type).
- IS:775 - Cast Iron brackets & supports for wash basins and sinks.
- IS:2548 - Plastic water closet seats & covers.



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IS:2527 - Code of Practice for fixing rain water gutters and down-pipes for roof drainage.

IS:2556 - Vitreous sanitary appliances.



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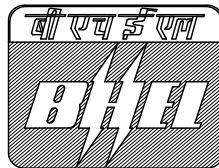
NTPC
MOUDA, SUPER THERMAL POWER PROJECT
2X660 MW, STAGE-II
STEAM GENERATOR PACKAGE

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FABRICATION OF STRUCTURAL STEEL WORK

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Bharat Heavy Electricals Limited
Project Engineering Management
Power Sector, PPEI Building
Noida -201 301



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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 customer 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



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and repairs of steelwork at site as may be required to complete the works in accordance with the Contract.

j) Specific technical requirements are given in Section –C of this document. In case of any contradiction between Section –D and Section –C , requirements as given in Section –C shall prevail.

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 : 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)



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- 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 are welding of high tensile structural steel
- IS : 1477 - Code of practice for painting of ferrous metals in buildings
Part –I Preheating
Part –II Painting
- 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, epoxy resin based Zinc Phosphate 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 :2932 - Enamel, Synthetic, exterior, (a)Under Coating and (b) finishing
- IS : 3757 - High strength structural bolts



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- 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.

2.05.02 Steel



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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 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 structural steels



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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 contract shall conform to the Indian Standard Specification IS: 2074 - Ready mixed Paint, Self Curing Inorganic Zinc Silicate Primer Coat as per following



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details:

- All Steel surfaces shall be provided with self curing Inorganic Zinc Silicate Primer Coat (Solid by Volume Minimum 60%) of Minimum 75 Micron Dry Film Thickness (DFT) applied over blast cleaned surface to near white metal conforming to Sa 2 ½ finish of Swedish standard SIS-05-5900. The Primer Coat shall be applied in Shop immediately after blast cleaning by Airless spray technique.
- Primer Coat shall be followed with the application of Intermediate Coat of Polyamide Cured pigmented Titanium Dioxide (TiO₂) or Micaceous Iron Oxide (MIO) Epoxy based Paint (Solid by Volume Minimum 60%) of Minimum 75 Micron DFT. This Coat shall be applied in Shop after an interval of Minimum overnight (from the application of Primer Coat) by Airless spray technique.
- Intermediate Coat shall be followed with the application of Finish Coat of Polyamide Cured colour pigmented Epoxy based Paint (Solid by Volume Minimum 60%) of Minimum 75 Micron DFT. This Coat shall be applied after an interval of Minimum overnight and maximum indefinite (from the application of Intermediate Coat) either before Erection by Airless spray technique or after Erection by brush and / or spray. Colour and shade of the Coat shall be as approved by the Customer. The Finish Coat thickness of 75 Micron can be built up either in Single application at Shop or in two applications one at Shop and the other at Site.
- Finish Coat shall be followed with the application of Final Finish Coat of Polyurethane based colour pigmented Paint (Solid by Volume Minimum 40%) of Minimum 25 Micron DFT. This Coat shall be applied within Seven (7) days (from the completion of Finish Coat), after Erection by brush and / or spray. Colour and shade of the Coat shall be as approved by the Customer.

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.1 & 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



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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.



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- 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.
- 2.08.10** Grating units shall be provided with all necessary clips, bolts, nuts and lock



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washers required for proper assembly and rigid installation and fastening to abutting units supporting structural steel framing members.

2.08.11 The gratings shall be of reputed make and manufacturer, as approved by Engineer. The unit rate quoted by him for this item shall be inclusive of transport of gratings to the project site, all taxes, duties etc. He shall also provide all facilities and access to the Engineer or his representative to carry out inspection during all stages of manufacturing of gratings.

