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Bharat Heavy Electricals Ltd.

Doc. No. TB-377-607-003

TECHNICAL SPECIFICATION FOR CIVIL WORKS OF 220KV CONTROL ROOM BUILDING, GIS BUILDING AND SWITCHYARD AT ROURKELA, ORISSA.

SECTION-1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES

SECTION - 1

SCOPE, SPECIFIC TECHNICAL REQUIREMENTS & QUANTITIES

1.0 SCOPE

1.1.1 The scope of work under this specification is Civil Works of 220kV Control Room Building, GIS Building and Switchyard at 1x250 MW Thermal Power Project, Rourkela by Bharat Heavy Electricals Ltd. The Customer is NTPC SAIL POWER COMPANY (P) LTD.

1.1.2 The Civil Works shall generally include, *but not limited to*, following:

- (i) Control Room Building
- (ii) GIS Building
- (iii) Tower Foundations
- (iv) Equipment foundations.
- (v) Cable trenches including precast covers & cable trench crossings.
- (vi) Drainage including Sump Pits
- (vii) Stone spreading including antiweed treatment,
- (viii) Fencing and gates
- (ix) Roads & Culverts
- (x) Any other work required for the project.

1.1.3 The works to be performed in the above construction includes preparation of bar bending schedules, based on the drawings released for construction and getting the same approved by the Engineer-in-charge plus the execution of the work including providing of all labour, supervision, materials, scaffolding, power, fuel, Dewatering Pump, construction equipment's, tools and plants, supplies, transportation, all incidental items necessary for successful completion of the work including contractor's supervision and in strict accordance with the drawings and specifications and with inspection and testing standards. The nature of work shall generally involve excavation in all type of soil including dewatering, shoring, strutting, and filling under and around structures, backfilling with available excavated earth around completed structures, cable trenches with covers, disposal of surplus soil, steel/wooden ply formwork, providing necessary steel embedment and other inserts, drainage work, concreting, brickwork, flooring and finishing etc. and all other works in building all complete as per detailed specification, drawings and directions of Engineer-in-charge.

1.2.0 SPECIFIC TECHNICAL REQUIREMENT

1.2.1 The specific technical requirements for the execution of civil works shall be as per Customer's specification (Section-VI-Volume - IIF) / I.S. Codes/ Specification. In case of any conflict between these, Customer's specification shall prevail.

1.3.0 BILL OF QUANTITIES

1.3.1 The Bill of Quantity cum price schedule shall be as per page 4 to page 17.

1.3.2 The quantities indicated in the 'Bill of Quantity cum price schedule' are indicative and can vary upto any extent, even may get deleted. Contractor shall not be entitled for any claim for any such variation in the quantities.

1.3.3 The provision of Bill of Quantity cum price schedule, specifications and drawings shall be read in conjunction with each other and in case of conflict amongst them, the clarification shall be obtained from the Engineer-in-charge whose decision shall be final and binding.

1.3.4 Method of measurement:

1.3.4.1 Excavation shall be measured in cubic meters. The lateral dimensions to be considered for working out excavation quantity upto 3.6mtr depth shall be vertical face from edge of the PCC dimension below the footing as per approved drawing. However, if depth of excavation is more than 3.6mtr, additional working space of 600mm or actual whichever is minimum on each side from the edge of PCC shall be paid for Vertical Excavation. Nothing extra shall be paid for slope cutting, etc. Backfilling & disposal quantities for payment purpose shall be worked out from above dimensions & excavation quantity only. However the contractor shall maintain the required slope and working space as per the safety /statutory requirement and its cost is deemed to be included in the quoted rate.

1.3.4.2 For other items, unless otherwise described the method of measurement as described in 'Method of Measurement of Building and Civil Engineering Works'-IS 1200(Part I to XXV)' latest edition of BIS shall be followed.

SECTION-2

STANDARD TECHNICAL SPECIFICATION

(NA)

SECTION-3

**ENCLOSURE TO TECHNICAL SPECIFICATION
- CUSTOMER TECHNICAL SPECIFICATION
(SECTION-VI-VOLUME-IIIF (TOTAL PAGES 440 Nos)**

NTPC SAIL POWER COMPANY (P) LIMITED



**ROURKELA POWER PROJECT
(PP-III: 1 X 250 MW)**

**TECHNICAL SPECIFICATION
FOR
EPC PACKAGE
SECTION – VI**

**VOLUME – II F
(TECHNICAL)
(CIVIL, STRUCTURAL, ARCHITECTURAL &
INSULATION & REFRACTORY)**





**MECON LIMITED
RANCHI – 834 002**

VOLUME : IIF

Part - A

Civil

	<p align="center">NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW)</p> <p align="center">TECHNICAL SPECIFICATION FOR EPC PACKAGE</p>	
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VOLUME : II-F

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SECTION : 1

01.00.00 SCOPE & SCOPE RELATED GENERAL REQUIREMENTS

This specification is to cover, survey works , site leveling works, analysis and design all structure, preparation of general arrangement drawings, construction and fabrication drawings, supply of labour & materials and construction of all civil, structural and architectural works by the Bidder.

Description of various items of work under this specification and nature of work in detail are given hereinafter. The complete work under this scope is referred to as civil works. Various buildings, structures, plant and systems, facilities, etc., covered under the scope is given herein.

The work to be performed under this specification consists of design, engineering, construction, erection and providing all labour, materials, consumables, equipment, temporary works, temporary storage sheds, temporary colony for labour and staff, temporary site offices, constructional plants, fuel supply, transportation and all incidental items not shown or specified but reasonably implied or necessary for the completion and proper functioning of the plant, all in strict accordance with the specifications including revisions and amendments thereto as may be required during the execution of work.

All construction materials including cement, reinforcement steel, coarse & fine aggregate and structural steel etc., shall be arranged by the Bidder.



The scope shall also include setting up by the Bidder a complete testing laboratory in the field to carry out all relevant tests for structural steel, reinforcement steel & constituents of reinforced cement concrete (RCC) etc.

Detailed geotechnical investigation in the proposed area has been carried out by the Owner and the borelog data is furnished in report in JOB No 2640 and detailed report is available with the Owner. The foundation system shall be evaluated by the bidder based on the above mentioned data. If required, additional Geotechnical Investigation may be carried out by the bidder at his own cost.

The work shall be carried out according to the design/drawings to be developed by the Bidder and approved by the Owner/consultant. For all buildings, facilities, systems, structures, etc., necessary layout and details are to be developed by the Bidder keeping in view the statutory and functional requirements and providing enough space and access for operation, use and maintenance. The Bidder's work shall cover the complete requirements as per IS codes, fire safety norms, requirements of various statutory bodies, International Standards, best prevailing practices and to the complete satisfaction of the Owner.

The Bidder shall make the layout and levels of all structures from the general grid of the plot and the nearest benchmark or other acceptable benchmark of Govt. deptt. as per the directions of the Engineer. The Bidder shall be solely responsible for the correctness of the layout and levels and shall also provide

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necessary instruments, materials, access to works, etc., to the Engineer for general checking of the correctness of the civil works.

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 Owner.

Wherever there is an anomaly in the design concept between the data furnished in the General Design Criteria & Design Concept of Buildings, the data furnished in the design concept of buildings shall be treated as final.

01.01.00 SCOPE

01.01.01 The scope of work for the EPC Bidder shall include the analysis , design , construction ,supply of all materials, erection of all civil , structural and architectural (scope covered in structural and architectural part in specification) work and all other items mentioned in this specification.

01.01.02 This section of the specification covers entire civil engineering work including Design & engineering for all buildings, structures and facilities for foundations and equipments, basements, silos, chimney, roads, ramps, paving, parking areas, storm water drainage, plumbing & sanitary fittings, service lines and all other miscellaneous civil engineering works within the battery limit as shall be necessary for completing this package on a turnkey basis within the battery limit.



01.01.03 Supply / procurement of cement, reinforcement steel, foundation bolts, inserts, etc. and all construction materials required for successful execution of civil works are included in the scope of the Bidder.

01.01.04 All civil works for the buildings, equipment foundations, facilities and miscellaneous civil works to be provided for the project shall include but not be limited to the following:

01.01.05 ~~STEAM GENERATOR & AUXILIARIES~~

~~Steam Generator & Accessories~~

- ~~1. Fans (FD, PA, ID, etc.)~~
- ~~2. Mills & Mill-Bunker Building~~
- ~~3. Chemical Dosing System~~



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49. Sewerage system including sewerage Treatment Plant
50. Mill Reject Handling System
51. Elevators
52. Intake well, pump house including MCC room & approach bridge
53. RCC Chimney with Steel Flue
54. Hydrogen Cylinder Storage Facility
55. RCC Pavement and Road
56. Drains and Culverts
57. Permanent Store Building
58. Pipes & Cable Trestles
59. Ladders, Platforms, Stairs, etc.
60. Cable Trenches
61. Administrative Building (with interconnection with existing Adm. Building-2 levels)
62. CISF Gate Complex Including Boundary Wall
63. Diversion of GURARIH nala by providing RCC Channel/drain and connecting existing township drain to this channel/drain. Provision of main approach road from existing PWD road and providing 2 numbers RCC bridges as shown in plot plan .
64. Security Posts

01.01.08 **Miscellaneous Works**



Following miscellaneous works are also in the scope of this Contract :

1. Conversion of existing road from the proposed gate-2 to the existing culvert as shown in the layout and a new road from existing culvert to proposed gate-1 as main approach road for the plant. Road connection between public silo and the nearest outside road by suitably modifying the boundary wall, installing gates at SAIL boundary wall and security post, along with approach road.
2. Dismantling of boundary wall and modification of roads on north and west direction & Relocation/construction of the same including construction of gate

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complex, security post, parking area, approach roads etc. Boundary wall dismantling (1200 m approx.) and construction of new boundary wall of approx 2600 m length which includes plant area, CHP area as shown in the layout, plus boundary wall for ash silo area. This length is approximate, the bidder shall make his own estimate for the length defined, any variation in length and cross section etc shall be borne by the bidder without any commercial implication to the owner.



3. Culvert cum road on existing CW ducts.
4. Main Approach road from plant boundary upto the SH (Rourkela-Bondamunda) along with all required culverts, bridges, retaining walls, etc.
5. Diversion of GURADIH nala by providing RCC Channel/drain (approx. 700m) and providing 2 numbers RCC bridges (1 & 2) as shown in layout plan and connecting existing town ship drain to this channel/drain. The bidder shall made their estimate in offer after visit of the site, Any variation in the length and cross section of the nallah shall be absorbed by the bidder without any commercial implication to the owner.
6. Desilting basin and desilting pump house shall be RCC construction to be located at near plant boundary wall as also mentioned elsewhere in the specification.
7. New road at plant grade level by shifting the existing road towards existing CWPH along with retaining walls, drains, approach roads to other existing facilities with ramp/smooth gradient.
8. Road approach to the existing CW pump house from behind the Pump House by suitably modifying the following:-
 - i) Dismantling of toilets.
 - ii) Rearrangement of outside structure for trash screen.
 - iii) Relocation of stairs inside pump house.
 - iv) Installing rolling shutter.
 - v) Relocation of cat ladder inside CW PH.
 - vi) New cut out for cat ladder approach to crane girder level/above for crane maintenance/ approach.
9. Dismantling of existing sheds/structures as required.
10. Modification of the road behind (southern side) of fuel oil pump house and storage tank area into main approach road for fuel oil area as the existing road will be blocked by conveyor trestles and transfer points for the new unit.
11. Separate service road (SSY road) beyond the new boundary on North side of the plant.
12. Dismantling of existing Gate No. 2.

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13. Dismantling of existing boundary walls & construction of new boundary walls.

01.01.09 **Scope Related General Requirements**

1. Cable and pipe trenches within the battery limit as required.
2. Permanent plant main/subsidiary roads, storm water drainage and their connection to the main plant road and pavements for the various facilities & storm water drainage system of the plant within the battery limit and its connection to the plant network.
3. Approach road shall be 15 mt wide from propose gate-2 to propose gate-1 main plant area to be provided including provision of bridges / culverts /rerouting of any existing structure /drainage network.
4. All plumbing, sanitary and water supply fittings & fixtures, rainwater drainage, industrial contaminated sewerage and connection to manholes/junction boxes of plants 'area drainage system which is also in the scope of this contract.
5. Sanitary faecal sewerage system including laying of underground pipe lines, construction of manholes, septic tanks, soaking pits, etc.
6. All necessary water proofing, heat resisting, fire proofing and anticorrosive treatment to buildings, concrete structures and foundations including underground construction.
7. All necessary protective civil works below roadways for water and other services inside battery limit.
8. Necessary sealing arrangement & PVC water stops at expansion joints/construction joint.
9. All under deck type roof insulation wherever necessary.
10. Civil work for utilities & services.
11. Protective Bituminous coating over structures in contact with earth and water as per specification.
12. All temporary facilities, buildings, offices, labour colonies, staff quarters, roads and services for construction for this package.
13. Removal and disposal of debris, site grading including micro levelling to the levels specified within the battery limit of the Bidder.
14. Within battery limit, diversion, relocation & protection of existing underground services.

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15. Protection of existing service lines beyond battery limits, if required, shall be done while executing the work within battery limit.
16. All necessary civil work required for road lighting.
17. Dismantling of buried / semi-buried structures, if any, encountered within the battery limit and disposal of generated debris and removal of slushy soil / loose soil, vegetation including roots and disposal of the same up to a maximum distance of 8 kms approx from the site including leveling and consolidation as directed by the Owner. For consolidation, as per specification (workmanship) shall be referred. Bidder to note that approach to disposal area, if required, shall be provided by the Owner.
18. Earthwork including dewatering, side shoring as required for buildings and equipment foundations, trenches, pits, sewers and other construction work including control blasting of soft rock or hard strata as required. If at all, blasting is required, it shall be done with the prior approval of Owner. Apart from shoring & temporary supports, all other necessary measures like use of sheet piling etc. shall be provided, if necessary.
19. Site clearing, dressing, levelling and grading of formation to achieve required terrace levels and soil compaction as necessary within the battery limit.
20. Necessary Survey work as may be required for the execution of work.
21. Soling & sub-grade work including backfilling & compaction for all foundations, floor, apron, paving, trenches, pits & other underground structures.
22. Reinforced concrete foundation system, as required in foundation for building, equipment, technological structures, pits, sumps, trenches, concrete encasing, grouting, basement & all underground structures.
23. RCC open foundation and pile foundation (if required) .
24. All masonry work in substructure and superstructure including plastering as required.
25. Fly Ash Bricks (class-7.5)as per IS code shall be used.
26. All fencing and gates as required.
27. Doors, windows, ventilators, louvres, rolling shutters, fire check doors, gates, shutters etc.
28. Hand railings, inserts, kerb angles, bolts etc.
29. Encasing all conduits above ground & below ground wherever necessary with RCC/PCC.

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30. Maintenance facilities for gutters, rainwater down pipes.
- Any special dewatering system like well point dewatering etc. required for lowering the ground water table to facilitate construction work of sub-structure / super structure in a water free condition is in the scope of successful bidder. Dewatering shall be planned and continued till backfilling is completed. For discharge of sub-soil water / rain water, a suitable piping system with pumping arrangement shall be provided by the successful Bidder. Bidder has to deploy dewatering diesel driven pumps/ DG sets of suitable capacity to take care of any exigencies in case of power disruption to the electrical driven dewatering pumps.
 - The scope shall also include setting up by Bidder complete testing laboratory in the field to carryout relevant tests at specified / required frequency & manning of field lab by competent technical personnel.
31. Toilet blocks (Ladies and Gents) shall be provided as per specification.

01.01.10 **Scope Related General Requirements**



- Before submission of tender, the bidder shall inspect the site to study the nature and extent of work involved and also to obtain first hand information regarding site condition. The Bidder shall assess the involvement of demolition, site clearance etc. & acquaint himself with the physical site conditions & accordingly the cost is to be considered in his offer. The bidder shall consider all such aspects in the quoted rate carefully and no claim whatsoever shall be entertained later on the plea of ignorance to site conditions.
- Co-ordinate system for the area under this Package shall be in accordance with the survey drawings for which the reference grid pillar shall be indicated by the Owner.
- All levels have to be established with respect to the permanent bench and reference bench mark shall be indicated by the Owner.
- All ancillary / auxiliary buildings shall be suitably enclosed to house all equipments with necessary working space, head clearance and other related facilities necessary for managing, operating and maintaining the plant. Requisite number of doors and windows shall be provided.
- Adequate natural ventilation shall be ensured through airinlets at sides & exhausts at roof as per specification.
- All RCC framed buildings with Fly Ash Brick walls/ fillers shall have good architectural façade.

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- 7) All auxiliary and ancillary buildings shall have peripheral apron and drain. Drains shall be connected to nearby storm water drains.
- 8) All auxiliary and ancillary buildings housing toilets / drinking water facilities shall be provided with PVC water storage tanks of suitable capacity on roof of the buildings. Plumbing and sewerage lines shall be suitably provided.
- 9) All buildings shall have arrangements for natural lighting and natural ventilation.
- 10) During detail engineering if it is found that space within the specified battery limit is a constraint, then units as indicated above may be logically clubbed and combined with the prior approval of the Owner.

The successful bidder shall dump surplus excavated material / unserviceable materials from plant boundary to an area earmarked for dumping at an approx. distance of 8 kms (max) from battery limit as indicated by Owner .



- 11) All necessary equipment for excavation of borrow pit & backfilling are in the scope of successful Bidder. The Bidder shall make necessary arrangement for excavation loading and conveying using their own equipment & at their own cost after making necessary arrangement with the authorities.
- 12) For civil work, the Bidder shall submit drawings, documents and design calculations for approval/information as listed and enclosed in clause-24 of this section.
- 13) The Bidder shall undertake within the battery limits any change in the location of units/items and/or building numbers/parameters, sizes etc which may be necessary during engineering/execution from those indicated by the Bidder in their contract drawings.
- 14) The Bidder shall submit architectural elevation of all buildings within battery limit for approval of Owner.
- 15) All drawings / prints shall bear a stamp at a prominent place indicating whether the drawings are submitted for approval or for information. Drawings supplied by the Bidder shall bear the date and signature of a responsible person of the Bidder.
- 16) All structural analysis shall be carried out by the latest version of STAAD-PRO software only. No other software for analysis of structure shall be acceptable.
- 17) Preparation of all drawings shall be carried out in latest version of AUTOCAD.

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- 18) Approval of the Bidder's design Drawings & Document means that these are checked for conformity with applicable specifications and general conformity with the engineering requirements covered in the specifications. Approval of the Bidder's design Drawings & Document shall not relieve the Bidder in any way whatsoever of any of his responsibilities under the Contract and the Bidder shall remain wholly responsible for any error in his design drawings, approved or otherwise.
- 19) The Bidder shall not make any change in the approved design drawings without the prior approval of the Owner. Manufacturer / procurement / fabrication prior to approval of design drawings shall be solely at the Bidder's risk.
- 20) In case of any deviations from the approved design drawings being called for at site due to any reason, Bidder shall take approval on such change from consulting engineers before carrying it into effect at site.
- 21) Since permanent road, permanent area drainage and sewerage system for the entire proposed plant area is proposed to be executed through the turnkey Bidder it shall ensure construction & connection of the new facilities to the main facilities & also ensure that these activities are facilitated by proper sequencing etc.
- 22) All sanitary and water supply lines, plumbing and electrical wiring within building of RCC / masonry construction shall be concealed within the concrete / masonry work.
- 23) Sheeting and shoring- The bidder shall ascertain himself the nature of materials to be excavated and difficulties, if any to be encountered in excavation , executing the work. Sheet piling, sheeting shoring , bracing and maintaining suitable slopes , draining etc shall be provided and installed by the bidder , to the satisfaction of the engineers.
- 24) General provisions, material, workmanship, dimensional tolerance, safety requirement for construction works etc. shall be in accordance with the "General specification for Civil Works)" and latest version of Indian Standards.