2.08.12 Maximum deviation in linear dimension from the approved dimension shall not exceed 12mm.

2.08.13 All fabricated grating section and accessories shall be blast cleaned to near white metal surface (Sa 2½) followed by either of the following two:

(a) Two coats of red lead primer and two coats of black enamel finish paint.

(b) Hot dipped galvanization at 610 gm/sq.m.

in the shop prior to erection at site, as the approved drawing.

2.08.14 Prior to finishing all surfaces shall be cleaned, free from rust, mill scale, grease, oil, or any other foreign matter by blast cleaning. BS: 4232 shall be followed for blast cleaning.

2.08.15 Primer can be applied by spray guns or by brushes, however the finish paint shall necessarily be applied by means of spray guns. The applied coatings shall be uniform, free from voids and streaks; drilled or punched holes shall be touched up prior to erection or assembly.

2.09.00 GALVANIZATION OF GRATINGS

2.09.01 Purity of Zinc to be used-for galvanizing shall be 99.5% as per IS: 2 15

2.09.02 After the shop work is complete, the structural material shall be punched with erection mark and be hot double dip galvanized. Before galvanizing the steel section shall be thoroughly blast cleaned to near white metal surface (Sa 2½).

2.09.03 The weight of the zinc coating shall be at least 610 gm/m² - unless noted otherwise.

2.09.04 The galvanized surface shall consist of a continuous and uniformly thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be cleaned and smooth and shall be free from defects like discoloured patches, bare spots, unevenness of coating, spelter that is loosely attached to the steel, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the



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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

2.10.01 Material

Stainless steel hopper of grade SS 304 as manufactured by SAIL or equivalent shall be provided in the lower portion of bunker hopper. SS 304 M having the following chemical composition shall be used.

Material	%	Remarks
Carbon	10.03%	Max.
Silicon	1.60%	Max.
Manganese	0.80% to 1.50%	
Phosphorous	0.03%	Max.
Sulpher	0.03%	Max.
Chromium	10.80% to 12.50%	
Nickel	1.50%	Max.
Titanium	0.75%	Max.



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Nitrogen 0.03% Max.

The mechanical properties shall be as follows:

Description	Value	Remarks
Hardness Rock Well B Scale	90	Max.
Tensile Strength	450 MPa	Min.
Yield Strength	300 MPa	Min.
Elongation	25%	Min.

2.10.02 Fabrication

The fabrication, erection, alignment and welding shall be carried out as per the accepted practice and in accordance with relevant I.S. and international specification as well as stipulations contained herein. Fabrication drawings shall be prepared by the contractor on the basis of the design / scope drawings furnished by Engineer. The fabrication and erection works shall be done as per the approved fabrication drawings.

2.10.03 Fabrication Drawings

- Fabrication drawing shall give the cutting plan for each hopper plate. Such, cutting plan shall be based on the size of the Stainless Steel plate available at store. In order to reduce the wastage and ensure the maximum utilization of stainless steel plate, the cutting plan shall take in the consideration of the reverse curvature and place the various elements of hopper plate in opposite fashion to reduce the end wastage. Similarly the hopper plate element having different radii shall be placed one inside the other, to optimize the stainless steel plate use. Such optimization may also required adjustment in the size of the each element of hopper plate and also additional weld joints.
- The bill of material of hopper plate shall indicate the inner surface area of the hopper, weight of the hopper based on the inner surface area, weight of each of the cut plate of hopper fabrication, weight of cut and scrap pieces generated. Contractor shall return to the Owner's store all unutilized (surplus) stainless steel plates and all waste and cut pieces generated. Non return of any part of the surplus/waste steel pieces to the Owner's store will call for the penal recovery at three (03) times the maximum procurement rate for the weight of stainless steel pieces not returned to the store.



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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 test specimens, general workmanship being good meeting the tolerance requirements given in IS: 7215.



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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 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.



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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.

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



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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, Nuts & Washers : Manufacturer's certificate, dimension checks, 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, D.P. test
- 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.