02.00.00 SUB SOIL CHARACTERISTICS & FOUNDATION SYSTEM

Detail soil investigation report for Power Plant area is available with the owner and the same may be collected by Bidders for their use and reference. All units/structures shall be designed based on the recommendations made on above Soil Investigation Report. However, if some of the facilities are coming in the Areas for which Soil Investigation Report is not available, the Bidder shall get Soil Investigation done (in consultation with the Owner) and submit the Report for Approval to the Owner prior to taking up design works. For bidding, the bidder may make their assessment based on the site visit. No claim shall be entertained for any variation in their assumption on soil properties.

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03.00.00 SITE CONDITIONS



The area selected for the Power Plant is generally even.

1. Site clearance of muck, debris including top vegetation upto root top soil, concrete blocks, stones, masonry blocks etc. and disposal of the same to a place shown by the Engineer-In-Charge shall be included in the Scope of Bidder's work.
2. The Bidder shall be deemed to have visited and carefully examined the site and surroundings, to have satisfied himself about the nature of all existing structures, existing underground services, general site conditions, the site for disposal of surplus materials, debris and about the availability of all construction material with lead etc. and all other matters affecting the work. Claims and objections due to ignorance of site conditions shall not be considered after submission of the tender.
3. Top Level of proposed Road in the entire area shall be 300mm above FGL.
4. Top Level of existing rail track shall be obtained from the owner by the bidder for their use, if any.
5. For the purpose of design of underground structures ground water table shall be considered as at finished ground level.
6. The environment of Rourkela may be considered as “ moderate ” for their design of concrete structure.

04.00.00 SOME IMPORTANT DESIGN/CONSTRUCTION ASPECTS / REQUIREMENTS

04.01.00 General



1. The design shall be compatible with atmospheric condition, and the prevailing condition in the proposed plant area which is adjacent to existing power plant of the Owner.
2. In general finished floor level (FFL) of all buildings shall be 500 mm above finished ground level (FGL).
3. All concrete surfaces in contact with soil / ground water shall be provided with bituminous coating as per specification.
4. In general, for calculation purpose 'Limit State Design' methods shall be adopted, however for design of Water Retaining structures, 'Working Stress Design' shall be adopted.
5. Grouting below machine/equipment bases and pockets shall be ready mix non-shrinking free flow type grout of adequate thickness and strength. For pipe supports, grouting shall be done with 1 : 1 : 2 concrete with 6mm down stone chips.

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6. The design for civil engineering works shall be in accordance with the design basis as contained in this document. Wherever detailed instructions are not indicated, those shall be as per latest Standards, Codes and Recommendations of BIS Specification / IRC & Specification Published by MORTH. In absence of BIS, other recognized International Standards and Codes such as International Standard Organization (ISO), British Standard Institutions (BIS), Deutsche Industries Norms (DIN), ACI etc. shall be used with prior approval of owner.

04.02.00 Foundations and Soil

- 1 Top level of open foundations i.e. top level of raft / strip beam and under ground facilities shall be kept at suitable level below FGL to accommodate service lines below ground.
- 2 Building column foundations shall be so provided that no part of the steel column base assembly protrudes over finished floor level (FFL). The column base assemblies shall be encased with plain cement concrete upto floor level.
- 3 Foundation pedestals for the legs of outdoor trestles, towers, staircases etc. shall be finished at least 300 mm above adjacent ground level.
- 4 For all settlement sensitive equipment and structures, due care shall be taken during designing of structures and foundations to limit the settlement as required for efficient functioning.
- 5 In case any loose soil or weak pockets are encountered during excavation at foundation level, the same shall be removed upto a depth where the design SBC is available and the extra depth shall be filled up with PCC (M7.5) based on site conditions. Minimum depth of foundation shall not be less than 1.5m.
- 6 Allowable differential settlement between two foundations shall be as per IS : 1904 (latest). Foundations for structures and equipment shall be proportioned to resist the worst conditions of loadings and shall be generally designed as per the provisions of IS:1904.
- 7 For equipment foundations, the total and differential settlements that are likely to occur shall be assessed. Design of such foundations will restrict expected settlements to within limits required for proper operation of the plant.
- 8 Machine foundations shall be separated from adjacent building column foundations by a minimum gap of 50 mm to avoid propagation of vibrations into the buildings.



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- 9 Foundations for FD, PA, ID fans foundation shall be of Reinforcement concrete foundation supported on vibration Isolation system comprising of steel helical spring units and viscous damper .
- 10 Structures and foundations supporting vibrating equipment shall be proportioned to avoid resonant frequencies. The dynamic analysis shall be done as per the stipulations as recommended by respective IS codes as well as the stipulations recommended by equipment manufacturer.
- 11 The depth of open foundation shall be determined based on loading on foundations, net SBC at founding level, settlement consideration, constructional, technological and utility services requirement. The maximum allowable bearing pressure for design of foundation shall correspond to values confirmed by results of detailed soil investigation taking into account limits of allowable settlement considered for design of structures and equipment..
- 12 Supporting structures and foundations for equipment which may cause vibration, shall be designed for the dynamic effect of equipment together with the direct loads. The dynamic loads and other relevant data required for analysing the dynamic effect shall be taken as per manufacturers' data and recommendations Equipment foundations requiring special foundation as a result of dynamic unbalanced forces shall be designed as per relevant clause of IS : 2974.
- 13 When seismic forces are considered, the safe bearing capacity shall be increased as specified in IS : 1893 (latest revision).
14. Generally foundation for buildings & equipment shall not be structurally connected to ground floor slab.
15. Allowable stresses for all reinforced concrete structures shall be as per IS:456 and for pre-stressed concrete structures as per IS:1343.
- 16 In addition to the minimum requirements outlined above, the Bidder shall design and construct the buildings, structure, foundations and other civil items as required for all equipments and systems and for the operational requirements and maintenance of these equipment and facilities.

04.03.00

~~Load Condition & Stability Requirement of Structure~~



- 1 ~~All foundations and concrete structures including crane, monorail and elevator loads shall be designed to resist full operating dead and live loads, with appropriate combination of wind and seismic forces and with due allowance for impact, inertia loading, vibration, steam piping loading, surcharge loading, construction loading etc. and secondary effects of live loads, temperature variation etc. While designing structures and foundations either the effect of seismic forces or wind loads, whichever~~

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- iii) For all underground structures and water retaining structures special care shall be taken to water-proof them and water proofing shall conform to provision of relevant IS standards or as per the specifications of approved manufacturer. Water-tightness shall be ensured by provision of PVC water bars of approved type with all necessary fittings and clippings to keep it in position during concreting. Water proofing compound as admixtures must be used in concrete.
- iv) All cellars, basements, cable, trenches subjected to liquid/water spillage shall be provided with proper drainage, sump and outlet points. Required size sump shall be provided depending on the quantity of the effluent/discharge/suction capacity of the pump.
- v) All underground structures such as basement, cellar etc. and water retaining structure etc shall be provided with integral water proofing admixture and non-shrink polymeric water proof grouting compound by injection from inside/outside along with application of two coats of acrylic polymer modified cementitious compound for water proofing coating as per approved manufacturer's specifications on outside surface.
- vi) Members, such as beams, slab, wall, column which are not stressed due to the liquid retained shall be designed as per the provision of IS:456 but the controlled crack width under all worst combination of forces shall not exceed 0.1 mm. The cover to the concrete surface shall be as per the provision of IS:3370.
- vii) In water retaining structures manholes, inlets, outlets, overflow pipes, vent pipes, drain pipes, steel rungs etc shall be provided as necessary. Also provision shall be made for adequate natural lighting and ventilation and for access by way of stairs with hand railing, platforms at intervals, etc.
- viii) Internal surface of all water retaining structures shall have 20 mm thick plaster (1:3) admixed with approved quality water proofing compound. 10 mm thick plaster (1:3) to be provided below roof slab of water retaining structure.
- ix) While water retaining structures shall be designed as per the provision of IS : 3370, temperature stresses wherever required / applicable and shall be taken into account for evaluation of extra bending moment which has to be algebraically added to bending moment obtained from static/dynamic analysis.

04.05.00 Concrete work and Reinforcement



- i) Concrete work shall secure a dense, homogenous, smooth mass including required finishes, possessing required strength and resistance to weathering and abrasion for the structures and foundations. The

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following concrete grade shall be considered for plain concrete and reinforcement concrete:

a)	Nominal mix concrete	:	M-7.5, M-10, M-15 & M-20 for plain cement concrete (PCC).
b)	Design mix concrete	:	M-25, M-30 & M-35 for reinforced cement concrete (RCC)

- ii) Design of all reinforced concrete structures shall be as per the latest IS:456, and pre-stressed concrete structures as per IS:1343. The structural safety of all foundations on soil shall, in general, be based on IS:1904.
- iii) Blinding concrete below foundation shall be minimum 100 mm thick plain cement concrete of M-10 Grade. Concrete for extra filling shall also be in Concrete Grade M-7.5.
- iv) Screed in basement floor, cable and pipe trenches etc shall be laid in slope as required over structural concrete floor with minimum thickness being 35 mm.
- v) The minimum grade of Reinforced concrete work shall be M-25 except for water retaining structures, Roads ,Grade slab and Pre-cast Concrete members. For water retaining structure the concrete shall be of grade M-30 and grade for Roads & top deck slab shall be M-35. Grade of RCC chimney, cooling tower, PT plant, ETP, CW Chemical treatment and CPU area shall be minimum M-30.
- vi) Heat resistant concrete of grade M-30 shall be used where temperature at the surface of concrete exceeds 200 °C with appropriate reduction in concrete & steel stresses.
- vii) Ground floor RCC slab shall be cast on 100 mm thick layer of pcc concrete over sub-base consisting of boulder/stone boulder/crushed stone of 300 mm compacted thickness.
- viii) Reinforcing bars shall be grade Fe-500 conforming to IS : 1786. Test certificate for reinforcement steel shall be obtained from required agency, before using. If the steel is purchased by the Bidder, Owner may desire to check the testing of the same & the Bidder shall arrange it in approved laboratory at his own cost.
- ix) Water retaining structure shall be provided with suitable approved water-proofing admixture as per manufacture's specifications . Synthetic fibre may be used in concrete for water proofing of roof-slab & under ground basement walls & rafts, as per manufacturer's specification and details.
- x) Minimum Thickness of Structural Elements

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The following minimum thickness shall be followed :

Suspended floor / slab / walkways / canopy slabs, etc.	150 mm
Ground floor slab (non-suspended)	150 mm
Water Retaining slabs / walls	200 mm
Cable / pipe trenches / underground pits /Launder walls and base slab	150 mm
All footings (including raft foundations)	300 mm
Parapets	125 mm
Sunshades at edge	75 mm
Road pavements	250mm
Pre-cast louvers / fins	50 mm
Pre-cast trench cover slabs / floor slabs / louvers	75 mm
Paving(light vehical)	150 mm
Paving (heavey vehical/equipment like boiler area, silo area etc)	250 mm
Basement walls and base slab	200 mm
Underground reservoir	
Below ground water table	200 mm
Above ground water table	150 mm

From fire resistance point of view minimum thickness of reinforced concrete members shall be as per IS Code.

04.06.00 Chemical Protection and Anti-termite to Structures & Foundation



- i) Concrete structures, floors and foundation coming in direct contact with acid/alkalis/other corrosive chemicals shall be provided with lining/treatment
- ii) Concrete structures, floors and foundations indirectly affected by acid/acidic fumes shall be treated with appropriate acid proof treatment .
- iii) All concrete structures, foundations below ground level coming on direct contact with soil shall be treated with two (2) coats of hot bitumen (20/30) over a coat of primer except for foundations requiring water proofing/hydro-insulation,

05.00.00 Civil Design Concepts

~~05.01.00 Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.,~~

~~05.02.00 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) For the design of main plant structures during seismic condition, the deaerator feed water tank shall be considered full upto operating level. However, for other load combinations, deaerator feed water tank in flooded condition shall be considered.~~
- ~~c) 'Lifted load' of crane shall not be considered during seismic condition.~~

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Areas on which the premix is to be laid shall be thoroughly cleaned of all dust and loose materials. On the cleaned surface, a tack coat at the rate of 1.0 Kg. per Sq.M. of hot Bitumen shall be uniformly applied by Sprayers. The applied Binder shall be evenly brushed.

The Binder bitumen 80/100 shall be heated to the temperature of about 190⁰ C with 3% kerosene, if required and mixed with stone chippings of size, as mentioned above, at the rate of 400 KG. with Six (6) Cu. M. of stone chips, for 100 Sq.M. of surface. The total mixed quantity, as mentioned above, is the quantity required for the total 50mm thick for 100 Sq. m. of area. Mixing shall continue until the aggregate is well coated.



12.00.00 Switchyard Civil Works

12.01.00 Civil works for switchyard includes:

- a. Towers, girders, lightning masts and equipment supporting structures including proto type assembly etc.,
- b. Foundations and supporting pedestals for towers, lightning masts, equipment supporting structures etc.,
- c. GIS/Control room/Auxiliary building as required for switchyard, foundation for AC Kiosks etc.
- d. Foundations for transformers and reactors including oil pit, stone filling, laying and fixing of rails for movement of Transformers / reactors, rail track, jacking pad and fire walls as required, arrangement for cabling etc. all complete
- e. Earthing mat, single lane roads and R.C.C. drains in switchyard area including road/drain/trench crossings etc.,
- f. All necessary embedments, inserts, supporting structures & supporting members as required etc.
- g. Cable trenches in switchyard and inside GIS/Control room/Auxiliary building including civil works for panel fixing etc.

12.02.00 Design Criteria

12.02.01 Gantry structure, which consists of open web towers connected by girders, shall be made of structural steel conforming to IS 2062 and duly galvanized conforming to IS: 2629 and IS 4759. All joints shall be bolted connections. All bolts for connections shall be of 16mm dia conforming to IS 12427 and of property class 5.6 as per IS 1367 (Part 3). Nuts shall conform to IS 1363 (Part 3) of property class 5. Foundation bolts shall conform to IS 5624 and property class shall be 4.6 as per IS 1367 (Part-3). Butt splice shall be used for splicing the main members and splice shall be located away from the node point. IS 802 "Code of practice for use of structural steel in overhead transmission line towers" shall be followed for design of structures. Height & type of towers shall be established based on electrical requirements. A provision of ± 30 degree angle

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of deviation of line in horizontal plane and ± 20 degree deviation in vertical plane is considered and the resulting worst combination of forces shall be considered for design. For all outgoing and incoming feeders, the conductor span shall be taken as 200m for design purpose.



The analysis of towers and gantries shall be carried out with combined model of critical configurations of towers and gantries using any established structural analysis software like STAAD Pro. etc.

12.02.02 Switchyard structures shall be designed for the worst combination of following loads:

- 1) Dead loads (load of wires/conductors, insulator, electrical equipment and structural members),
- 2) Live loads,
- 3) Wind loads
 - a. Switchyard gantries, towers, equipment supporting structures and lightning mast shall be designed as per IS 802. The wind load calculations shall be made as per IS: 802 except the parameters basic wind speed (V_b) and terrain category as stipulated in “Criteria for wind resistant design of structures and equipment”.
 - b. All other structures shall be designed as per IS 456 / IS 800. The wind load calculations to be made as per IS: 875 shall be with the parameters as stipulated in “Criteria for wind resistant design of structures and equipment”.
- 4) Seismic loads,
- 5) Loads due to deviation of conductor (gantries shall be checked for ± 30 deg. deviation in horizontal plane and ± 20 degree deviation in vertical plane),
- 6) Loads due to unbalanced tension in conductor/wire,
- 7) Torsional load due to unbalanced vertical and horizontal forces,
- 8) Erection loads,
- 9) Short circuit forces including snap in case of bundled conductors, etc.

Note:

- i. The occurrence of earthquake and maximum wind pressure is unlikely to take place at the same time. The structure shall be designed for either of the two. However, temperature stresses can be ignored, as these towers are freestanding structure in open space.
- ii. Short Circuit forces and Wind pressure shall be considered to act together for design of switchyard structures

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- iii. Direction of wind shall be assumed such as to produce maximum stresses in any member for the combination of wind load with conductor tensions. The wind acting perpendicular and parallel to bus conductor and shield wire shall be considered separately.
- iv. The conductor tension shall be assumed as acting on only one side of the gantry for the analysis and design of switchyard gantries.
- v. The distance between terminal and dead end gantry shall be taken as 200 meters.

12.02.03 Factor of safety:

The factor of safety for the design of members shall be considered as 2.0 for normal condition and broken wire condition, 1.5 for combined short circuit and broken wire condition. Foundation shall be designed for a factor of safety of 2.2 for normal and broken wire condition and 1.65 for combined short circuit and broken wire condition.

12.02.04 Design consideration for switchyard equipment support:

The supporting foundation for equipments shall be RCC structural .

12.02.03 Special design consideration for lightning Mast:

Diagonal wind condition shall be considered for lightning masts. Diagonal wind shall be taken as 1.2 times the wind calculated on Longitudinal/Transverse side. Lightning mast shall be provided with minimum two nos. of platforms as per requirement and an ladder for climbing purpose shall be provided up to platform at top level. Top of platform shall have grating, railing and toe guard plates. The minimum width of platform shall be 900mm. Live load minimum of 300kg/m² above platforms shall be considered for design of Lightning Mast.



12.03.04 The architectural features including roof water proofing, rain water down comers and RCC parapet walls etc. shall be as specified elsewhere in the specifications.

12.04.05 The fabrication and erection of the switchyard works shall be carried out generally in accordance with IS 802 and IS 800. All materials shall be completely shop fabricated and galvanised.

12.05.06 All structural steel members including stub members, bolts, nuts, spring washers, etc., shall be hot dip galvanised after fabrication. Minimum section thickness should not be less than 4 mm. Weight of zinc coating shall be at least 0.610 kg/m² and foundation bolts shall have heavier zinc coating at least 0.80 kg/m².

12.06.07 Cable Trenches

Cable trenches shall be provided for routing of cables as required and shall be of adequate size. The trenches located within switchyard shall project at least 300 mm above the finished formation level so that no storm water shall enter into the trench. The bottom of trench shall be provided with a longitudinal slope of 1:500. The downstream end of cable trenches shall be connected to sump pits. The precast covers shall not be more than 300mm in width and shall not be more than 65 kg. Lifting hooks shall be provided in the precast covers. Trenches shall

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be given a slope of 1:250 in the direction perpendicular to the run of the trenches. Angle of size 50x50x6 mm (minimum) with lugs shall be provided in the edges of RCC cable trenches and any other place where breakage of corners of concrete is expected. All cable trenches shall be provided with suitable insert plates for fixing support angles of cable trays and channel section for supporting panles. All internal cable trenches shall have minimum 6mm thick (o/p) chequered plate covers while external cable trenches shall have pre - cast RCC covers. However, the portion of the cable trench behind and sides of control panel / MCC shall be provided with suitable chequered plate covers as required along with necessary channel/angle section for supporting panels. Cable trenches inside switchyard, having depth more than 500mm, shall have wall thickness of minimum 150mm with two layer reinforcement.