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



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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), he shall prepare progressively the detailed fabrication drawings for the corresponding 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:

- a) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.
- b) Dimensional drawings of base plates, foundation bolts location etc.
- c) Comparison sheets to show that the proposed alternative section, if any, is as strong as the original sections shown on the Design Drawings.
- d) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.
- e) 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, 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



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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.

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



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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 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.



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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 nor 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 the holes. Rivets shall be heated uniformly to a temperature not exceeding 1125°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 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.



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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.

3.03.04 Welding Sequence

In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless



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distortion and minimize shrinkage stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shop splicing not more than three sub-sections, each made in accordance with this paragraph.

When required by the Engineer, welded assemblies shall be stress relieved by heat-treating in accordance with the provisions of the relevant Indian Standard or any other Standard approved by the Engineer.

3.03.05 Welding technique

Submerged-Arc-Welding/ process employing semi-automatic welding (GMAW/SAW) shall be used for welding longitudinal fillet welds (connecting flange with web) and longitudinal butt joints for fabrication of columns, framing beams and crane girders, unless manual arc welding is specifically approved by the Engineer. Necessary jigs and fixtures and rotation of structures shall be so arranged that vertically down-hand position of welding become possible. 'Open-Arc-Welding' process employing coated electrodes shall be employed for fabrication of other welded connections and field welding.

All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 mm thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross-section. Groove welds made with the use of the backing of the same material, as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness.

Groove welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates need not be removed upon completion of the weld unless otherwise specified elsewhere in the contract.

3.03.06 Temperature

No welding shall normally be done on parent material at a temperature below (-) 5°C. However, if welding is to undertaken at low temperature, adequate



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precautions as recommended in relevant Indian Standard shall be taken. When 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.

3.03.07 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.

3.03.08 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-butteted 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.



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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.



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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.



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3.15.00 Shop painting

3.15.01 General

Unless otherwise specified, steelwork, which will be concealed by interior building finish, need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Engineer.

After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other methods of loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by the solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by trough sweeping with a fibre brush.

3.15.02 Inaccessible parts

Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, Positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

3.15.03 Contact surfaces

Contact surface shall be cleaned in accordance with sub-clause 3.13.1 before assembly.

3.15.04 Finished surfaces

Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

3.15.05 Surfaces adjacent to field welds

Unless otherwise provided for, surfaces within 50 of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.



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3.16.00 Galvanizing

3.16.01 General

Structural steelwork for switchyard or other structures as may be specified in the contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS: 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.

3.16.02 Surface Preparation

All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing. Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

3.16.03 Procedure

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested 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 & other allied products.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanizing and shall not be clogged with zinc. The threads of nuts may be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after leaving been dipped twice, it shall be rejected. Special care shall be taken not to injure the skin on galvanized surfaces during transport, handling, and



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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.

4.02.02 Welding



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- 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.

4.02. 12 Galvanizing

All galvanizing shall be uniform and of standard quality when tested in



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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: 7215 - 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.



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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
- e) A schedule of parts or pieces, giving the parts or piece number with



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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 as applicable.



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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 operations described in the Specifications.



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- 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.
- 6.01.07** The bidder's rates for foundation bolts assembly shall include fabrication 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 materials not issued by the Owner.
- 6.01.08** The bidders rates for application of inorganic primer shall include surface preparation to near white metal surface by blast cleaning, abrasives, touch up painting, suitable enclosure to avoid contamination and the necessary statutory approval from the factory inspector/pollution control board etc. regarding the method of blast cleaning and abrasives used, and getting approval of the specialized agency supplying the zinc silicate primer.
- 6.01.09** The bidder's rates for application of finish painting system shall include surface preparation, application of intermediate (under) coat, finish coat and final finish coat, and getting approval of the specialized agency supplying the finish paint.