12.07.08 Stone Filling:

Stone filling shall be provided as specified elsewhere in the specifications. Each layer shall be compacted by using 1/2 tonne roller with 4-5 passes and suitable water sprinkling. Before laying the stone fill, the top layer of the soil shall be treated for anti-weed considering the types of weeds found in the vicinity. The anti-weed/soil sterilization chemical shall be procured from reputed manufacturer. The Bidder shall submit necessary details pertaining to the types of weeds found in the vicinity, anti-weed/soil sterilization such as manufacturer's name, their specification, test certificate, etc., for Owner's approval. Any modification, if required in the proposed anti-weed treatment chemicals, shall have to be done by the Bidder at no extra cost to the Owner. The Bidder shall be required to furnish a performance guarantee of three years for the anti-weed treatment. This guarantee shall commence from the date of completion of work or date of handing over, whichever is later.



12.08.09 Transformer/reactor foundations

Foundations of transformers/reactors shall be designed for seismic and wind loads. Block foundations shall be provided for the main transformer block.

The oil soak pit, if provided, shall be filled with gravel of size 40mm. The volume of the soak pit shall be sufficient to store complete oil of the transformer/reactor along with 10 minutes of fire water considering only 40% of the volume as available voids between Stone-filling. However, in case a separate oil collection tank is provided for the transformer/reactor, oil soak pit of volume equivalent to one-third (1/3) the oil volume of transformer/reactor shall be provided around transformer/reactor. The oil collection tank, in such cases, shall be designed for an effective capacity of complete oil of the transformer along with 10 minutes of fire water. The oil soak pit shall also be provided with a sump at the corner to allow drainage of water/oil from the soak pit.

Arrangement for moving the transformer into place using rail cum road, jacking pads and pulling blocks including inserts, as required, shall be provided along with the transformer/reactor foundations.

RCC Firewall shall also be provided between the transformers wherever required.

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300 mm thick PCC M20 encasement all around the Pylon supports inside soak pit for fire fighting system shall be provided up to top of Stone filling. Coarse aggregate filling inside the transformer oil soak pit shall be carried out only after construction/erection of Pylon supports and PCC encasement.

- 12.09.10 The switchyard roads, drains, fencing and gate shall be as specified elsewhere in the specification.

13.00.00 COAL HANDLING PLANT

It includes the Civil, Structural and Architectural works related mainly to the following areas (but not limited to):

13.01.00 Wagon Tippers, Underground TP's & Tunnel

Wagon Tipplers, Underground portion of TP's and Underground Tunnel shall be of R. C. C construction.

The vertical and inclined portion of coal hopper and beams in Wagon tipplers shall be provided with 50 mm thick guniting (shotcreting). Details of shotcreting have been given elsewhere in this specification.

Expansion joints shall be provided at a maximum distance of 40m unless otherwise shown in the tender drawing. 600 mm wide water stop fabricated with 22G copper plate with bitumen board fillers and polysulphide sealing compound as specified elsewhere shall be used as expansion joint material. Detailing of expansion joints shall be as per details in the tender drawing. Construction joints shall also be provided with 600mm wide water stop 22G copper plate.



Floor shall be provided with cross slope not flatter than 1 in 50 towards side drains. Side drains shall be sloped towards sump where sump pumps as specified elsewhere, shall be provided. The slope of side drains shall not be flatter than 1 in 400. Side drains and sump shall have removable type steel grating cover. Gratings shall be galvanized to grade 610 gm/m².

Water proofing / Damp proofing of underground portion of Wagon tippler, reclaim hoppers, tunnels, underground (i. e. basement) portion of transfer houses shall be done by providing the following treatments:

(a.) Chemical injection grouting for inner faces (details as specified elsewhere).

(b.) Polymer modified cementitious coating on earth side face as per the following :

- (1.) On the outer surface of walls, frames and roof slabs coming in contact with earth, polymer modified cementitious coating in two layers as specified and as per manufacturer's specifications shall be provided directly on the concrete surface.

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in the orthogonal direction unless mentioned otherwise in the preceding clauses. Columns having depth of 400mm & less shall have bracing in single plane and at the centerline of column. For columns having depth of more than 500mm, the longitudinal bracings shall comprise a pair of members (spaced) with spacing equal to the column depth. Only where axial bracing to one vertical plane is to be waived due to functional requirement, columns in that vertical plane may be allowed to undergo biaxial bending. Beam column joints shall be detailed as per seismic resistant joint with adequate ductility.

All 2-legged structural steel trestles shall be completely braced in the vertical plan. All 4-legged structural steel trestles shall be completely braced in all four vertical planes. In addition, specified horizontal planes shall be completely braced to provide stiffness against torsional sway.

Design of steel structures shall be done using working stress method as per IS 800

ii) **RCC Structures**

If the superstructure is RCC structure, the superstructure shall be moment resisting away frame in both orthogonal direction and all the members shall be designed for biaxial bending. Design of RCC structures shall be done using as per IS 456. Detailing for ductility shall be followed as per guidelines of IS 13920 to be effective against seismic load. Design of liquid retaining structures shall be done as per IS 3370

19.00.00 Sewage Treatment Plant



A permanent sewage treatment plant (extended aeration type) is to be provided to cater to the sewage discharge of the plant area. The treatment plant shall be so designed as to meet the requirements of applicable local by-laws/pollution standards and conditions as stipulated by the State/Central agencies while according environment clearance to the project. Provision shall also be made for collection and disposal of solid waste.

19.02.00 Sewerage System

Cement concrete pipes of class NP-3 as per IS:458 shall be used below ground level for sewage disposal in all areas other than main plant area. However, for pressure pipes and in main plant areas, spun C.I. pipes conforming to IS:1536 of required class shall be used. RCC manholes with CI cover shall be provided at every 30m along the length, at connection points, and at every change of alignment, gradient or diameter of a sewer pipeline. This shall be as per IS:4111. Sewage pump house shall be provided as per IS:4111. Sewage treatment plant is to be provided by the Bidder. Bidder shall have to provide complete arrangement for sewage disposal up to the Sewage treatment plant including pumping facilities. Extended Aeration method of sewage treatment shall be used.

20.00.00 Roads

All roads shall be of rigid pavements unless otherwise specified. The design of rigid pavement shall be carried out as per IRC: 58. The effects of design wheel load, maximum tyre inflation pressures, tyre contact area for the vehicle, traffic loads, environmental factors such as temperature changes in the pavement, other factors, like impact, load repetitions, etc., are to be taken. Detailed plate load tests to determine the modulus of sub grade reaction “K” shall be carried out

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as per the procedure outlined in IS: 1888. The design traffic load shall be a minimum value of 4 million standard axles. The road shall be designed for 30years of life and considering a minimum traffic growth rate of 1 per cent per annum. The concrete pavement for roads shall be minimum 250 mm thick slab.

The road construction including its shoulders, base, sub base and concrete pavement shall be as per IRC standards. IRC: 58 shall be followed for the pavement design and IRC: 15 shall be followed for the construction of the concrete pavement.

The road base shall be with minimum 150 mm thick dry lean concrete over granular sub base. Dry lean concrete shall be laid by a mechanical paver and compacted by vibratory rollers. Concrete pavement of the road shall be done with fully mechanized paver fitted with electronic sensors for construction techniques. Dry lean concrete shall be minimum M10 grade and concrete pavement slab shall be minimum M35 grade concrete.

The finished top (crest) of all roads shall be 350 mm above the surrounding finished ground level.

The sub grade under all roads and its shoulders shall be compacted to achieve 95 percent or more of Standard Proctor's Density MDD using mechanical means. Cutting / extending / rerouting / remaking of existing roads including associated works to maintain continuity of road system / network shall also be carried out.

All culverts and RCC bridges at crossings of all roads / rail tracks / facilities with drains / nallahs / channels / roads / rail tracks / pipes / other facilities, etc. are to be designed and constructed.

Unless otherwise specified, all roads (excluding access roads to all buildings / facilities / structures, patrol road along boundary wall and road inside the switchyard) shall be double lane roads.

20.01.01



Double lane roads:

The double lane roads shall be (12 metres wide) with 7.5 metres wide concrete pavement and 2.25 metres wide raised shoulders on both sides of the roads. The raised shoulders (on both sides of the road) shall comprise of 75mm thick inter locking precast designer concrete blocks (M35 grade) at the top, over 20 mm thick sand layer. A200mm diameter NP3 pipes shall carry the surface water from the road through a PCC drain trench (M20) on both sides of the roads to the drain. The pipes shall run over PCC (M 20) continuous cradle bedding. The pipes shall be laid at 10 metres centre to centre. A layer of 100 mm (average) thick PCC (M15) shall be laid over the pipes and below the sand layer. All roads shall be provided with edge protection on both sides of the road using pre - cast kerb blocks minimum (450 mm long x 250 mm wide x 500 mm deep) (M25) laid in 1 (cement) : 6 (coarse) and cement mortar.

20.01.02

Single lane roads:

All access roads to all buildings / facilities / structures, road approaches / connections, access roads to liquid fuel storage areas and other equipment areas where access is necessary from inspection, operation and maintenance point of view and all roads inside the switchyard shall be single lane roads. These shall be single lane roads (6.75 metres wide) with 3.75 metres wide concrete pavement and 1.5 metres wide shoulders on both sides of the roads. The shoulders shall also have 150 mm thick dry lean concrete and 75 mm thick inter locking blocks over compacted granular sub base of two layers of 75mm

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thick WBM grade III 53-22.4mm. All roads shall be provided with edge protection on both sides of the road using PCC blocks (300 mm long x 250 mm wide x 150 mm deep) (M25) laid in 1 (cement) : 6 (coarse sand) cement mortar.

20.02.03

Patrol roads:



All patrol roads along the boundary wall shall be single lane roads with 3.75 metres wide concrete pavement and 1.5 metres wide shoulders on one side of the road. The shoulders shall also have 150 mm thick dry lean concrete and 75 mm thick inter locking blocks over compacted granular sub base of two layers of 75mm thick WBM grade III 53-22.4mm. All roads shall be provided with edge protection on both sides of the road using PCC blocks(300 mm long x 250 mm wide x 150 mm deep) (M25) laid in 1 (cement) : 6 (coarse sand)cement mortar. The road shall slope towards the inner drain. The centre line of the black topof the road shall run at a distance not less than 2625 mm from the centre line of the boundary wall.

21.00.00

Plant Storm Water Drainage System & Rain Water Harvesting

Plant storm water drain shall be designed taking into account the finished ground levels of the plant area, drainage pattern, intensity of rainfall, etc with a return period of 50 years. These values shall be based on the "Detailed Area Drainage Study" subject to minimum rainfall intensity of 75mm/hr. All RCC drains shall be either RCC Cast-in-Situ or RCC Precast drains. The minimum grade of concrete shall be M25 for RCC Cast-In-Situ drains and M30 for RCC Pre-cast drains. The maximum velocity for RCC open drains shall be limited to 1.8 metre per second. However, minimum velocity of 0.6 metre per second for self -cleansing shall be ensured. Bed slope not milder than 1 in 1000 shall be provided. Open RCC rectangular section, unless required otherwise due to functioned requirement, shall be provided for all drains. The thickness of side walls and bottom slab of RCC drains shall be minimum 200 mm or as per design considerations whichever is higher. The drains shall be provided on both sides of the double lane roads and single lane roads. The drains shall be provided on one side of the patrol roads. These shall be designed to drain the road surface as well as all the free and covered areas, etc. Box culverts shall be provided at all rail, road and other crossings.RCC drains located within and along both sides of peripheral roads of the main plant shall be covered with perforated precast RCC slabs of minimum 50 mm thickness with provision of openable galvanized steel grating covers at about 4.0 metre intervals. Similarly all artillery drains and the drains along the periphery of all buildings shall also have perforated precast RCC cover of minimum 50 mm thickness with provision of openable galvanized steel grating covers at about 4.0 metre intervals. In areas where vehicular loads would be coming, precast RCC covers of suitable thickness without perforations and designed for the vehicular loading shall be provided. All drains in the main plant area shall be provided with heavy duty galvanized steel grating.

All drains inside the building shall have minimum 40 mm thick grating covers. In areas where heavy equipment loads would be coming, precast RCC covers shall be provided in place of steel grating. The invert levels of the in-plant and plant peripheral drains shall be kept such that water can be discharged by gravity to the main / trunk drains under all conditions. The invert levels of the drains shall

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be decided in such a way that the water can easily be discharged to the natural water bodies above the high flood level.

21.01.00 Diversion of Existing Drainage and Discharge Of Plant Drainage into Natural Drainage System

All existing drains crossing the project / site shall be diverted suitably and shall be discharged into a natural drainage outside plant boundary. The controlled drainage from plant area and ash pond shall also be discharged at a single point. The final disposal point shall be same which is indicated for diverted drains. Bidder scope shall be upto an existing natural drain/ natural stream. All external discharge / diversion drains shall be in trapezoidal section lined with 150mm thick RCC in M25 grade concrete. The controlled drainage from plant area and ash pond including the discharge of all existing drains crossing project/site shall be discharge in natural drain / natural stream.

21.02.00 Desilting basin and desilting pump house:



Desilting basin and desilting pump house shall be located as shown in the layout drawings. Desilting basin shall be RCC vertical wall projecting 300mm above finished ground level. There is divided in two part with hand railing all around. Crane/monorail shall be provided as per technological requirement.

22.00.00 Miscellaneous item

22.01.00 Area Paving in Main Plant Block

RCC paving of minimum 150 mm thick with M25 grade concrete, over an underbed as specified herein shall be provided for areas mentioned below. RCC paving shall be designed as rigid reinforced concrete pavement for the crane/ vehicular/ equipment movement loads which the paving has to bear. The underbed for paving shall consist of preparation and consolidation of sub-grade to the required level, laying of stone soling of 200mm compacted thickness for normal duty paving and 400mm compacted thickness for heavy duty paving with 63 mm and down aggregate with interstices filled with selected moorum followed by 75 mm thick PCC of M7.5 grade with 40 mm nominal size aggregate. Paving areas shall be provided with the metallic hardener floor finish as specified elsewhere in the specification. Entire main plant area from chimney to transformer yard as enclosed within the peripheral roads of the main plant area shall be provided with paving (on chimney side, paving shall be upto the edge of the storm water drain by Bidder. Passages shall be provided inside the main plant block connecting to the outer periphery road to have access to the various facilities/buildings. The passage areas shall be provided with heavy duty paving for movement of heavy vehicles. The top surface of the passages shall be finished with 50 mm thick metallic hardener topping.

Heavy duty paving shall be provided for the areas in the Mill bunker building, equipment lay down area in the TG hall and handling areas for PA/FD fans with 50 mm thick metallic hardener topping. The ground floor area in the boiler shall be provided with normal duty paving and shall be finished with 50 mm thick metallic hardener topping. Lightly loaded areas such as corridors below trestle

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and other areas in the main plant block where no heavy traffic movement is envisaged shall be provided with interlocking concrete block paving with RCC concrete blocks of minimum M 35 grade and minimum 80 mm thickness underlain by 200mm thick with 63 mm and down aggregate with interstices filled with selected moorum. All other area inside the main plant block shall be provided with normal duty paving. 2.5 m wide paving around periphery of all sumps and underground tanks without metallic hardener shall be provided. Suitable drains shall be provided to dispose off storm water as well as floor wash of the main plant block. The paving shall be provided with slope of 1:500 to dispose the surface water/wash water to the nearest drain. Drains shall be provided to dispose the floor wash water of ESP to a sump of suitable size. Further, the overflow from the sump shall be drained to the nearest storm water drain. Sewer lines (Cast Iron), interconnected by sewer manholes (RCC) at regular intervals (not exceeding 30 meter centre to centre) shall be provided to dispose off sewage from ESP area, Main Plant Building, Control Room, CD bay & transformer yard area to sewage treatment plant.

22.02.00



Technical Specifications for Pre-cast Boundary Wall and Watch Tower

A pre-cast boundary wall all around the land acquisition line as shown in the General layout Plan for plant area shall be provided. The total height of boundary wall shall be 3600mm above formation level (natural ground level in case formation level is less than natural ground level). Upto height of 3000mm it shall be constructed with precast reinforced cement concrete panels / cast in situ RCC panels and over that for 600mm concertina coil with maximum loop spacing of 125mm shall be provided with Y-shaped MS angle. The RCC precast/cast in situ reinforced concrete columns shall be provided at spacing not more than 2500mm c/c. The RCC precast/cast in situ reinforced concrete columns and footing shall be minimum 1500mm below finished formation level with suitable foundation designed for horizontal and vertical loads. The precast reinforced concrete panels/ cast in situ RCC panels shall be at least 600mm below formation level. The RCC precast concrete columns/ cast in situ RCC panels of minimum size 300mmX350mm shall be provided with two grooves of minimum size 115mmX50mm, so as to receive Precast Concrete RCC panels spanning from column to column with minimum width of 600mm and minimum thickness of 100mm as filler wall. The grade of concrete for all precast/cast in situ work shall be of M30 grade conforming to IS 456. The boundary wall shall be designed as per relevant IS codes and as per standard practices.

The same shall be submitted to Owner for approval at the time of detailed engineering, The architecture of boundary wall shall be finalized in consultation with owner. The precast/ cast in situ reinforced cement concrete coping with minimum projections of 150mm on each side shall be provided at the top of the precast reinforced cement concrete panels / cast in situ RCC panels with suitable provision for MS angle Post for concertina throughout the boundary wall. Opening for gates/drains and for other crossing shall be suitably provided as per the requirement.

All exposed concrete surfaces of all precast members/ cast in situ RCC members have high quality shuttering finish with tolerance of +/- 5mm. Plinth protection of 150mm thickness PCC (M20) shall be provided on both side of boundary wall extending upto 300mm from centre line of boundary wall. High quality shuttering to be approved by Owner.

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Watch Towers shall be RCC construction with all weather enclosure at 6M height. Watch Towers shall be provided at 600 m interval along the Boundary as well as at corner turning points of the plant boundary. Watch Towers shall be provided with caged MS ladders.