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- 6.01.10** The bidder's rates for electro-forged gratings (if specified) shall include supply, fabrication, transportation to the site, erection and alignment of factory made electro-forged gratings, all taxes, duties thereon etc. The rates shall also include preparation of grating design for different spans and load intensifies, preparation of design and fabrication drawings, edge preparation, blast cleaning followed by finish paint.
- 6.01.11** The bidder's rates for galvanization of factory made electro-forged gratings (if specified) shall include the application of hot dipped galvanization as finish over the fabricated gratings and the treatment to be given for prevention of white storage stains, as per the technical Aspiration.
- 6.01.12** The bidder's rates for permanent mild steel bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types of Structural Steel works, as per the technical specification.
- 6.01.13** The bidder's rates for high strength structural bolts, nuts and washers shall include the supply and fixing of such bolts, nuts and washers in position, for various types, of Structural Steel works, as per the technical specification.
- 6.01.14** The bidder's rates for dismantling, additions to, alterations in and/or modifications shall be inclusive of all operations such as lowering of material, carriage etc., as mentioned in the technical specification. Unutilised steel pieces cut/removed shall be returned to the project stores free of charge. Non-return of unblized steel pieces to the Owner's store would be considered as wastage and recovery would be affected as per the provision of contract for structural steel consumption. This shall not include the weight of temporarily dismantled/supported members, connected member.
- 6.01.15** The bidder's rates for re-erection of erection marks after additions to, alterations in and/or modifications shall be inclusive of all operations mentioned in technical specification for the calculated weight of the rectified/modified erection mark rejected at site. This shall not include the weight of temporarily dismantled/supported members, connected member. All the operations mentioned above for restoring such members shall be carried out at no extra cost. The work of erection of any erection mark which has not been dismantled but have been modified/rectified before erection shall not be paid under this item but shall be paid under relevant item of fabrication and erection of steel work of Schedule of items for the modified weight.
- 6.01.16** The bidder's rates for PTFE shall include design, supply, transportation of the complete assembly with guides and dust protection cover and installation of bearings in position drilling, bolting, erecting aligning etc. along with any taxes, duties thereon etc.
- 6.01.17** The bidder's rates for Stainless Steel hopper (if specified) shall include



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fabrication and erection, transportation to site, preparation checking collecting and distributing of the fabrication drawings and design calculations, all other operations mentioned in the technical specification. The rates shall also include for erection scheme, alignment, making cutting plan, cutting, jointing, bending, rolling, grinding, drilling, bolting, assembly, edge preparation, welding including pre-heating, post-heating, testing of welders, inspection of welds, inspection and testing, protection against damage in transit, stability of structures, installation of temporary 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.

6.01.18 The bidders rates for preformed flexible open ended bellow strap of neoprene (if specified) shall include supply and transportation, installation in position, drilling, bolting, aligning etc. complete along with any taxes, duties thereon etc.

6.01.19 The bidder's rates for Stainless Steel Hand Rail (if specified) shall include complete Hand Rail including, stainless steel beading, stainless steel cleats, stainless steel fasteners, neoprene gaskets, preparation of shop drawing but excluding the cost of glazing. The Owner for this item of work shall supply no material.

6.02.00 MODE OF MEASUREMENT

6.02.01 The measurement for the item of foundation bolts assembly including that of nuts; locknuts shall be based on the calculated weight of steel installed in Metric Tonne, corrected to second place of decimal. The weight of the 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.



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- 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 0.2 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 0.2 sq.m. the actual profile of the plate shall be considered 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 0.2 sq.m. The weight shall be calculated by deducting the area of holes, if area of individual hole is more than 0.2 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 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.



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- 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 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 actual weight 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



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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 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.