22.03.00 Site Levelling and Slope Protection Work

22.03.01 Complete levelling of entire plant area including the area earmarked for administration building, ash based units, ash silos, and make up water pump house and associated facilities shall be done by the Bidder. Bidder shall carry out the topographical survey before commencing detailed design and site leveling. This survey shall cover the entire plant area including the areas earmarked for administration building, ash based units, ash silos, make up water pump house & associated facilities, and the diversion drains in Bidder's scope of work. Based on field observations the bidder shall prepare and submit for Owners review the survey maps of the surveyed site on suitable scale, indicating grid lines, contour lines and demarcating all permanent features like roads, railways, water-ways, buildings, power lines, natural streams, trees etc. For each area two sets of survey maps shall be prepared and submitted, one showing the spot levels and contours with grid lines and the other showing the grid lines, contours and permanent features. Established methods of surveying like triangulation, traversing, fly leveling etc. shall be adopted for the survey work. Spot levels shall be taken at 25 metres interval and at closer intervals where pits, undulations etc. are met with. these levels shall be taken in two orthogonal directions. Contours shall be plotted at 0.5m interval. It is proposed that for the purposes of site leveling the entire plant and associated areas will be divided into various blocks as defined in the drawing no. 4410-001-POC-A-001 titled, "Site Levelling Works". Each block shall be finished to the formation level as specified in drawing. Bidder shall deploy adequate number of experienced site leveling contracting agency(s) with requisite earth moving and compacting equipment to complete the work as per schedule. Since the construction of roads and drains for the entire plant is included in the scope of Bidder, it shall be the responsibility of the Bidder to ensure that these facilities are also constructed along with site leveling works. Bidder shall ensure that road access and drainage facilities for each block is available when site leveling in that block is completed. Unless otherwise instructed by the Engineers, all roads and drains within a block shall be constructed by the bidder within a month from the date of completion of site leveling of that block.

The specified formation level(s) shall be achieved either by excavation where the existing ground levels are higher than the specified formation level or by raising by controlled filling with borrowed earth where the existing ground levels are lower than the specified level. The excavation shall be in all types of soils or rock or a mixture of these. Bidder should assess and satisfy himself about the actual nature of soil present at site, before submitting his bid. All materials arising out of site clearance and excavation shall be the property of owner. They shall be dealt with in the manner specified by the Engineer. Earth / boulders / rock etc. excavated and useful portion (serviceable materials) of trees cut shall be stacked at suitable places within Owner's acquired land for the plant and the ash disposal area in a manner as directed by the engineer. Woods, branches, trunks of trees shall be termed as serviceable material. Other materials like twigs,



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leaves, roots, vegetable and organic matters etc. shall be termed as unserviceable material and shall be sorted out from the serviceable materials before disposal. They shall be cleared from the area and disposed off at places within Owner's acquired land for the plant and the ash disposal area in a manner as directed by the engineer. If the excavated material is suitable and accepted by the Engineer as fill material, the same can be used for filling in other areas where raising by filling is required. Otherwise the same shall be taken and stacked at places(s) within the plant boundary as directed by the Engineer. Filling with rock shall be done only after the written permission of the Engineer in the following manner:



- Filling with rock shall be done only in areas identified for laydown and preassembly and ash based units.
- Original ground after removal of all organic and vegetable matters shall be consolidated by rolling as directed by the engineer subject to a minimum of six passes of 8-10 tonnes roller.
- Excavated rock shall be laid (on original ground or after filling 300 mm thick layers of soil as specified), in layers not exceeding 1000 mm and rolled with vibratory roller (10-15 tonnes static weight) with minimum six passes.
- Over the compacted layer of rock, soil shall be filled in horizontal layers not exceeding 300mm in compacted thickness. The soil shall be compacted as specified elsewhere.
- It shall be ensured that the top soil layer is in minimum 3 layers of 300 mm each. To achieve this the thickness and number of rock fill layers below can be suitably adjusted. Contour map and spot levels of the area based on the preliminary survey carried out by Owner is enclosed for the purpose of guidance of Bidder. Refer tender drawing no. 4410- 001-PVC-A-001. However, Owner does not take any responsibility about the accuracy of the survey details furnished and any variation of the said data shall not constitute a valid reason for changing the terms and conditions of the contract. Bidder is requested to carry out his independent assessment of the existing ground levels before furnishing his Bid. Detailed survey shall be carried out by Bidder after award of work and all findings as stated earlier shall be submitted for Owner's review.

22.03.02 All existing drains/channels in the plant and other areas associated with the plant except those proposed to be constructed by the Owner shall be suitably diverted by the Bidder before taking up any construction. These diversions shall be so designed as to ensure effective disposal of water without any accumulation or flooding within the limits of overall land acquisition line and in adjoining areas.

22.03.03 Before commencement of cutting/filling, all organic and vegetable matters like grass. Plants shrubs bushes, weeds, trees etc. in the areas to be filled, shall be completely removed along with their roots and disposed off. It shall also be ensured that the area to be filled is clear of any water, slush etc. Original ground shall be compacted by rolling as directed by the Engineer subject to a minimum of six passes of 8 to 10 tonne roller. The earth shall then be spread in horizontal layers not exceeding 300 mm in compacted thickness. Each layer shall be watered and compacted with proper moisture content and with such equipment as may be required to obtain a compaction of 95% or more of Standard Proctor's maximum dry density. The moisture content of the fill material shall be controlled to obtain near optimum moisture content during compaction. The fill

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- material shall be tested for determining optimum moisture content and maximum dry density by Standard Proctor Test as per IS : 2720 (Part-VII). The fill material shall also be tested for determining moisture content before compaction as per IS: 2720 (Part-II). For each of the above tests, one sample for every 10,000 cubic meter of fill material shall be tested. Additional samples shall be tested, whenever there is a change in the source or type of fill material. The compacted soil shall be tested for its dry density as per IS 2720 (Part-XXIX) ~~or Part-XXVIII~~. Samples shall be taken at the rate of one sample for every 10,000 sq.m. area for each compacted layer. In addition random checks shall be carried out in compacted soils by means of Proctor needle penetration. Bidder shall submit to the Engineer, the test results immediately after completion of the tests. A sample shall be deemed to have passed the test when the in-situ dry density is equal to or more than the specified percentage of maximum dry density. If a sample taken from a layer fails to pass the test, the layer shall be further compacted till two samples taken and tested from this layer pass without any negative deviation. Only after this, spreading of further layers shall be taken up.
- 22.03.04** Before start of filling, the Bidder shall submit to the Owner his proposal for the methodology to be adopted for compaction for each type of fill material. The Bidder shall also carry out compaction trials to establish the proposed methodology. The Bidder shall start the compaction work only after approval of the methodology by the Owner. The surface of the cut/filled up areas after reaching final level shall be dressed to the required levels and slopes. The difference in levels shall not be more than +/- 10cm locally.
- 22.03.05** The borrow areas outside the overall plant boundary limits for obtaining suitable fill material which is required over and above the earth available after cutting high grounds within the plant area, for site levelling shall be arranged by the Bidder himself and all expenses in respect of royalties, taxes, duties, etc. for borrow areas/fill material shall be borne by him. He shall also obtain and submit to the Owner the necessary clearances/permission from the concerned authorities for the borrow areas/fill material.
- 22.03.06** Material suitable for filling shall be loaded and transported to the filling site by the Bidder.
- Any coarse grained or fine grained low plastic soil, free from shingle, salts, organic matter, sod or any other foreign substances, may be used for filling. The Bidder shall test the fill material to establish its suitability and submit its results to the Owner. Fill material shall be approved by the Owner. The following types of materials shall not be used for filling:
- a) Material from swamps, marshes and bogs.
 - b) Expansive clays
 - c) Peat, logs, stumps, sod and perishable materials.
 - d) Materials susceptible to combustion
 - e) Any material or industrial and domestic produce which will adversely affect other materials in the work.
 - f) Materials from prohibited areas
- 22.03.07** Bidder shall include in his offer any extra filling that may be required on account of subsidence of the original ground due to overburden of filling above and/or compaction works for site levelling.
- 22.03.08** After levelling, the bidder shall establish concrete pillars at the intersection points of the grid lines for future reference. These pillars shall project at least 450 mm

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above the formation level and shall be labeled permanently with their respective coordinates and reduced levels.



22.03.09 Filling upto the specified formation level shall extend at least 2.0 m beyond the outside face of boundary wall/fence. Thereafter, it shall be finished at a suitable slope (not steeper than 1 Vertical: 2 Horizontal) and provided with good quality dry stone pitching minimum 300mm thick.

22.04.00 Toilets

Toilet with potable water line facilities shall be provided of the following locations.

- (a.) Main plant building
- (b.) Mill and bunker building
- (c.) Crusher building
- (d.) Control Room
- (e.) Each gate
- (f.) ESP Control building
- (g.) Administer building
- (h.) Fire water pump house
- (i.) Ash Slurry pump house
- (j.) C.W. Pump house
- (k.) Silo Utility building
- (l.) Other than above Toilet shall be provided as per requirement :

In addition adequate no of potable water with adequate plumbing facility to be provided during construction period.



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SECTION : 2

TECHNICAL RULE FOR CIVIL ENGINEERING WORKS

01.00.00 General

- 01.01.00** This Technical Rule is meant for Civil Engineering works which includes loading standards, permissible stresses, functional requirements, quality standards, architectural guidelines norms etc. to be adopted as a basis for preparation of designs and drawings by the Bidder. These designs and drawings shall cover building for boiler etc., auxiliary facilities, foundations for buildings and equipments, roads, railways, drains, sewers and other miscellaneous civil engineering items of works to be provided and/or to be modified/rectified by the Bidder.
- 01.02.00** The design prepared by the Bidder shall not only provide for the requirements indicated in this Technical Rule but also consider the overall process requirements, service conditions etc any other requirement. The designs shall be compatible with the operating conditions in the plant and the atmospheric conditions prevalent at proposed Site. For this 1x250 MW project, which is adjacent to the existing power plant while designing and preparing new facilities for this project, the Bidder shall take into account the existing structures, foundations, drains, sewers, roads, railway network , pipe lines etc. of the existing units at site and modify them to suit his construction activity without any extra claim .
- 01.03.00** Standards and unification shall be carried out to the maximum extent possible and in the interest of standardisation. Owner reserves the right of selecting a particular make of materials and components. The Bidder shall supply materials/ components of the particular make, if so required.
- 01.04.00** This Technical Rule shall also be read in conjunction with the “General Specification for Civil Engineering works” which is included as a part of tender documents (Section-3 of Volume: II-F).
- 01.05.00** The main Bidder may engage one or more sub-bidders for carrying out the Civil works.
- 01.06.00** In case of anything mentioned in this Technical Rule for Civil Engg. Works (Section-2 of Volume: II-F, Part - A) is at variance with “General specification for Civil Engg. Works” (Section -3 of Volume: II-F, Part - A), BIS or other standards mentioned herein, the provisions of this “Technical Rule for Civil Engg. Works” will prevail. Also in case of variance of provisions in “Technical Rule for Civil Engg. Works” and “Technical Specification for Civil Engg. Works” (Section-1 of Volume: II-F, Part - A), the provisions of “Technical Specification for Civil Engg. Works” will prevail.

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02.00.00 Codes / Standards

Any Standards / Codes mentioned in this specification means the latest revision of it including its all amendments, if any.

In case of any conflict between the requirement of this specification & those of the referred codes / standards, the requirement of this specification shall govern.

Any special requirements as shown or noted on the project drawings shall govern over this specification.

03.00.00 Minimum Cement Content -

Minimum cement content for RCC shall not be less than 400 Kg/m³.

04.00.00 External Cladding, Internal Partitions and Finishes

04.01.00 This section deals with cladding, internal partitions and finishes for building and auxiliary buildings.

04.02.00 External cladding for all buildings including auxiliary buildings where specified shall be constructed of brick masonry using Fly Ash Bricks. The thickness of brick masonry walls shall be minimum 230mm. Design of masonry walls shall conform to IS:1905.

04.03.00 Internal non load bearing partition walls shall be minimum 115 mm. thick brick masonry for Plant and auxiliary buildings.



04.04.00 Masonry walls of thickness 230 mm. or more shall be constructed in cement-sand mortar not leaner than 1:6. Partition walls of half brick walls of 115 mm. thick shall be constructed in 1:4 cement-sand mortar with suitable reinforcement.

04.05.00 All brick shall be plastered on both sides with cement mortar (1:6). Thickness of plaster shall be minimum 20 mm in two layers for unfair faces and for all external surfaces and 15 mm for internal walls with fair faces. Thickness of plaster for ceiling shall be minimum 6 mm with (1:4) cement sand mortar

04.06.00 At junction of columns/ beams and external masonry walls, suitable chicken wire mesh shall be provided at the time of plastering.

04.07.00 All outside plastered surfaces of masonry walls shall be applied as per architectural specification.

04.10.00 False Ceilings

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04.10.01 In rooms for Senior Officers, in offices and in control room and other areas where false ceilings are required, False Ceiling shall be provided in accordance with Architectural Specification as given in Volume II - F, Part-C.

04.10.02 Lighting, fittings and ventilation grills, A/C defuser, smoke detector etc. shall be flush mounted with the false ceiling bottom and aesthetically pleasant.

05.00.00 FLOORS AND FLOOR FINISHES

05.01.00 Floors

05.01.01 For the building, the design of floor shall also take into consideration technological requirements, imposed loading and other service condition etc.

05.01.02 The sub-grade below the RCC floor slab shall be with minimum 100 mm thick P.C.C. over minimum 250 mm thick compacted boulder soiling over compacted soil.

05.01.03 All sub-grade shall be laid on compacted soil.

05.01.04 Minimum 1200mm wide Apron around building and structures shall generally consist of cement concrete. Apron shall be laid to slope to drain rain water to nearby surface drain. For the boiler areas Paving shall be of RCC concrete of designed thickness & reinforcement. The minimum reinforcement mesh shall be of 8mm dia bars at a spacing of 200mm both ways on Top & Bottom faces of RCC Slab. The RCC Slab shall be laid on 100mm thickness blinding concrete placed on 250mm thick (minimum) stone boulder soiling course. Paving shall be sloped to drain rainwater to nearby surface drains.



06.00.00 DOORS AND WINDOWS

06.01.00 Relevant provisions of the BIS specification shall be applicable in design and selection of doors and windows (List of IS codes referred in the document) with due consideration of the salient aspect of various buildings, units etc.

06.02.00 Standard types of doors and windows shall be used to the extent possible. The doors and windows shall be of approved make, quality and colour. Non-standard doors and windows shall be used only where there is a specific requirement for such doors and windows.

06.03.00 Doors in Plant Buildings

06.03.01 Main entry doors to buildings shall be steel doors or steel rolling shutters of width and height to suit the requirements. Unless otherwise specified, rolling shutters with area upto 8 sq m shall be pull and push type hand operated, between 8 sq m to 12 sq m pull and push type with ball bearings. Rolling shutters with areas larger than 12 sq m shall be mechanical gear type or electrically operated.

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- 06.03.02 Generally in all rooms inside the power units, steel doors with steel sheeting shall be provided except for offices, rest room etc. where solid core block board flush doors with teak veneering shall be used.
- 06.03.03 For areas where chances of excessive water spillage exists such as toilets, solid core FRP door shall be provided.
- 06.03.04 All air conditioned or pressurised rooms, the doors shall be of airtight type. The main control room in electrical bay, which is air-conditioned or pressurised, the door shall be automatic sliding aluminium door/sensor type and for other control rooms, the doors shall be of glazed aluminium type only.
- 06.03.05 For cable galleries, switch gear room etc. and/or in such places where there is a likelihood of fire hazard the door shall be fire check door as specified in IS:3614 (Part-I) and fire check doors shall be duly approved by Tariff Advisory Committee.
- 06.03.06 Doors in specific areas of buildings shall be designed to suit technological requirements.
- 06.03.07 Width and height of door shall be decided based on various technical requirements like taking in and out of equipment during erection as well as maintenance purpose. However the minimum height of the door shall be kept at 2100 mm.

07.00.00 WATER-PROOFING AND DAMP-PROOFING

- 07.01.00 Water proofing admixtures has to be added in concrete for all underground RCC structure like pits, trenches. In case of any leakage, the Bidder shall rectify the same by means of injection of non-shrink polymeric water proof grouting compound from inside along with an application of water proof plaster on external surfaces as per approved manufacturer's specification. In addition, PVC water bars of approved quality and make shall be provided at construction joints and expansions joints.



08.00.00 Miscellaneous Item

- 08.01.00 Roof Water Proofing

Roof water proofing treatment shall be as follows:

- a) For roofs having structural slope:

Top surface of sloped R.C.C. slab shall be finished with 15mm thick cement plaster (1:4). Over the finished surface elastomeric membrane shall be laid. The elastomeric shall comprise of high solid content liquid applied urethane laid over reinforcing layer of polyscrim cloth or non woven geo-textile. The top of the elastomeric membrane shall be finished with 20 mm thick cement: sand (1:4) mortar with chicken wire mesh and pressed precast concrete tiles of 20 mm thickness wherever applicable shall be laid over mortar at green stage. Provision for thermal expansion of roofing tiles shall be kept by providing an expansion gap in both directions

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filled up with polysulphide joint sealant. The expansion gap shall be provided in the cement sand mortar underbed layer also.

b) For roofs having no structural slope:



Screed concrete mix (M-15 grade) grading having minimum 25mm thickness at the lowest point of the slope shall be laid over R.C.C. slab and shall be laid as per the slope specified elsewhere in the specification. Top surface of grading underbed shall be finished with 15mm thick cement plaster (1:4). Over the finished surface elastomeric membrane shall be laid and top of the elastomeric membrane shall be finished with 20 mm thick cement: sand (1:4) mortar with chicken wire mesh and pressed precast concrete tiles of 20 mm thickness where applicable shall be laid over mortar at green stage. Provision for thermal expansion of roofing tiles shall be kept by providing an expansion gap in both directions filled up with polysulphide joint sealant. The expansion gap shall be provided in the cement sand mortar underbed layer also

08.02.00 Floor

- i) In general, all floors on ground shall be made reinforced concrete of 150 mm minimum thickness. However, for the production buildings, the design of floor shall be done taking into consideration technological requirements, imposed loading and other service conditions etc. For mill maintenance floor, storage area, etc. vacuum dewatering floor shall be done with concrete.
- ii) All sub-bases shall be laid on compacted/hard subgrade having required soil characteristic.
- iii) In specific areas, of production/storage buildings where concrete floor is not required at ground floor level, the flooring shall consist of minimum 250 mm thick well compacted and rolled sub-base consisting of stone boulder/graded crushed stone blinded with moorum / granulated blast furnace slag or sand as directed, over sub-grade having required soil characteristic.

08.03.00 Roof Details

Roof slab shall be minimum 150 mm thick and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom. 900 mm high and minimum 100 mm thick R. C. C. parapet wall shall be provided over roofs. Parapet wall shall have suitable coping. External face of parapet wall of the buildings provided with metal cladding shall also be finished with metal cladding of design and colour as per approved architectural drawings. Junction of roof and parapet shall be provided with 150 x 150 mm size concrete fillet. Drain level shall be provided with 45 x 45 cm size khurras having minimum thickness of 30 mm of M-15 concrete over PVC sheet of 1 m x 1m x 400 micron and finished with 12 mm 1 :3 cement : sand plaster. Roofs of

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all M. C. C./control rooms, penthouse etc., shall have roof water proofing treatment.

08.04.00



Floors and Grade level details

The floor slabs shall be minimum 150 mm thick and shall have minimum 10 dia HYSD reinforcement bars placed at 200 mm center both ways at top and bottom Floors of transfer points shall have cross slope of not flatter than 1: 80, towards the floor washing drainage outlets, for efficient drainage. For ground conveyor & crusher house slope shall be 1:100. Chequered plates (used for platforms, walkways etc.) shall be minimum 6 mm thick o/p or as indicated on drawings. The chequered plate pattern shall be approved by Owner / Engineer. Mild steel flats/angles of suitable size shall be welded to the bottom portion of chequered plates at a designed spacing to stiffen chequered plates to restrict deflection within span/200. Chequered plates shall be fixed by staggered welding of suitable size. Toe guard of size 100 x 6 mm shall be provided at various openings provided in floors e.g. around stair case openings, chute openings and other similar cutouts. For conveyor walkways, angle runner to act as toe guard shall be provided. All along the periphery of R. C. C. floors (where no brick masonry walls are provided) shall be provided with one brick thick 300 mm high brick wall and 700 mm high steel hand rails all around over this brick work. The grade slab shall consists of 230 mm thick rubble soling (63 mm downgraded hard stone aggregate as per IRC specification, watering and compaction to minimum of 90% Standard Proctor density, including filling the interstices of stone aggregates with sand), over well compacted earth, overlaid by 75 mm thick P. C. C. M-7.5 and 150 mm thick R. C. C. of grade M-20 with minimum 8 mm dia bars placed at 200 mm C / C in either direction respectively. There will be minimum 50 mm thick metallic hardener finish over the R. C. C. slab. All buildings (including reclaim hopper, penthouse, MCC rooms, pump houses, transfer houses and crusher house) and ground conveyors shall be provided with 750 mm wide plinth protection all around. It consists of 50 mm thick P.C.C. M-20 grade with 12 mm maximum size aggregate over 200 mm thick stone soling using 40 mm nominal size rammed, consolidated and grouted with fine sand. An area of 5 m width all round the reclaim hopper, around water tanks near pump house, transfer houses and crusher house shall be paved. This paving will be in addition to plinth protection. The paving construction shall be as per specifications for the grade slab at ground level. However, 50 mm thick metallic hardener finish is not required to be provided in paved area. Plinth level of all buildings shall be kept at least 500 mm above the finished grade / formation level.

08.00.05

Fencing

Fencing with toe wall and steel gates shall be provided around the transformers. Fencing shall comprise of PVC coated GI chain link fencing of minimum 8G (including PVC coating) of mesh size 75 mm and of height 2.4 m above the toe wall. The diameter of the steel wire for chain link fence (excluding PVC coating) shall not be less than 12G. Fence posts shall be of pre – cast R. C. C. of minimum M20 grade. All corner posts will have two stay posts and every tenth post will have transverse stay post. Suitable R. C. C.

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foundation for the post and stays shall be provided based on prevailing soil conditions. Gates shall be sturdy with locking provisions.

Toe walls of brick masonry shall be provided between fence posts all along the run of the fence with suitable foundation. Toe wall shall be minimum 200 mm above the formation level with 50 mm thick P. C. C. coping (1: 1. 5: 3) and shall extend minimum 300 mm below the formation level. Toe wall shall be plastered on both sides and painted with two coats of cement paint of approved colour and shade. Toe wall shall be provided with weep holes at suitable spacing.

- 08.06.00 Bituminous Coating over surface of structures in contact with water /soil
Bituminous coating shall be applied on the inside faces of the water retaining structures and also on that portion of water retaining structure which are in contact with ground water. Surface to be treated shall be absolutely dry, clean and dust free. The surface shall be sand papered, before applying the coating. The external surfaces of concrete which are in contact with ground water shall be applied with hot industrial bitumen conforming to IS : 702, of grade 85 / 25. The rate of application shall not be less than 1.70 Kg / sq.m / coat, in three coats and it should be heated to about 120 degree celsius before application. Anti stripping compound shall be added wherever necessary. After application of third coat and before it is dried up, sand shall be spread on the surface to cover it completely. Sufficient time shall be allowed after spreading sand, before back filling is done in order to allow the final coat to dry up completely. The internal surfaces of water retaining structure which are in contact with water shall be applied with one coat of suitable primer followed by minimum 3 coats of bitumen paint conforming to IS 9862 to achieve a DFT of 150 micron of bitument coat

- 08.07.00 **HAND RAIL**
Minimum 1000 mm high (from floor/ roof level) hand railing shall be provided around all floor/roof openings, projections/balconies, walkways, platforms, steel stairs, etc., wherever the height of the building is more than 12m, railing ht to be 1.2m. All handrails and ladder pipes (except at operating floors) shall be 32 mm nominal bore MS pipes (medium class) conforming to IS:1161 and shall be galvanised as per IS : 4736 and finished with suitable paint. All rungs and ladders shall also be galvanised. Minimum weight of galvanising shall be 610 g/sqm. The spacing of vertical posts shall be maximum 1500mm. Two number of horizontal rails shall be provided including the top member. In addition, toe guard/ kick plate of min size 100x6th shall be provided above the floor level

- 08.08.00 **EARTHING MAT**
40mm Dia. MS rods as earthing mat, placed at a distance of 1.0M away and at depths between 0.60M and 1.00M shall be supplied and laid all around the periphery of buildings, structures, and out doors equipment, as per approved drawings. Riser of 40m Dia. MS rods and connecting to the above Earthing mat shall also be supplied and laid in position by the Bidder, as per the approved drawings. Raiser shall be laid up to a height of 300mm above the local Ground level, at each of the columns of the buildings on the outside of the buildings, and minimum 2 (two) numbers of structures and equipment. The Bidder also

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supply and lay necessary number of 3.0 M deep 40mm Dia.MS rods Earthing electrodes and connecting them to the Earthing mat, as per the approved drawings and supplying and laying of 40 mm Dia.MS rods for connecting the Bidder's earthing mat with the Owner's earthing mat separately of two locations.

08.09.00 VIBRATION ISOLATION SYSTEM

These specifications are meant for the design, supply and erection of vibration isolation system for supporting coal crushers (ring granulators).

08.09.01 Supporting Arrangement

The crushers shall be supported on vibration isolation system consisting of steel helical springs and viscous dampers. The supporting arrangement for each crusher shall consist of an R. C. C. deck supported on steel helical spring units and viscous damper units which in turn shall be supported on girders. The girders shall be an integral part of the crusher house building. The part of the structure consisting of the R. C. C. deck, springs and viscous dampers shall hitherto be referred to as “spring supported foundation”. The part of the structure, which is below the spring shall hitherto be called “supporting structure”.


The Bidder should do the Engineering / design, supply and erection of vibration isolation system consisting of steel helical spring units and viscous dampers supporting the top deck which in turn would support the coal crushers. The vibrations isolation system supplied shall be of a proven make. The Bidder or his sub - contractor who designs and supplies the system should have designed, supplied and installed such systems for not less than five machines of speeds and unbalance forces comparable to the machine proposed by the vendor. The vibration isolation systems installed by the Bidder or his sub - contractor in such machines should have been working satisfactorily for atleast five years.

08.09.02 Engineering

Design of the vibration isolation system using steel helical springs and viscous dampers to support an R. C. C. top deck supporting the coal crusher. This includes the static and dynamic analysis of the vibration isolation system with the R. C. C. top deck and the coal crusher. Structural design of the R. C. C. top deck including preparation of General Arrangement drawings, detailed reinforcement drawings, bar - bending schedules etc. Calculation of loads on the structure supporting the springs and viscous dampers, their points of application and the stiffness requirements of the supporting structure. Drawings showing embedments and their locations and details on the R. C. C. top deck. Drawings showing blockouts, recesses etc. on the top deck. Design of the supporting structure, including preparation of detailed drawings and bill of materials.

08.09.03 Supply including packing and transportation to site

Steel helical spring units and viscous dampers, including associated auxiliaries for installation of the spring units and dampers like steel shims, adhesive pads etc. Frame (s) for pre-stressing of spring elements. Suitable hydraulic jacks

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system including electric pumps, high pressure tubes etc. required for the installation, alignment etc. of the spring units, two extra hydraulic jacks, one hand operated pump and spares for the hydraulic jack system as required.

08.09.04

Erection and Commissioning

Complete erection and commissioning of the vibration isolation system including : Pre-stressing of spring elements, placing of spring elements in position, checking clearances on the shuttering of the R. C. C. top deck, construction of the supporting structure and the R. C. C. top deck, releasing to pre-stress in spring elements and making final adjustments and alignments after machine installation etc. 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 completion of the work for which these specifications are intended. This part of the specifications is for vibration isolation system. For the construction of the supporting structure for the crusher and the top deck, the relevant parts of the specification should be referred to.

08.09.05

Documentation



Submission of detailed design calculation, analysis (static and dynamic) and drawings for Owner's acceptance and approval. Furnishing methodology of providing shuttering and its removal as well as concreting of deck slab, installation of springs and dampers and the sequence of operation. Furnishing installation and maintenance manual indicating equipment, procedure etc., necessary for installation, maintenance of vibration isolation system. Furnishing a check list for confirming the readiness of the civil fronts for the installation of vibration isolation system and equipment required at each stage installation. Bill of materials of various elements such as springs, visco-dampers, with their rating, stiffness etc., included in supply.

Detailed specifications of the vibration isolation system and various items included in the supply and the standard (local or international) to which they conform. Proposed erection strategy of the entire system.

08.10.00

CHEMICAL INJECTION GROUTING

Minimum, 12 mm dia (NB) threaded nozzle of suitable length, shall be provided over the surface and along the construction joint line in a grid pattern at a spacing not exceeding 1.5 m c / c before concreting operation. Adequate precaution shall be taken to keep the nozzles plugged at both ends to prevent them from getting closed by concrete. For fixing of any nozzle in set concrete suitable size hole shall be drilled, preferably by using percussive hammer drill electrically operated, in grid pattern and grouting nozzle shall be fixed in these holes. After the nozzles are fully set, neat cement slurry admixed with water soluble non – shrink polymer / monomer based chemical shall be injected through the net - work of nozzles with low pressure grout pumps at a pressure of about 2.0 Kgs. / cm². Cement slurry shall be prepared by mixing cement with non-shrink polymer/monomer @ 500 gm/50 kg bag of cement and water, ensuring that Water: Cement ratio does not exceed 2 (by weight). Wetter the structure, lesser should be the water cement ratio. The property of the polymer/monomer should be such that when it is mixed with water @0.5% by weight of water, the viscosity of the resultant solution (water and polymer/monomer) should not be more than 1.2 centipoises. Plasticizing agent

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shall be added wherever required. The grouting shall be started at very low pressure and increased gradually to a required pressure. The grouting shall continue, till the hole refuses to take any further grout, even at an increased pressure. Applied pressure shall not be more than the designed strength of the concrete. After completion of grouting operation, the nozzles shall be sealed properly to the satisfaction of the Engineer.

08.11.00 POLYMER MODIFIED CEMENTITIOUS COATING

08.11.01 Materials

Modified liquid polymer blend shall be a dispersion containing 100 % acrylic based polymer solids. Polymer shall be mixed in the ratio of 1 cement: 0.5 polymer (for minimum solid content of polymer 30%). Portland cement based dry powder. Clean, fine specially prepared quartz sand approximately 0.6 mm size.

08.11.02 Mixing



The liquid polymer shall be stirred well and cement based powder shall then be added slowly to make a Slurry Mix. For preparation of Brush Topping Mix, quartz sand shall be added slowly and mixed well till a homogeneous mixture is obtained. The mix shall be used within half an hour of the preparation. Addition of quartz sand may not be necessary, in case dry power contains the same.

08.11.03 Properties of Coating

It must adhere to wet surface. It should develop adequate bond strength, with the concrete surface, not less than 2 N / Sq.mm. Co - efficient of permeability shall be about 5x10⁻¹⁰ Cm / Sec. Water absorption after continuous soaking shall not be more than 1 %.The materials shall be permeable under water vapour.The material shall be resistant to acids and alkalies present in the soil and underground water with normal pH value between 4 and 14. The co - efficient of thermal expansion of the material shall be close to that of concrete.

08.11.04 Application

The concrete surface shall be cleaned and made free from grease, oils or loosely adhered particles. The surface shall be damp without any free water. For exterior underground part, application (b) pertaining to Brush topping Mix shall be followed. (a) For Slurry Mix A minimum of 2 coats shall be applied on the surface. The first coat being applied, when the surface is still damp and left to harden for 4 to 6 hours. After 4 to 6 hours of the application of second coat, it shall be finished by rubbing down with a soft dry sponge. The coverage shall not be less than 1 : 1 Kgs. / m² in the 2 coats. A lap of 75 mm shall be provided at the joints. The coating shall be air dried for 4 to 6 hours and, thereafter, cured for 7 days after the application of last coat. (b) For Brush Topping Mix This shall be applied in two coats. A primary coat of slurry mix can also be first applied on the surface as first coat. After the coating has dried up, a coat of Brush Topping Mix shall be applied over it with a push broom or any other similar brush. It shall be left in broom finished condition. The nominal thickness shall be 1.5 mm and minimum thickness shall be 1.0 mm. A lap of 75 mm shall be provided at the joints. It shall be ensured that no pinhole exists and rebrushing shall be done to cover the pinholes, if any.

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The Coating shall be air dried for 4 to 6 hours and thereafter cured for 7 days after the application of last coat. Rate of application of coating shall be established to achieve the required thickness.

08.12.00 SHOTCRETING

08.12.01 General Requirements



Generally, shotcreting shall be done in accordance with IS : 9012. Reinforcement for shotcreting shall be as detailed below, unless specified otherwise. Reinforcement in one direction consisting of 6 mm M. S. bars at 750 mm c / c shall be connected to the lugs for fastening of the wire fabric. This shall be used in case of 50 mm or above thick shotcreting. Wire fabric conforming to IS : 1566 shall be used as reinforcement and shall consist of wire, 3 mm diameter, spaced 50 mm both ways and shall be electrically cross welded. Wire fabric shall be securely tied to 6 mm bars for 50 mm thickness. Adjacent sheet of wire fabric shall be lapped at least 100 mm and tied. Clear cover to reinforcement mesh shall not be less than 15 mm. Minimum thickness of shotcreting shall be 50 mm. for abrasion resistant work and 25 mm for ordinary surface protection work.

08.12.02 Material

Generally, the materials shall be in accordance with aggregates specification given hereunder. Fine aggregate shall consist of natural sand or crushed stone from a known source and shall be strong, hard, coarse, sharp, chemically inert, clean and free from any coating. It shall be free from clay, coal or coal residue, organic or any other impurities that may impair the strength or durability of the concrete and shall conform to IS : 383. Fine aggregate (Sand) shall be well graded and particles shall range in size within the following limits. The Engineer, may approved the use of any other grading as per requirement or as per IS : 9012. The fineness modulus shall be preferably between 2.5 and 3.3. Any other value can be used, with prior approval of the Engineer.

08.12.03 Application

After the placement of reinforcement and / or welded mesh and not more than six hours prior to the application of shotcrete, the surface shall be thoroughly cleaned of all loose materials and dirt. The Bidder shall properly prepare the surfaces, reinforcement and / or welded mesh to receive the shotcrete. Cleaned surfaces shall be wetted not more than hour prior to shotcreting. The mix as placed on surface shall be one part cement to three parts approved sand by mass. Cement and sand shall be dry mixed; not water shall be added after mixing and before using in the gun. The quantity of water when added shall be only that which is sufficient to hydrate the cement. For average atmospheric conditions, the water cement ratio for shotcrete in place shall be between 0.35 and 0.5 by mass. Suitable admixture shall be used wherever required. A uniform pressure of not less than 3 Kg/cm² at the nozzle shall be maintained. Necessary adjustments shall be made to ensure this pressure, taking into account the length of hose and height of the place to be shotcreted, above location of the machine. The application shall proceed in an upward direction. Beams, stiffeners and intermediate walls, if any, shall be wrapped with wire fabric and completely covered with shotcreting. All rebound shall be

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removed from the area of application as the work progresses and such rebound material shall not be reused. As soon as the freshly shotcreted surface shows the first dry patches, a fine spray of water shall be applied to keep too moist. After the surface has hardened, it shall be kept continuously moist for minimum seven days. If there is extreme heat, especially when accompanied by hot winds, the shotcreted surface, immediately upon completion, shall be covered with burlap or similar covering, which must be kept continuously moist for 14 days after shotcreting. The temperature of the lining shall not be permitted to exceed 38oC during placing and curing.

08.13.00 DRAINS

08.13.01 All drains shall be made of RCC and designed for surcharge loading and provided with pre-cast RCC covers with lifting arrangements as per requirement. All crossing under roads, RCC box culverts or pipe culverts shall be provided.

08.13.02 All manholes, inspection pits, collection pits etc. shall be of reinforced concrete construction with covers for access.

08.13.03 Generally minimum earth coverage of one metre shall be provided over underground drainage sewer pipe lines.

08.14.00 Collapsible Steel Gate



The gates shall be manufactured out of M.S. channel pickets of size 20 x 10 mm and flats 20 x 6 mm.

The top runner flat shall be at least 50x12mm section. The bottom guide shall consist of a channel or two angles of specified size laid in the flooring to guide the free movement of the gate. The gate shall move in the guide channel on rollers of adequate size fixed at top and bottom of the gate. The gate shall be painted with one coat of zinc chromate primer as per IS 2074 before fixing in position and two coats of ready mixed synthetic enamel after erection.

08.15.00 Metal Deck Shuttering

Metal Decking

- (a) Troughed permanently colour coated metal decking sheet of steel for floor/roof decking shall conform to the requirements of Table-1.
- (b) Alternatively aluminium feed material of minimum 0.9 mm (bare metal thickness) thick colour coated aluminium alloy of series 31,000 and above as per IS 737 and IS 1254 can also be used for metal decking.
- (c) Steel/ aluminium alloy shall be colour coated with total coating thickness of 35 microns (nominal) dry film thickness (DFT) comprising of silicon modified polyester (SMP with silicon content 30% to 50%) paint or polyester paint, of 20 microns (nominal) SMP or polyester paint on one side (exposed side) on 5 micron (nominal)

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primer coat and 5 microns (nominal) SMP or polyester paint over 5 micron (nominal) primer coat on the other side. SMP and polyester paint systems shall conform to Product type 4 as per AS/ANZ 2728.

- (d) Sheet shall be of approved profile, sectional properties, colour and shade.
- (e) Chemical composition of troughed permanently colour coated metal decking sheets shall conform to the provisions of the same reference code to which the mechanical properties conform to.
- (f) Mechanical properties shall be confirmed by relevant tests

Table 1

group	Grade/ Reference	Yield strength (min) MPa	Tensile strength (Min)MPa	Elongation % (min) L0=50mm	Coating class Designation L0=80mm	BMT mm	+ve tolerance mm	Upper limit of BMT mm	+ve tolerance mm	Lower limit of BMT mm
I	G250/A S1397	250	320	25	22		.04		-0.04	
	SS255/ ASTM A653M	255	360	18	Z275	0.8	.04	.84	-0.04	0.76
	S250G D/EN10 326	250	330	19			.04		-0.04	
II	G350/A S1397	350	420	15	14		.04		-0.04	
	SS340 CLASS 4/ASTM A653M	340	410	12	Z275	0.6	.04	.64	-0.04	0.56
	S350G D/EN10 326	350	420	16			.04		-0.04	
III	G550/A S1397 SS550/ Class 1	550	2	2	Z275	0.6	.04	.64	-0.04	0.56
	ASTM A653M	550	570	-			.04		-0.04	
	S550G D/EN10 326	550	560	-			.04		-0.04	

- i) For metal decking the sectional modulus and moment of inertia of troughed profile per meter width shall be so as to limit the deflection of sheets to span/250 over a span of 1.7 m under total super imposed loading (DL +LL) of 450 kg per Sq.M. for two span condition. The sectional modulus and moment of inertia of troughed profile shall be computed as per the provisions of IS: 801 for satisfying the deflection and strength requirements. All structural calculations for checking the adequacy of the profiled sheet for strength & deflection criteria is to be done taking into consideration the maximum permissible negative tolerance over the

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specified BMT i.e. the lower limit of BMT is to be considered as per last column in Table -1.