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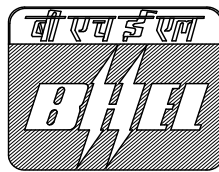
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SPECIAL QUALITY ASSURANCE



**Bharat Heavy Electricals Limited
Project Engineering Management
Power Sector, PPEI Building
Noida -201 301**

CLAUSE NO.	QUALITY ASSURANCE				
<p>1.02.08</p> <p>1.02.09</p> <p>1.02.10</p> <p>1.02.11</p>	<p>8.0 All electric hoists shall be tested as per is-3938 and chain pulley blocks shall be tested as per IS-3832.</p> <p>Lube Oil systems/ Hydraulic Power Pack</p> <p>Lube Oil system/ hydraulic power packs shall be tested for performance.</p> <p>Fans & pumps which are not mentioned in other clauses above shall be dynamically balanced and functionally tested at Manufacturer's works. Complete performance tests shall be carried out on first pump/fan of each type and capacity to verify its output against total head, power input, efficiency, vibration and noise level. Head/volume, efficiency and power input curves corrected for site conditions shall be furnished.</p> <p>Dampers</p> <p>(a) All the dampers shall be subjected to operational test/checks.</p> <p>(b) Leak tightness of test of Dampers / Gates shall be carried out as given in Sub-Section – II M1, PART- B (Technical Requirements of Steam Generator & Auxiliaries)</p> <p>(c) All dampers shall be checked for sealing dimensions to establish guaranteed tightness.</p> <p>Boiler Structure, Ducts, Hoppers etc.</p> <p>Steel Structure of Boiler, Mill Bunker building including Coal bunkers, Coal transfer points. Coal conveyor galleries and supporting trestles, Ducts, Hoppers, etc.</p> <p>(a) Only material which has been identified against mill sheet or test certificates shall be used for construction. All plates above 40mm thickness shall be 100% ultrasonically tested.</p> <p>(b) Visual inspection of all welds shall be performed in accordance with AWS D.1.1.</p> <p>(c) NDT requirements of structural steel welds (other than Coal Bunkers) shall be as under :-</p> <p>(i) 100% RT/UT on butt-welds of plate thickness ≥ 32 mm.</p> <p>(ii) For plates of thickness ≥ 25mm & < 32mm - 10% RT and 100% MPI</p> <p>(iii) For plates of thickness ≤ 25mm - 10% MPI/LPI.</p> <p>(iv) All fillet welds of built up plate girders shall be inspected 100% by MPI.</p> <p>(d) (Edge for field weld shall be examined by MPI for plate thickness > 32mm. Edge for field weld for ceiling girders shall be examined by UT for 100mm from the edge).</p> <p>(e) Ceiling girders/columns, ducts hoppers & tunnels shall be trial assembled and match marked prior to dispatch/erection. At least two consecutive girders along with cross member shall be assembled at a time.</p>	<p>MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE</p>	<p>TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2</p>	<p>PART-B SUB-SECTION-VII:QM1 STEAM GENERATOR AND AUXILIARIES</p>	<p>PAGE 11 OF 13</p>

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1.02.13	<p>(f) Production test coupons for Butt and fillet welds of Main columns, ceiling grinders shall be carried out.</p> <p>(g) Coal Bunkers / Bins</p> <p>(i) 10% DPT after back gouging.</p> <p>(ii) 5 % spot radiography test on butt welds. Where access not available, UT shall be carried with prior approval of NTPC.</p> <p>(iii) Full penetration welds (other than butt welds) shall be subjected to 10% Ultrasonic testing.</p> <p>Hangers & Supports:</p> <p>(a) All major raw materials used shall have co-related mill test certificate meeting mandatory checks of material specification.</p> <p>(b) Completed springs shall be tested for Scragging Test & Load vs Deflection Test and for dia. > 25mm MPI shall be carried out.</p> <p>(c) Butt Welds shall be tested for UT and fillet welds shall be tested for MPI.</p> <p>(d) Turn buckle/ pipe clamps/ Hangers of thickness > 25mm shall be checked by MPI/DPT on bent portion.</p> <p>(e) Assembled Hangers shall be checked for Variation in deflection and Travel vs Load test and shall meet the requirements of NTPC data sheet.</p>			
1.02.14	<p>Metallic Expansion Joint (if applicable)</p> <p>(a) Hydraulic pressure test shall be carried out on each pipe and expansion bellow.</p> <p>(b) Longitudinal butt weld on bellow shall be subjected to suitable NDT examination before forming, and after forming MPE / DP test shall be carried out.</p> <p>(c) All welds shall be subjected to 100% magnetic particle/dye penetrant check and butt welds shall be subjected to 100% radiographic testing.</p> <p>(d) All the bellows subjected to vacuum service shall be subjected to vacuum test.</p> <p>(e) The bellows shall be subjected to movement test to establish suitability to perform satisfactorily in site conditions. During this test spring rate shall also be measured.</p> <p>(f) Life cycle test, meridional yield rupture test and squirm test to be carried out on a prototype/expansion bellow as per Sec.D clause 3.2 of standards of Expansion joint Manufacturer Association (EJMA). In case these tests have already been accepted by NTPC on a prototype expansion bellow, as defined in Sec.D Clause 3.2 of Expansion Joints Manufacturers Association (EJMA) test reports may be furnished by manufacturer for consideration and approval of Employer.</p>			
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE		TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2	PART-B SUB-SECTION-VII:QM1 STEAM GENERATOR AND AUXILIARIES	PAGE 12 OF 13

CLAUSE NO.	QUALITY ASSURANCE			
1.02.15	<p>Thermal Insulation, Lagging & Cladding:</p> <p>(a) Lightly resin bonded mineral wool:</p> <p>LRB mattresses/sections of Rockwool/ Glasswool shall confirm to & tested as per relevant clauses of Indian Standards given in Sub-Section – II M1 (Technical Requirements of Steam Generator & Auxiliaries) and shall meet the requirements of NTPC data sheet. Type tests except Thermal Conductivity shall be regularly carried out once in three months, Thermal Conductivity Type Test shall be carried out minimum once in twelve months by the manufacturer. Requirements of various components like Binding wires, Lacing wires, Wire mesh, etc. shall be as per NTPC approved data sheet / as given in Sub-Section – II M1 (Technical Requirements of Steam Generator & Auxiliaries).</p> <p>(b) Castable Refractory:</p> <p>Fire Bricks / Castable Refractory confirming to & tested as per relevant clauses of Indian Standards and shall meet the requirements of NTPC data sheet. Castable Refractory shall have proper identification, supplier name, customer name, Batch No., Date, material name & Net weight in Kgs. with proper instructions for handling.</p> <p>(c) Lagging &Cladding:</p> <p>All insulation shall be protected by means of an outer covering of Aluminium sheeting confirming to ASTM B-209-1060 temper H14 from reputed manufacturer meeting the requirements of NTPC data sheet.</p>			
2.00.00	FIELD /ERECTION CHECKS FOR STEAM GENERATOR & AUX.			
2.01.00	<p>(1) Raw Material, In process and Non Destructive Testing indicated during manufacture shall be applicable for site fabrication/erection of the respective item.</p> <p>(a) All rotary equipments shall be checked for its direction of rotation and free movement after placing it on the foundation.</p> <p>(b) All Valves shall be checked for its direction of flow.</p> <p>(c) Insulation shall be carried out only after satisfactory inspection of leak test.</p> <p>(d) Erection checks, tolerance limits and Quantum of NDE are indicated in respective Drawing, Field Quality plan and Field Welding Schedule.</p>			
2.02.00	Hydraulic Tests of Pressure Parts			
2.02.01	<p>On completion of erection of Steam Generator, Piping and Auxiliaries, the unit with its fittings and mountings in position shall be subjected to hydraulic pressure test in accordance with requirements of Indian Boiler Regulations.</p> <p>Water used for hydraulic test shall be made alkaline by addition of suitable chemicals. After the test, the steam generator shall be drained and suitably preserved. The stipulations specified in General Technical Requirements (GTR) shall also be complied with.</p>			
MOUDA STPP-II (2x660MW) / SOLAPUR STPP (2 x 660MW) / NABINAGAR STPP (3x 660MW) / MEJA TPP-I (2 x 660MW) / RAGHUNATHPUR TPP PHASE-II (2 x660MW) STEAM GENERATOR PACKAGE	TECHNICAL SPECIFICATION SECTION-VI BID DOC NO.: CS-9575/ 9571/ 0370/ 0360/ 9586-102(R)-2	PART-B SUB-SECTION-VII:QM1 STEAM GENERATOR AND AUXILIARIES	PAGE 13 OF 13	