- ii) The sheeting shall be fixed as per the working drawings. Sheets shall be supplied in required sizes (based on purlin spacing) according to the cutting schedule. Generally cutting of sheets to length shall not be permitted at site. Specific approval under exceptional circumstances shall be obtained before cutting of any sheet at site. Power tools shall be used for cutting. Cutting and trimming of small openings which were not finalised at the time of working drawings can be allowed at site. Wherever possible, site cut edges shall be concealed at laps or with flashings. Suitable steel members for stiffening shall be provided at the cut edges. No gas cutting shall be done on the sheet. If any sheet is found with gas cut mark, same shall stand rejected and shall be immediately replaced.
- b) Distorted, blemished or water stained sheets shall not be used.
- c) Before installing decking sheet, it shall be ensured that the purlins are in true planes, correctly placed and securely fixed.
- d) Side and end laps of the sheets shall be made weather proof by securing them with the fasteners not less than 4.0mm diameter with 2.0 mm thick neoprene washer. Maximum spacing of the fasteners should not exceed 500 mm.
- e) Precautions shall be taken during the erection of the sheets to ensure that partially erected decking sheets are protected during inclement weather and damage at all times.
- f) Side and end of decking sheet shall be located and positioned in such a manner as to provide the maximum weather protection taking into account the direction of the prevailing wind.
- g) Length of the sheet shall be such as to cover minimum 3 span purlin spacings.
- h) The roof decking sheets shall be fixed to the purlins with the help of self drilling and tapping type fasteners and neoprene washers
- i) Sheets shall be laid over the supporting purlins with a minimum bearing of 50 mm and end projection of 75 mm at lap joints.
- j) End and side laps between the sheets shall be sufficiently large to ensure the weather tightness. In no case, the end laps shall be less than 150 mm and side laps less than one trough length with proper weather tight arrangement.

08.16.00 False Floor (Cavity Floor)

In general, structural floor slab, where false floor are provided, are lowered as functionally required so that the finished level of false floor is maintained at the same level of adjacent rooms. In case it is not possible to provide drop in structural floor, false floor may be raised with provision of suitable ramps/steps and should be supported on adjustable jacking system.

Clear space available under false floor shall be minimum 300 mm.

To provide dust-free environment in the rooms, entire sub-floor may be rendered smooth with cement slurry trowel and neat cement finish and wall surfaces under

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the false floor may be painted with two coats of synthetic enamel paint over a coat of primer.

The false floor shall provide a rigid and a highly durable load carrying surface constructed generally in square jacks. The flooring system shall be such as to allow any framing members or floor boards to be removed quickly and easily to facilitate complete freedom for laying cables or other services in any direction without removing large section of the floor.

The floor shall be capable of supporting a point load of 70 kg at centre with maximum deflection of 1:250 of span and a minimum distributed load of 750 kg/sq m.

The base of the floor jacks shall be fixed to the sub-floor by special adhesive or plugged and screwed.

A 10 mm thick x 37 mm high teak-wood lining shall be provided around the room where the floor panels meet the wall surfaces with the top of the lining matching with the finished top of floor panels.

A 2 mm thick and 100 mm high homogenous anti-static PVC skirting shall be provided around the room.

False flooring with M.S. channel support system.

False flooring with cement bonded particle boards 600 x 600 x 30 thk. Supported on same grid made by M.S. channel sections on both directions supported on ISMB of required sections fixed to true floor.



08.17.00 False Floor with Jacks

Materials

Floor Jacks : The jacks shall be made out of 19 mm dia bright rods welded to 6 mm thick MS base of size 100 mm x 100 mm. the top part of the jacks shall be threaded and provided with double check nuts and washers to provide for level adjustment of 50 mm minimum. All the MS members shall be galvanized as per recommended practice for hot-dip galvanizing of iron and steel specified in IS : 2629 while threaded portion should be hot-dip galvanized as per IS : 1367 (Part – XIII) . Chromating treatment conforming to IS : 1340 should be employed for providing protection to the coated surfaces.

The jack heads shall be of standard pressure die cast aluminium-zinc alloy component of proper composition.

Stringers : The stringers for supporting the false floor panels shall be made of 40 mm x 40 mm x 3.15 mm thick cold formed steel plates and be finished with electroplated coatings of cadmium conforming to IS : 1572 . Chromating treatment conforming to IS : 1340 should be employed for providing protection to the coated surfaces.

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Floor panels shall be 35 mm thick un-veneered teak wood particle board bonded with BWF type phenol formaldehyde synthetic resin generally conforming to IS : 3087 similar to 'Anchor Novateak Super' or cement bonded particle board conforming to IS : 14276 or any approved equivalent.

All the four edges of the floor panels shall be fitted with edge lipping made of teak wood of rigid PVC of suitable thickness or in combination of TW lipping and hard PVC – Z beading to protect from damage during installation and removed of panels and also to protect from moisture absorption.

22 gauge galvanized iron sheet shall be fixed to the underside of floor panels for moisture resistance as well as to further improve fire resistance quality.

Top of the floor panels shall be provided with 2 mm thick homogeneous PVC sheets conforming to IS : 3462 and having antistatic property similar to "Anstat" of Premier Vinyl Flooring Limited 15 mm thick Agrowood strips of Andaman Timbers Limited or any other approved equivalent.

Workmanship

Entire workmanship shall be carried out in strict accordance with the specification. Rigidity, steadiness and leveling of the false floor system shall be ensured. Painting work for wood surfaces, floor and walls, fixing of PVC sheets on floor panels shall be in accordance with the instructions of the relevant manufacturers.

08.18.00 False Flooring with Structural Post

The supporting arrangement of false floor shall be by ISMC 100 with 150 x 150 x 8 thick MS base plate fixed to concrete sub-floor @ 2000 c/c both ways and with 150 x 150 x 8 thick base plate @ 600 c/c walls.

09.00.00 Services and Facilities

09.01.01 Fire Protection Facilities

Building shall be provided with fire protection facilities as per LPA Norms.


09.01.02 Safety measures

Necessary grills, railing, protective paint coatings shall be provided as per requirements.

09.01.03 Toilet facilities

Separate toilets for ladies and gents are to be provided on each floor/wing of the building as per requirements Minimum one set of fittings shall be provided in each toilet. Sanitary facilities shall be as per following norms.



09.01.04 Environmental Norms

	<p align="center">NTPC SAIL POWER COMPANY (P) LIMITED ROURKELA POWER PROJECT (PP – III : 1X250 MW)</p> <p align="center">TECHNICAL SPECIFICATION FOR EPC PACKAGE</p>	
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The building design has to be evolved taking into account the climatic and environmental factors prevailing in the Project site. The building fenestrations have to be designed to provide adequate protection to window/door openings etc. (like chajjas, fins, roof projections) against sun and rain.

10.00.00 LIST OF RELEVANT I.S CODES



I.S CODE NO.	TITLE
IS:269	Specification for 33 grade ordinary portland cement.
IS:383	Specification for coarse and fine aggregates from natural sources for concrete.
IS:432 (PART-1)	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement - mild steel and medium tensile steel bars.
IS:432 (PART-2)	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement - hard drawn steel wire.
IS:455	Specification for portland slag cement.
IS:456	Code of practice for plain and reinforced concrete.
IS:458	Specification for precast concrete pipes (with or without reinforcement).
IS:651	Specification for salt glazed stone ware pipes and fittings.
IS:783	Code of practice for laying of concrete pipes.
IS:814	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel.
IS:816	Code of practice for use of metal arc welding for general construction in mild steel.
IS:875 (PART-1)	Code of practice for design loads (other than earthquake) for buildings and structures - dead loads.
IS:875 (PART-2)	Code of practice for design loads (other than earthquake) for buildings and structures- imposed loads.
IS:875 (PART-3)	Code of practice for design loads (other than earthquake) for buildings and structures - wind loads.
IS:875 (PART-5)	Code of practice for design loads (other than earthquake) for buildings and structures - special loads and load combinations.
IS:1003 (PART-1)	Specification for timber panelled and glazed door shutters door shutters.
IS:1003 (PART-2)	Specification for timber panelled and glazed shutters – windows and ventilator shutters.
IS:1038	Specification for steel doors, windows and ventilators.
IS:1080	Code of practice for design and construction of shallow foundations on soil (other than raft, ring and shell).
IS:1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.

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I.S CODE NO.	TITLE
IS:1172	Code of basic requirements for water supply, drainage and sanitation.
IS:1230	Cast iron rain water pipes and fittings.
IS:1343	Code of practice for prestressed concrete.
IS:1346	Code of practice for water proofing of roofs with bitumen felts.
IS:1361	Specification for steel windows for industrial buildings.
IS:1609	Code of practice for laying damp proofing treatment using bitumen felts.
IS:1742	Code of practice for building drainage.
IS:1786	Specification for high strength deformed steel bars and wires for concrete reinforcement.
IS:1826	Specification for Venetian blinds for windows.
IS:1893	Criteria for earthquake resistant design of structures.
IS:1904	Code of practice for design and construction of foundations in soil : General requirement.
IS:1905	Code of practice for structural use of un-reinforced masonry.
IS:1948	Specification for aluminium doors, windows and ventilators.
IS:2062	Structural steel (fusion welding quality).
IS:2191(PART-1)	Specification for wooden flush door shutters (cellular and hollow core type)-plywood face panels
IS:2191 (PART-2)	Specification for wooden flush door shutters (cellular and hollow core type) - particle board and hard board face panels.
IS:2202 (PART-1)	Specification for wooden flush door shutters (solid core type) - plywood face panels.
IS:2202 (PART-2)	Specification for wooden flush door shutters (solid core type) - particle board and hard board face panels.
IS:2204	Code of practice for construction of reinforced concrete shell roof.
IS:2210	Criteria for design of reinforced concrete shell structures and folded plates.
IS:2470 (PART-1)	Code of practice for installation of septic tanks - design criteria and construction.
IS:2470 (PART-2)	Code of practice for installation of septic tanks - secondary treatment and disposal of septic tank effluent.
IS:2751	Welding of mild steel plain and deformed bars for reinforced concrete construction.
IS:2911(PART-1/SEC-1)	Code of practice for design and construction of pile foundations- driven cast in-situ concrete piles.
IS:2911 (PART-1/SEC-2)	Code of practice for design and construction of pile foundations - bored cast in-situ concrete piles.
IS:2911 (PART-1/SEC-3)	Code of practice for design and construction of pile foundations - driven precast concrete piles.
IS:2911 (PART-1/SEC-4)	Code of practice for design and construction of pile foundations - bored precast concrete piles.
IS:2911 (PART-3)	Code of practice for design and construction of pile foundations - under reamed piles.
IS:2911 (PART-4)	Code of practice for design and construction of pile

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I.S CODE NO.	TITLE
	foundations - load test on piles.
IS:2950 (PART-1)	Code of practice for design and construction of raft foundations - design.
IS:2974 (PART-1)	Code of practice for design and construction of machine foundations - foundations for reciprocating type machines.
IS:2974 (PART-2)	Code of practice for design and construction of machine foundations - foundations for impact type machines (Hammer foundations).
IS:2974 (PART-3)	Code of practice for design and construction of machine foundations - foundations for rotary type machines (medium and high frequency).
IS:2974 (PART-4)	Code of practice for design and construction of machine foundations - foundations for rotary type machines of low frequency.
IS:2974 (PART-5)	Code of practice for design and construction of machine foundations - foundations for impact type machines other than hammers (forging and stamping press, pig breakers, drop crusher and jolter).
IS:3006	Specification for chemically resistant glazed stone ware pipes and fittings.
IS:3067	Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.
IS:3114	Code of practice for laying of cast iron pipes .
IS:3370 (PART-1)	Code of practice for concrete structures for the storage of liquids - general requirements.
IS:3370 (PART-2)	Code of practice for concrete structures for the storage of liquids - reinforced concrete structures.
IS:3370 (PART-4)	Code of practice for concrete structures for the storage of liquids - design tables.
IS:3414	Code of practice for design and installation of joints in buildings.
IS:3614 (PART-1)	Specification for fire check doors - plate, metal covered and rolling type.
IS:3764	Excavation work - code of safety.
IS:4021	Specification for timber door, window and ventilator frames.
IS:4111 (PART-1)	Code of practice for ancillary structures in sewerage system.
IS:4127	Code of practice for laying of glazed stone ware pipes.
IS:4326	Code of practice for earthquake resistant design and construction of buildings.
IS:4351	Specification for steel door frames .
IS:4913	Code of practice for selection, installation and maintenance of timber doors and windows.
IS:4962	Specification for wooden side sliding doors.
IS:4998 (PART-1)	Criteria for design of reinforced concrete chimneys - assessment of loads.
IS:6163	Centrifugally cast (spun) iron low pressure pipes for water, gas, sewage.

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I.S CODE NO.	TITLE
IS:6248	Specification for metal rolling shutters and rolling grills.
IS:6494	Code of practice for water proofing of underground water reservoirs and swimming pools.
IS:7452	Hot rolled steel sections for doors, windows and ventilators.
IS:11504	Structural design of reinforced concrete natural draught cooling towers.
IS:771	Specification for glazed earthenware sanitary appliance (line water closets and urinals wash basins, sink etc.)
IS:774	Specification for flushing cistern for water closets and urinals (valveless syphonic type).
IS:778	Specification for gun metal gate, globe & check valves for water, steam & oil only (not intended for use in Petroleum industry).
IS:781	Specification for sand cast brass screw -down bib taps and stop taps for water services.
IS:782	Specification for caulking lead.
IS:1239	Specification for mild steel tubes, tubulars and other wrought steel fittings (Part-I Mild Steel Tubes).
IS:1580	Bituminous compounds for water proofing and caulking purposes.
IS:2326	Specification for automatic flushing cistern for urinals.
IS:2548	Specification for plastic water closet seats and covers.
IS:13311(Part-1)	Non-destructive testing of concrete.
IS:1077	Specification for common burnt clay building bricks.

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(SECTION-3)

GENERAL SPECIFICATION FOR **CIVIL ENGINEERING WORKS**

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SPECIFICATION FOR CIVIL ENGINEERING WORKS



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PART – I (MATERIALS)

1.0 GENERAL

1.1 Scope

This part deals with the requirements of materials for use in construction work with regard to quality, testing, approval and storage, before they are used on work. This part is supplementary to Part-II: Workmanship and Other requirements of the Technical Specifications for civil works.

1.2 Standard

A high standard of quality is required for all materials used in construction work. They shall be the best of the kind obtainable indigenously in each case and shall be procured from manufacturers of repute in order to ensure uniformity of quality and assurance of timely supply.

1.3 Approval and Tests

1.3.1 All materials to be used in construction shall be subject to approval of the Engineer. The Bidder shall supply sufficiently in advance with samples of the materials including the supporting test results from the approved laboratory and other documentary evidence from the manufacturer wherever applicable and indicating the types of materials and their respective sources. The delivery of materials at site shall commence only after the approval of the quality, grading and sources of the materials by the Engineer.



1.3.2 The quality of all materials once approved shall be maintained throughout the period of construction and periodical tests shall be carried out to ensure that it is maintained. Such routine tests shall be listed under the different materials and/or as may be ordered by the Engineer from time to time.

1.3.3 Where a particular "Brand" or "Make" of material is specified in the Schedule of Items or Technical Specifications, such "Brand" or "Make" of material alone shall be used on the work. Should it become necessary for any reason (such as non-availability/ceased to be produced), to use any material other than the specified "Brand" or "Make", the Bidder shall submit sample of the same to the Engineer for approval together with test certificates and other documents necessary for examining and giving approval thereof.

1.4 Codes

1.4.1 The years of publication against various standards, referred in this specification, correspond to the latest standards as on date of preparation of this specification. During use of this specification in future, the latest publication as on date shall be referred to. Where standards are not yet published by the BIS or IRC, adoptable British Standards or other International Standards shall apply.

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- 1.4.2 In case of any conflict in meaning between these specifications and those of BIS or IRC, or British /International Standard; the provisions of these specifications shall prevail.

1.5 Rejection of Materials

- 1.5.1 Any material brought to site which, in the opinion of the Engineer is damaged, contaminated, deteriorated or does not comply with the requirement of this specification shall be rejected.
- 1.5.2 If the routine tests or random site tests show that any of the materials, brought to site, do not comply in any way with the requirements of this specification or of I.S. Codes as applicable, then that material shall be rejected.
- 1.5.3 The Bidder at his own cost shall remove from site any and all such rejected material within the time specified by the Engineer.

2.0 MATERIALS FOR CONCRETE

2.1 Aggregates

- 2.1.1 Aggregates shall comply with the requirements of IS: 383 "Coarse and Fine Aggregates for Concrete". They shall be hard, strong, dense, durable, clean and free from veins and adherent coating, vegetable matter and other deleterious substances; and shall be obtained from approved sources. Aggregates shall not contain any harmful material such as pyrites, coal, shale or similar laminated material, clay, alkali, soft fragments, sea shells and organic impurities in such quantity as to affect the strength or durability of concrete. Aggregates which are chemically reactive with alkalies of cement shall not be used. Aggregates which are not sufficiently clean shall be washed in clean fresh water to the satisfaction of the Engineer.



2.1.2 Testing

All aggregates shall be subject to inspection and testing. The Bidder shall submit samples for testing as may be required by the Engineer. Sampling and testing shall be carried out in accordance with IS: 2386 "Methods of Test for Aggregates for concrete".

2.1.3 Grading

The Bidder shall ensure that the full range of aggregate used for making concrete is graded in such a way as to ensure a dense workable mix. The delivery of aggregates will commence only when the Engineer has approved the samples and the quality and grade shall be maintained consistent and equal to the approved sample. Before construction commences, the Bidder shall carry out a series of tests on the aggregates and on the concrete made therefrom to determine the most suitable grading of the available aggregates. Once the most suitable grading has been found, the grading shall be adopted

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for the construction of the works and periodic tests shall be carried out to ensure that it is maintained.

2.1.3.1 Size and grading of fine aggregates

The grading shall conform to IS: 383 and shall be within the limits of Grading Zone-III. The maximum size of particle shall be 4.75mm and shall be graded down. Sand containing more than 10% of fine grains passing through 150 micron sieve or having the fineness modulus less than 2 shall not be used for concrete work.

2.1.3.2 Size and grading of coarse aggregates

The nominal maximum size of the aggregates for each mark of concrete or for each type of work shall depend upon the description of the particular item in the Specified Items and/or according to relevant clauses of IS: 456. The aggregates shall be well graded and the grading shall conform to relevant requirements of IS: 383 depending upon the maximum nominal size as specified or as required.

2.1.3.3 Fine aggregate for mortar and grout

The grading of fine aggregate for mortar and grout shall be within the limits of grading zone III and IV as defined in IS: 383.

2.1.4 Storage & stacking

Care shall be taken in the storage to avoid intrusion of any foreign materials into the aggregates and where two types of aggregates are stored close to each other, they shall be separated by a wall or plate. In case of stockpiling, care shall be taken to avoid forming pyramids resulting in segregation of different sized materials. The height of the stacks shall be generally limited to 150 cm.

2.2 Coarse Aggregates



2.2.1 Types

The type of coarse aggregate viz., stone chips, gravel or broken brick shall be as described in the Technical Specification. Unless otherwise specified stone chips shall be used as coarse aggregate.

2.2.2 Stone chips

It shall be crushed or broken from hard stone obtained from approved quarries of igneous or metamorphic origin. The stone chips shall be hard, strong, dense, durable and angular in shape. It shall be free from soft, friable, thin, flat, elongated or laminated and flaky pieces and free from dirt, clay lumps, and other deleterious materials like coal, silt, soft fragments, and other foreign materials which may affect adversely the strength & durability of concrete. The

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total amount of deleterious /foreign materials shall not exceed 5% by weight according to relevant clause of IS: 383. If found necessary the stone chips shall be screened and washed before use.

2.2.3 Gravel

It can be either river bed shingle or pit gravel. It shall be sound, hard, clean, irregular in shape and suitably graded in size with or without some broken fragments. It shall be free from flat particles, powdered clay, silt, loam and other impurities. Before using, the gravel shall be screened and washed to the satisfaction of the Engineer. However, the foreign/deleterious materials shall not exceed 5% by weight.

2.2.4 Broken bricks / Brick aggregates

These shall be obtained by breaking well burnt or over burnt dense brick bats. They shall be homogeneous in texture, well graded in size, roughly cubical in shape, clean and free from dirt, clay, silt or any other deleterious matter. Before use, these shall be screened.

2.3 Fine Aggregates

2.3.1 Unless specified otherwise it shall either be natural river sand or pit sand.



2.3.2 Sand shall be clean, sharp, strong, angular and composed of hard siliceous material. It shall not contain harmful organic impurities in such form or quantities as to affect adversely the strength and durability of concrete. Sand for reinforced concrete shall not contain any acidic or other impurities which are likely to attack steel reinforcement. The percentage of all deleterious materials including silt, clay etc., shall not exceed 5% by weight. If directed, sand shall be screened or washed before use to the satisfaction of Engineer.

2.3.3 Crusher dust

Crusher stone dust (that is retained on 300 micron sieve) may be used as replacement for certain quantum of sand aiming to improve the fineness modulus of fine aggregate. The quantum of replacement for sand shall be arrived at by suitable trial mixes. The Engineer will decide the final usage of crusher dust depending on the circumstances.

2.4 Lime

Lime for mortars and concrete shall conform to IS: 712 The total of CaO and MgO content in quick lime shall not be less than 85% (MgO shall not exceed 5%). Quicklime, after slaking, shall leave a residue of not more than 5% by weight on IS sieve 85.

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2.5 Surkhi

Surkhi used in lime concrete for flooring, terracing etc., shall conform to IS: 3182 Surkhi shall be made from well burnt bricks or brickbats. Surkhi shall pass through I.S. sieve 3.35mm with at least 50 % of it passing through I.S. sieve 1.70mm and be perfectly clean and free from foreign matter. Surkhi shall not be made from bricks which have come in contact with any mortar.

2.6 Cement

Portland cement -43 grade / Portland slag cement /Portland Pozzolana cement complying with the requirements of IS:8112 I.S. 455 and IS: 1489 respectively shall be used for making plain and reinforced concrete, cement grout and mortar.

Other types of cement may be used depending upon the requirements of certain jobs with the approval of the Engineer. These shall conform to the following standards :

Rapid Hardening Portland Cement	IS: 8041
53 Grade Ordinary Portland Cement	IS: 12269
Hydrophobic Portland Cement ..	IS: 8043
High alumina cement for structural work	IS: 6452
White portland cement	IS: 8043
Sulphate Resisting Portland Cement	IS: 12330

2.6.1 Testing of samples



The Bidder shall supply a copy of the manufacturer's test certificate for each consignment of cement supplied by him and consignments shall be used on work in the order of delivery. The Bidder shall supply samples of cement to the Engineer as frequently as he may require for testing. The sampling of cement for testing shall be according to IS: 3535. All tests shall be in accordance with the relevant clauses of IS: 4031 (Part-I to Part-15) & IS: 4032.

2.6.2 Bidder's responsibility

From the time a consignment of cement is delivered at site and tested and approved by the Engineer until such time as the cement is used on the works, the Bidder shall be responsible for keeping the same in sound and acceptable condition and at his expense and risk. Any cement which deteriorates while in the Bidder's charge and is rejected as unsuitable by the Engineer shall be removed from the site to outside the limits of work at the cost of bidder within two days of ordering such removal by the Engineer.

2.6.3 Stock of cement

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In order to ensure due progress, the Bidder shall at all times maintain on the site at least such stock of cement as the Engineer may from time to time consider necessary. No cement shall be used upon the works until it has been accepted as satisfactory by the Engineer.

2.6.4 Storage of cement

The cement shall be stored in such manner as to permit easy access for proper inspection and in a suitable weather-tight, well ventilated building to protect it from dampness caused by ingress of moisture from any source. Different types of cement shall be stored separately. Cement bags shall be stacked at least 15 to 20 cm clear of the floor leaving a space of 60 cm around the exterior walls. The cement shall not be stacked more than 10 bags high. Each consignment of cement shall be stacked separately to permit easy access for inspection. Cement shall not be stored for more than 90 days.

2.7 Water

River water shall be supplied by M/S NTPL for construction purpose. Water for construction purpose shall be stored in proper storage tanks to prevent any organic impurities getting mixed up with it.

2.8 Admixture for Concrete

2.8.1 Approval

Admixtures to concrete shall not be used without the written consent of the Engineer. When permitted, the Bidder shall furnish full details from the manufacturer and shall carry out such test as the Engineer may require before any admixture is used in the work.

2.8.2 Types

2.8.2.1 Integral water proofer



Admixtures used as integral water proofer shall be free of chlorides and sulphates and shall conform to IS: 2645. The application and doses shall be as per manufacturer's specification.

2.9 Interval of Routine Test

2.9.1 The routine tests of materials, delivered at site, shall be at the following intervals :

Aggregates - Fortnightly or for every 200 m³ for each aggregate whichever is earlier and in other respects generally as per IS : 2386 (Part 1 to 8).

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- Cement - Fortnightly or for each consignment, within 4 days of delivery and in other respects generally as per IS : 4031.
- Water - Once in two months for each source of supply and in other respects generally as per IS : 456.
- Reinforcement - For each consignment within 4 days of delivery in accordance with I.S. 1786, I.S. 1599 and I.S. 1608.

3.0 STEEL



3.1 For Reinforcement

Reinforcing bars for concrete shall be Corrosion Resistant bars (manufactured by reputed companies of the following types as may be shown on the drawing :

- Plain mild steel bars conforming to Grade-I of IS : 432 "Mild Steel & Medium Tensile Steel for Concrete Reinforcement".
- "Corrosion resistant steel with properties conforming to IS : 1786 for Concrete Reinforcement".
- Reinforcement fabrics conforming to IS:1566 "Hard Drawn Steel Wire Fabric for Concrete Reinforcement"

All reinforcement bars shall be of uniform cross sectional area and be free from loose mill scales, dust, loose rust, coats of paint, oil or other coatings which may destroy or reduce bond. Unit weight of reinforcement bars conforming to I.S. 1786 is as given below.

Nominal Size (Dia) (mm)	Mass Per Metre Run (Kg)
6	0.222
8	0.395
10	0.617
12	0.888
16	1.580
18	2.000
20	2.470
22	2.980
25	3.850
28	4.830
32	6.310

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3.2 Binding wire

Binding wire for reinforcement shall be annealed steel wire 16/18/20 BWG conforming to IS : 280 "Specification for Mild Steel Wire". The number of strands shall be as per IS Specification.

3.3 Light structural work and inserts

Steel for light structural work and for preparation of inserts and embedments shall conform to IS: 2062 "Steel for general structural purposes - Specification."

3.4 Steel Tubes

Steel tubes for use in light structural work and inserts shall be of light or medium class (as may be specified in drawings or the schedule of items) and of grade YST 25 conforming to IS : 1161 "Specification for Steel Tubes for Structural Purposes".

3.5 Foundation Bolts

3.5.1 Bolts to be embedded in concrete shall, unless otherwise detailed in drawings, conform to IS : 5624 "Specification for Foundation Bolts". Material for bolts, shall, unless otherwise mentioned in drawings or the schedule of items, be of steel conforming to IS : 2062.



3.5.2 Nuts and locknuts shall conform to IS : 1363 (Part 1 to 3) "Specification for Black Hexagon Bolts, Nuts and Lock Nuts (Diameter 6-39 mm) and Black Hexagon Screws "Specification for Hexagon Bolts and Nuts (M-42 to M-150)".

3.5.3 Plain washers shall conform to IS : 2016 "Specification for Plain Washers and spring washers shall conform to IS : 3063 "Spring Washers for Bolts, Nuts & Screws".

3.6 Steel Tubes for Non-structural use

3.6.1 Steel tubes for non-structural use shall conform to IS : 1239 (Part-I) "Specification for Mild Steel Tubes, Tubular and Other Wrought Steel fittings, Part-I : Mild Steel Tubes".

3.6.2 Fittings for steel tubes used for non-structural purposes shall conform to IS : 1239 (Part-II) "Specification for Mild Steel Tubular and Other Wrought Steel Pipe Fittings".

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3.7 Threaded Fasteners

Bolts and nuts for fastening shall conform to IS:1367 (Part 1) "Technical Supply Conditions for Threaded Fasteners".

3.8 Testing

Test certificates from manufacturer shall be submitted for each consignment. Any additional test which the Engineer may require shall be done according to IS : 1786, 1566, 280, 2062, 1161, 2614, 3063, 1239 (Part 1 and 2) and 1367.

3.9 Cast Steel

3.9.1 Quality

Cast steel shall conform to IS : 1030 "Carbon Steel Casting for General Engineering Purpose". Unless otherwise specified, it shall conform to Grade2.

3.10 Conduits

3.10.1 Steel for electrical wiring

Rigid steel conduits for electrical use shall conform to IS : 9537 (Part 2) for rigid pipes and to IS : 3480 for flexible conduits. Fittings for conduits shall conform to IS : 2667.

All conduit pipes shall be finished with galvanised or stove-enamelled surface. All accessories shall be of threaded type and pipes shall be jointed by means of screwed couplers only. Bend in conduits shall be made to the dimension shown in drawing, but a minimum of 12 times the diameter. Where shown in drawing they shall be treated with anticorrosive preservative as specified.

3.10.2 Non-metallic conduit for electrical wiring

Non-metallic conduits for electrical use shall conform to IS : 9537 (Part 3) for rigid pipes and to IS : 6946 for flexible pipes. Fittings shall conform to IS : 3419.

Bends shall be achieved by bending the pipes by inserting suitable solid or inspection type normal bends, elbows or similar fittings.



4.0 ASBESTOS CEMENT PRODUCTS

4.1 General

Asbestos cement products shall be free from visible defects, uniform in colour, of required density, length, thickness and diameter within the allowable tolerance. They shall be obtained from an approved source of manufacture and stored safely. Methods of test shall be according to IS:5913 "Method of Test for Asbestos Cement Products."

4.2 Building Boards

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These shall be of Class A, B and C with board thickness being 6.5mm, 5mm and 4mm respectively. The length shall be 2400, 1800 and 1200mm and width in all cases 1200 mm. Building boards shall conform to IS : 2098 "Asbestos Cement Building Boards". They shall, when tested in two perpendicular directions, take a load of not less than 15 kgf for Class-A and 10 Kgf for Class-B and Class-C boards. The boards shall show water absorption of not more than 40% of their dry weight.

4.3 Flat Sheets

Flat sheets shall conform to IS : 2096 "Asbestos Cement Flat Sheets". They shall have a bending stress of not less than 225 kgf/cm² & a density of 1.6 kg/dm³ for compressed sheets & a bending stress of not less than 160 kgf/cm² and a density of 1.2 Kg/ dm³ for uncompressed sheets. Nominal thickness shall be 5, 6, 8, 10 and 15 mm, length 2400, 1800 and 1200mm and width 1200mm. Water absorption shall not exceed 28% of dry wt.

4.4 Pipes and fittings

Pressure pipes shall conform to IS : 1592 "Asbestos Cement Pressure Pipes" and to IS : 9627 "Asbestos Cement Pressure Pipes (Light Duty)". Pipes for sewerage and drainage shall conform to IS : 6908 "Asbestos Cement Pipes and Fittings for Sewerage and Drainage ". Building pipes gutters and fittings shall conform to IS : 1626 - (Part 1 to 3) "Asbestos Cement Building pipes and pipe fittings".

Pressure pipes shall satisfy Hydraulic test and transverse crushing test as per IS : 5913.



4.5 Corrugated and Semi-Corrugated Sheets

These shall conform to IS : 459 "Unreinforced Corrugated and Semi-Corrugated Asbestos Cement Sheets". Unless otherwise stated the sheets shall be corrugated and not less than 6mm thick. The sheets shall have a load bearing capacity of not less than 5 N/mm width of specimen and shall not absorb more water than 28% of its dry weight. Overall width of corrugated sheets is 1050mm and of semi-corrugated sheet is 1100mm.

4.6 Asbestos Cement Roof fittings

These shall conform to IS : 1626 (Part 3). Shapes and dimensions shall be as given in the above mentioned code. All finished products shall be free from visual defects that impair appearance or serviceability. Surface of fittings shall be of uniform texture and shall have neatly trimmed edges. Mean water absorption shall not be more than 28% of dry mass of the material.

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5.0 BRICK AND STONES

5.1 Bricks

Bricks for masonry in foundations, walls and other locations shall be common burnt clay building bricks having minimum crushing strength of 5 N/sq.mm., or such other strength as may be described in the Schedule of Items, when tested in accordance with IS : 1077 "Common Burnt Clay Building Bricks". They shall be sound, hard and thoroughly well burnt, with uniform size having rectangular faces with parallel sides and sharp straight right angled edges and be of uniform colour with fine compact uniform texture. Bricks shall be of uniform deep red cherry or copper colour. They shall be free from flaws, cracks and nodules of free lime. Water absorption after 24 hours immersion in cold water shall be not more than 20% by weight. They shall not absorb more than 10% by weight of water after immersion for six hours. They shall emit a clear metallic ringing sound when struck by a mallet and shall not break when dropped on their face, from a height of 60 cm. Fractured surface shall show homogeneous, fine grained uniform texture, free from cracks, air holes, laminations, grits, lumps of lime, efflorescence or any other defect which may impair their strength, durability, appearance and usefulness for the purpose intended. Underburnt or vitrified bricks shall not be used. Samples of bricks brought to the site shall be tested periodically for compression and other tests according to IS : 3495 (Parts-1 to 4) "Method of Test for Burnt Clay Building Bricks". Where the size of bricks is not specifically mentioned, it shall be taken to mean conventional sizes as is commonly available in the area. In case modular bricks are to be used, it shall be accordingly specified in Schedule of Items. The bricks shall be classified on the basis of average compressive strength as given in table 1 of IS : 1077.

5.2 Handling

Bricks shall be unloaded by hand and carefully stacked and all broken bricks shall be removed from the site.



5.3 Samples and Inspection

Representative samples shall be submitted by the bidder and approved samples retained by the Engineer for comparison and future reference. Bricks shall be obtained from approved manufacturer. All bricks shall be subject to inspection on the site and shall be to the approval of the Engineer who may reject such consignment as are considered by him to be inferior to the quality specified. The Bidder shall provide all labour and plant required for the inspection and conduct such test as shall be required by the Engineer without additional charges.

5.4 Brick Bats

Brick bats shall be obtained from well burnt bricks of approved quality.

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5.5 Laterite Stone Blocks

These shall conform to IS : 3620 "Laterite Stone Blocks for Masonry". The laterite stone blocks shall have a minimum compressive strength of 30 kg/cm² and to be tested as per IS : 1121. The blocks shall be minimum 15 cm thick but not exceeding 30 cm. They shall be dressed to the desired sizes and shapes with an axe. Laterite stones shall be well seasoned by exposure to air before dressing and using on work.

5.6 Stone (granite, trap, sandstone, quartzite etc.)

5.6.1 Stone used shall be strong, durable, dense, compact, close grained, homogeneous, fire resistant and shall be obtained from sources approved by Engineer. Stones shall additionally be hard, sound, free from cracks, decay and other flaws or weathering and shall be easily workable. Stones with round surfaces shall not be made use of.

5.6.2 Stones shall have a crushing strength of not less than 200 kg/cm². Stones with lesser crushing strength may be used in works with prior approval of the Engineer. Stones shall be non-porous and when tested in accordance with IS : 1124 "Method of Test for Determination of Water Absorption Etc.," shall show water absorption of less than 5% of its dry weight when soaked in water for 24 hours. Tests for durability and weathering shall be done in accordance with IS : 1126 and IS : 1125 respectively. The working of stones to required sizes and their dressing shall be as per IS : 1127 "Recommendations for dimensions and workmanship of natural building stones for masonry work" and IS : 1129 "Dressing of Natural Building Stones". Stones especially limestone and sand stones shall be well seasoned by exposure to air before use in construction works.



5.6.3 Size

Normally stones shall be of size that could be lifted and placed by hand, between 20 to 30 kg per piece. The length of stones shall not exceed 3 times the height and the breadth on base shall not be greater than 3/4 of the thickness of wall or less than 15cm. The height of stone may be upto 30cm.

5.6.4 Dressing

5.6.4.1 Random rubble

Stones shall be hammer dressed on the face, the sides, and the beds to enable it to come into close proximity with the neighbouring stone. The bushings in the face shall not project more than 4cm on all exposed faces and 2cm on a face to be plastered, nor shall it have depressions more than 1cm from the average wall surface.

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5.6.4.2 Coursed rubble - First sort

Face stones shall be hammer dressed on all beds, and joints, so as to give them approximately rectangular block shape. These shall be squared on all joints and beds. The bed joint shall be rough chisel dressed for atleast 5cm back from the face, and side joints for atleast 4cm such that no portion of the dressed surface is more than 6mm from a straight edge placed on it. The bushing on the face shall not project more than 4cm as an exposed face and one cm on a face to be plastered. The hammer dressed stone shall also have a rough tooling for a minimum width of 2.5cm along the four edges of the face of the stone, when stone work is exposed.

5.6.4.3 Coursed rubble - Second sort

Dressing shall be as specified in 5.6.4.2 except that no portion of dressed surface shall exceed 10mm from a straight edge placed on it as against 6mm for first sort.

5.6.4.4 Stone for veneering

Stone lining upto 8cm shall be treated as veneering work. The stone shall be cut into slabs or required thickness along the planes parallel to the natural bed. Every stone shall be cut to the required size and shape so as to be free from any waviness and to give truly vertical and horizontal joints. Adjoining faces shall be fine chisel dressed to a depth of a 6mm, so that when checked with a 60cm straight edge, no point varies from it by more than 1mm. All edges shall be chisel dressed to be true, square and free from chippings. Top and bottom faces shall be dressed to within 3mm tolerance and vertical faces to within 6mm tolerance, when checked with a 60mm straight edge. Dressing at the back shall not be done.