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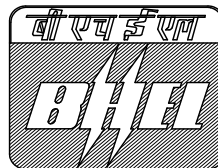
NTPC
MOUDA, SUPER THERMAL POWER PROJECT
2X660 MW, STAGE-II
STEAM GENERATOR PACKAGE

VOLUME: II B

SECTION - D
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ERECTION OF STRUCTURAL STEELWORK

SPECIFICATION NO. PE-TS-385-600-C001



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Project Engineering Management
Power Sector, PPEI Building
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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, levelling, 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.



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- g) All minor modifications of the fabricated steel structures as directed by the 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: 12843 – Tolerances for Erection of structural steel

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.

2.05.00 Material



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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 designed racks and platforms off the ground in a properly covered store building to be built at the cost of the Contractor.



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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.

3.01.02 Method and sequence of erection

The method and sequence of erection shall have the prior approval of the



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Engineer. The Contractor shall arrange for most economical method and sequence available to him consistent with the drawings and specifications and other relevant stipulations of the contract.

3.01.03 Temporary Bracing

Unless adequate bracing is included as a part of the permanent framing, the erector during erection shall install, free of cost to the Owner, temporary guys and bracings where needed to secure the framing against loads such as wind or seismic forces comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well as loads due to erection equipment and erection operations.

If additional temporary guys are required to resist wind or seismic forces acting upon components of the finished structure installed by others during the course of the erection of the steel framing, arrangement for their installation by the erector shall be made free of cost to the Owner.

The requirement of temporary bracings and guys shall cease when the structural steel is once located, plumbed, levelled, aligned, and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Engineer.

The temporary guys, braces, false work, and cribbing shall not be the property of the Owner and they may be removed immediately upon completion of the steel erection.

3.01.04 Temporary Floors for Buildings

It shall be the responsibility of the Contractor to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of Parliament and/or bylaws of state, Municipal or other local authorities.

3.01.05 Setting Out

Positioning and levelling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance with the approved Drawings and to the satisfaction of the Engineer. For heavy columns, etc. the Contractor shall set proper screed bars to maintain proper level. No extra payment shall be made for this.

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.



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

TABLE-I

Bolts length not exceeding 8 times	Bolt length exceeding 8 times	Remarks



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dia or 200 mm

dia or 200 mm

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 14.7 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



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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 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.



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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 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



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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 two 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.

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



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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.

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.



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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:

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 other member connection levels:	
	i) For a column upto and including 10M height	i) ± 3.5 mm from true vertical
	ii) For a column greater than 10M but less than 40M height	ii) ± 3.5 mm from true vertical for any 10 M length measured between connection levels, but not more than ± 7 mm per 30m



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		length.
	c) For adjacent pairs of columns across the width of the building prior to placing of truss	± 9.0 mm on true span.
	d) For any individual column deviation of any bearing or resting level from levels shown on drawings.	± 3.0 mm
	e) For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating	3.0 mm
Trusses	a) Deviation at centre of span of upper chord member from vertical plane running through least.	1/1500 of the span or greater than 10mm whichever is the centre of bottom chord.
Trusses	b) Lateral displacement of top chord at center of span from vertical plane running through center of supports.	1/250 of depth of truss or 20 mm which ever is the - least.
Crane Cirders	a) Difference in levels of crane rail measured between adjacent columns.	2.0 mm.
	b) Deviation to crane rail-gauge	± 3.0 mm
	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	



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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.

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



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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.