5.7 Hollow and Solid Concrete Blocks



5.7.1 Cement concrete blocks used in the construction of concrete masonry load bearing as well as non-load bearing walls shall conform to the requirements of IS : 2185 (Part 1). Physical properties such as density, compressive strength, water absorption etc., shall be determined in accordance with the procedure laid down in IS : 2185 (Part 1) and shall conform to the requirement laid therein. When inspected visually all blocks shall be sound, free from cracks, broken edges, honeycombing and other defects which would interfere with the proper placing of blocks or impair strength or permanence of construction.

5.7.2 Dimensions and tolerance

The blocks shall be made in sizes and shapes to suit the particular job and shall include stretcher, corner, double corner or pier, jamb, header, bullnose and floor units.

5.7.2.1 The nominal dimensions of concrete block shall be as follows :

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Length : 400, 500 or 600mm
Height : 200 or 100mm
Width : 50, 75, 100, 150, 200, 250 or 300mm

In addition, blocks shall be manufactured in half and other suitable lengths and shapes to suit Architectural requirements.

- 5.7.2.2 The maximum dimensional tolerances shall be plus or minus 5mm in length and plus or minus 3mm in height and width.

5.7.3 Hollow blocks (open and closed cavity)

- 5.7.3.1 The blocks having solid material about 50% to 75% of total volume of the block calculated from the overall dimensions shall be termed as hollow blocks. Grade-A blocks used as load bearing units shall have a minimum block density of 1500 kg/m³ and shall have minimum average compressive strength of 3.5, 4.5, 5.5 or 7.0 N/mm² at 28 days as specified.

- 5.7.3.2 Grade-B Blocks used as load bearing units shall have block density less than 1500 kg/m³, but not less than 1000 kg/m³ and shall have compressive strength of 2.0, 3.0, or 5.0 N/mm² or as specified.

- 5.7.3.3 Grade-C blocks used as non load bearing units shall have block density less than 1500 kg/m³, but not less than 1000 kg/m³ and compressive strength of 1.5 N/mm² at 28 days.

5.7.4 Solid blocks



The blocks having solid material more than 75% of the total volume of the block shall be termed as solid block. Solid blocks (Grade-D) used as load bearing units shall have a block density of not less than 1800 kg/m³ and compressive strength of 4.0 or 5.0 N/mm² as specified.

5.7.5 Mix proportion

The concrete mix used for blocks shall not be richer than one part by volume of cement to six parts by volume of combined aggregates before mixing.

5.7.6 Surface texture and finish

Surface texture, that is, very fine closed texture or coarse open texture and finish, whether coloured or not shall be according to the drawing, description in the Schedule of Items or instructions of the Engineer.

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5.7.7 Marking and certificate

The blocks shall be marked permanently indicating the Grade of the unit, identification of the manufacturer and the year of manufacture. Manufacturers test certificate shall be supplied with the delivery of each lot.

5.8 Cement, Lime and Water

Cement, lime and water shall conform to the specification under the Section Concrete of this part.

5.9 Sand for Masonry Mortar

Sand for masonry mortars shall be natural sand, crushed stone sand or crushed gravel and shall comply with IS : 2116 "Sand for Masonry Mortars". The sand shall be hard, durable, clean and free from adherent coatings and shall not contain amount of clay, silt and fine dust more than 5% by wt. Sand shall not contain any harmful impurities such as iron pyrites, alkalies, salts, coal, mica and organic matters. The particle size grading of sand for use in mortars shall be within the limits as specified in Table I of above code.

6.0 SAND FOR PLASTERING

Sand for use in mortars for internal wall, ceiling and external plastering and rendering shall conform to IS:1542 . It shall not contain any harmful impurities such as iron pyrites, alkalis, salts, coal, mica and organic matters. Percentage of salt and dust shall not be more than 5% by weight. Grading of sand shall be within the limits specified in clause no. 5.1 of above code. Fineness modulus of naturally occurring sand shall not be less than 1.5.

7.0 MATERIALS FOR FLOORING & PAVING



7.1 Cement and Binders

7.1.1 Cement

Cement, fine aggregates, reinforcement and water used shall comply with the requirements of concrete as per clauses 2.1, 2.3, 2.6 and 2.7 of this part.

7.1.2 Water

Water for construction shall be clean, soft, free from loam, salt and organic materials. Hard water shall not be used.

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7.2 Aggregates

7.2.1 Coarse Aggregate

7.2.1.1 Coarse aggregate shall conform to the requirement as per clauses 2.1 and 2.2 of this part.

7.2.1.2 For granolithic floor the screeded bed shall comprise of aggregates size 15mm and down graded and topping shall comprise of clean fine stone chippings, size 4mm and down. For concrete floor with hardener treatment the topping shall comprise of stone chippings, size 6mm and down and for in-situ terrazzo flooring, chippings shall be within sizes 12mm to 6mm graded. The marble chips for topping of terrazzo floor shall be of 3-6mm size and shall conform to Grade-I of IS : 2114 "CP for laying in-situ terrazzo floor finish".

7.2.2 Common burnt clay bricks

Common burnt clay bricks shall conform to IS : 1077 and comply with requirements under the section "Brick and Stones" of this part.

7.2.3 Rubble

Rubble of approved quality shall be used and shall be clean and free from dirt. The loose and weathered sections shall be removed before use. Rubble used as hard core shall have a least lateral dimension (thickness) between 100mm and 225mm, depending on the thickness of hardcore.

7.3 Tiles

7.3.1 Terrazzo Tiles



Terrazzo tiles shall be machine made under a minimum pressure of 140 kg/cm². It shall have a minimum total thickness of 20mm including a minimum of 6mm thick topping. It shall be of size, texture, colour, shade and pattern as specified in schedule of item and as approved by the Engineer.

7.3.2 Vitrified Ceramic Tiles

Vitrified Ceramic tiles shall be of approved manufacture and quality. They shall be true in shape, free from hair cracks, crazing spot, chipped edges and corners and surface shall be perfectly flat without warps and of uniform colour. The top surface shall be glazed either gloss or matt as specified. The tolerance on average facial dimension value shall be plus or minus 0.8 mm and on thickness plus or minus 0.5mm. The specials such as coves, internal and external angles, beads, cornices and their corner pieces shall be of specified sizes and of thickness not less than the thickness of tiles. For floor the minimum thickness 10mm and for wall glazed variety (of minimum thickness 5mm) shall be used of approved quality and size.

7.3.3 Coloured tiles

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Only glaze shall be coloured as specified. The size and specification of tiles shall be of approved quality / size of approved make.

7.3.4 Marble tiles

It shall conform to IS : 1130 "Marble (Blocks, Slabs and Tiles)". Marble for paving and facing work shall be of selected quality, hard, sound, dense and homogeneous in texture (with crystalline texture) and free from cracks, decay, weathering and flaws and shall be of kind and quality, size and thickness as specified in schedule of items. The samples of tiles shall be got approved by the Engineer before use. The tiles shall be cut to the requisite dimensions.

7.3.5 Acid Resist Tiles

Acid resist tile shall be ceramic unglazed and vitreous type conforming to IS 4457.

7.4 Pigments

Pigments incorporated in mortar or used for grouting shall be subject to approval of Engineer and as per table I of IS : 2114.

7.5 Red Oxide of Iron

Red oxide of iron where used for "Red Artificial Stone Flooring" shall be of quality approved by the Engineer, and shall be of uniform tint.

7.6 Hardening Agents

Hardening agents such as ironite used for "Cement Concrete Flooring with Hardener Treatment", shall be of quality approved by the Engineer for every work.



7.7 Dividing Strips

Dividing strips shall be of aluminium, glass, brass, copper, plastic or similar materials as specified in the schedule of item and of quality approved by the Engineer. Strips shall be 1.5 mm thick unless otherwise specified penetrating to the full depth of the flooring. Aluminium strips when used shall have a protective coating of bitumen.

7.8 Marble Chips

It shall be in sizes varying from 1mm to 25mm and in different colours as per requirement. Marble chips shall be hard, sound, dense and homogeneous in texture with crystalline and coarse grains. It shall be uniform in colour and free from cracks, stains, decay and weathering and shall be obtained from approved source.

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7.9 Marble Powder

It shall be clean, free from dust and other foreign materials and of approved quality, obtained from approved source. It shall pass through sieve 300 conforming to IS: 460- (Part-1).

8.0 TIMBER

8.1 General

All timber used for carpentry and joinery works shall be new. It shall be well seasoned by a suitable process conforming to IS : 1141 before being planed to the required sizes. It shall be sound, straight, free from sap, radial cracks, decay, fungal growth, boxed heart, pitch pockets, borer holes, splits, loose knots, flaws or any other defects and shall show a clean surface when cut. Timber shall conform to the requirements of IS : 1003 (Part 1&2) . The finished components shall be given suitable preservative treatment wherever necessary.

8.2 Teak wood/Sal / Bija Sal / Deodar / Kail and other varieties of timber

8.2.1 Teak wood

The timber shall be of good quality and well seasoned. It shall be of fairly uniform colour and shall be free from defects such as cracks, dead knots, shakes etc. No individual hard and sound knot shall be more than 15 sq. cm. in size and aggregate area of all such knots shall not exceed 2 % of the area of the piece. Wood shall be generally free from sap wood but traces of the same shall be allowed. The timber shall be fairly grained having not less than 2 growth per cm width in cross section.

8.2.2 Sal / Bija Sal wood



Timber shall be of good quality and well seasoned. It shall have fairly uniform colour, reasonable straight grains and shall be free from all defects as mentioned in previous clauses. No individual hard and sound knot shall be more than 6 sq. cm. in size and aggregate area of all such knots shall not exceed 2 % of the area of the piece. There shall not be less than 5 growth rings per 2 cm of the width.

8.2.3 Deodar wood

The timber shall be of good quality and well seasoned. It shall have fairly uniform colour, reasonable straight grains and shall be free from all defects as mentioned in previous clauses. No individual hard and sound knot shall be more than 15 sq.cm. in size and aggregate area of all such knots shall not exceed 2 % of the area of the piece. There shall be at least 3 growth rings per cm width in cross section.

8.2.4 Kail wood

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The timber shall be generally as specified in clause 8.2.3 for Deodar wood. However, there shall not be less than 2 growth rings per cm width in cross section.

8.2.5 Other varieties of timber

The timber as named in the item of work shall be used. It shall be well seasoned and generally free from defects such as dead knots, cracks, shakes, sap wood etc. However, traces of sap wood shall be allowed and sound and hard knots up to 2 % of the area of the piece shall be allowed.

8.3 Storage and Inspection

Timber shall be carefully stored and subject to inspection on site, piece by piece. The Engineer may reject such pieces as are considered by him not of the quality or meeting the requirements specified herein.

8.4 Moisture Content

Timber shall be accepted as well seasoned if its moisture content does not exceed the permissible limit as per IS : 287.

8.5 Tolerances for Timber

For timber allowance as specified in the IS : 1003 (Part 1&2) shall be applicable.



8.6 Flush Door Shutters, Shelves

Flush door shutters, shall be wooden, solid core or cellular and hollow core type, as may be shown in drawing or described in the Schedule of Items or directed by Engineer. They shall be obtained from an approved source of manufacture, covered on face with commercial ply, wood veneer or other finish as may be necessary. Solid core shutters shall conform to IS : 2202 (Part 1&2) and cellular or hollow core shutters to IS : 2191 (Part 1&2) . The resin used shall be phenol formaldehyde. A full size sample door shall be offered for inspection and approval.

8.7 Wood Particles Boards

Particle boards for general purposes shall be of medium density conforming to IS:3087. These are of four types, Flat pressed single layer board (FPSI), Flat pressed three layer board (FPTH), Extrusion pressed solid board (XPSO) and Extrusion pressed tubular core (XPTU). Adhesive shall be BWR, WWR or un-extended CWR type. High density wood particle board shall conform to IS:3478 and are in flat sheets or moulded forms. These shall be of type 1 (BWR type of resin) or Type 2 (WWR or CWR type of resin). Both types of boards shall be of Grade A (resin content 20 to 50 percent) and Grade : (resin content 8-12 percent).

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8.8 Veneered Particle Board

These shall conform to IS : 3097 and shall be of two grades. Exterior (grade-I with BWP or BWR type adhesive) & interior (grade-II with WWR or CWR type adhesive). Each grade of boards shall be of 4 types, solid core general purpose, solid core decorative, Tubular core general purpose and Tubular core decorative and accordingly designated.

8.9 Plywood for General Purpose

Plywood for general purpose shall conform to IS:303. Depending on type of adhesive used for bonding veneers, it is of 4 grades, BWP (boiling water proof), B.W.R (boiling water resistant), WWR (warm water resistant) and CWR (Cold Water resistant). Any species of timber may be used for plywood manufacture. However list of species, for the manufacture of plywood is given in Annexure 'B' of the IS : 303 for guidance.

Plywood is classified in 10 different types as per appearance of the surface. These are type AA,AB,AC,AD,BB, BC,BD,CC,CD and DD as detailed in IS : 303. It is available from 3 ply to 11 ply with thickness from 3mm to 25mm.

8.10 Veneered Decorative Plywood

This quality of plywood shall conform to IS : 1328. These plywood shall be of two types Type 1 and Type 2 as per details given in IS : 1328. Species of timber for decorative face commonly used are given in Table 1 of IS : 1328 but the purchaser shall specify the particular veneer to be used. Timber for cores and backs shall be either class I or II as specified in IS : 303. Adhesive used shall be BWR or WWR synthetic resin.

9.0 FITTINGS FOR DOORS, WINDOWS, ETC.



9.1 General

Fittings shall be of iron, brass, aluminium or as specified. These shall be well made, reasonably smooth and free from sharp edges, corners, flaws and other defects. Screw holes shall be countersunk to suit the head of specified wood screws. All hinge pins shall be of steel and their riveted heads shall be well formed.

Iron fittings shall be finished bright or black enameled or copper oxidised or painted as specified. Brass fittings shall be finished bright, oxidised or chromium plated and aluminium fittings shall be finished bright or anodised as specified. Fittings shall be got approved by the Engineer before fixing. Screws used for fittings shall be of the same metal and finish as the fittings. However, anodised cadmium/chromium plated M.S. screws of approved quality shall be used for fixing aluminium fittings.

9.2 Hinges

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9.2.1 Butt hinges

These shall be mild steel but hinge (medium), brass butt hinges, extruded aluminium alloy butt hinges or as specified. Type (light/medium/heavy weight) and size shall be as specified in the drawing or schedule of items. Brass / Aluminium and M.S butt hinges shall conform to Indian Standard Specification for butt hinges IS : 205 and IS : 1341 respectively. Hinges shall be finished bright or satin polished or anodised.

9.3 Sliding Door Bolts

Mild steel sliding door bolts shall conform to IS : 281 and are of 2 types, plate type and clip or bolt type. Plate type bolts shall have plates and straps stove enameled black with hasp and bolt finished bright or copper oxidized or nickel / chromium plated. Clip or bolt type are copper oxidized or plated. All screw holes in the M.S bolts shall be countersunk. Diameter of bolt for plate type is 12mm and for clip type is 16mm.

Non ferrous metal sliding doors are of brass or aluminium alloy and shall conform to IS:2681. Brass sliding bolts are of 150 to 450mm size with bolt dia being 16mm for 150 to 300mm and 18mm for 375 and 450 size. Aluminium alloy sliding bolts are of size 200 to 450mm with 16mm bolt dia. Brass quality is finished satin, polished or plated and aluminium alloy bolts are anodised.



For both ferrous and non-ferrous metal bolts the size of the sliding bolt is determined by the length of the bolt.

9.4 Door Rim Latch

This shall be of mild steel, brass, aluminium alloy or as specified and of sizes 75, 100, 125 and 150mm denoted by overall length of the body measured from outside face of the fore end to the rear end. These are of type 1 and type 2 and shall conform to IS : 1019.

9.5 Tower Bolts

Tower bolts may be of one of the following types and shall conform to IS : 204 (Part 1 and 2).

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i) Barrel tower bolts

These shall be of bright finished/stove enamelled/ black painted mild steel tower bolts, brass barrel tower bolts with cast brass barrel and rolled or drawn brass bolt/brass barrel tower bolts with barrel of extruded sections of brass and rolled or drawn brass bolt/brass barrel tower bolts with brass sheet barrel and rolled or drawn brass bolt. Aluminium barrel tower bolts with barrel and bolt of extruded section of aluminium alloy-bolts and barrel anodised.

ii) Semi-barrel tower bolts

These shall be mild steel semi barrel tower bolts full cover/open type with mild steel sheet pressed barrel and cast iron/mild steel bolt. Bolt bright finished other parts stove enameled black.

iii) Rivetted or spot welded tower bolts

These shall be mild steel tower bolts rivetted type with black flat and mild steel/cast iron bolt and open staple.



iv) Skeleton tower bolts

These shall be of bright finished / stove enameled / black painted mild steel or brass bright finished skeleton tower bolts with cast brass/extruded sections plate and staples and rolled or drawn brass bolt or Aluminium skeleton tower bolts with plates staples and bolt or extruded sections of Aluminium alloy plate and staple anodised.

9.6 Door Handles

Door handles shall conform to IS : 208 and shall be of 4 types. Type 1 is cast Iron / Brass / Aluminium or zinc alloy die casting and available in 75,100,125 150mm sizes. Type 2 is mild steel pressed oval in 75, 100,115 and 135mm sizes. Type 3 is mild steel present half oval in 75,90 and 100mm sizes. Type 4 is fabricated (brass / aluminium alloy) in 75,100 and 125mm sizes. The size of the handle shall be determined by inside (grip) size overall size and internal depth of the handles shall be as detailed in IS : 208.

Finish for type 1 shall be satin/nickel plating, copper oxidising and bronze finish for cast-brass and zinc die cast handles and stove enamelled black or copper oxidized for cast iron handles. Aluminium handles shall be anodized. Type 2 and 3 handles shall be stove enamelled black. For type 4 it shall be satin finish, nickel plating, copper oxidized and bronze finish for brass handles and anodizing for aluminium handles.

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9.7 Mortice Lock and Rebated Mortice lock

Mortice lock with latch and pair of lever handles shall have body of steel, Aluminium alloy or brass and shall be right or left handed as shown in the drawing or as directed by the Engineer. It shall be of the best Indian make of approved quality and shall conform to IS: 2209 / 6607. The shape and pattern shall be approved by the Engineer. The size of the lock shall be determined by its length. The lock for single leaf door shall have plain face and that for double leaf door a rebated face. Lever handles with springs shall be mounted on plates and shall weigh not less than 0.5 kg per pair. These shall be of brass, finished, bright chromium plated or oxidised. The locks shall be of 65, 75 and 100 mm sizes.

9.8 Floor Door Stopper

These are for the use of the door shutters of 30, 35, 40 & 45mm thickness. It is made of aluminium alloy/ brass with springs of phosphor bronze or hard drawn steel wire and tongue of aluminium/brass/nylon/ plastic. The floor door stoppers shall conform to IS : 1823 and shall be best Indian make of approved quality. Width of cover plate is 40mm but its overall length is 140mm for 30 and 35mm thick shutters & 150mm for 40 and 45mm shutters. The body shall be cast in one piece and fixed to cover plate by brass or M.S screws. On the extreme end there shall be rubber cushion to absorb shocks. The extension of the door stopper shall be in flush with floor and be finished bright/satin/chromium plated or anodised.

9.9 Hooks and Eyes



These shall be of mild steel or hard drawn brass and shall generally conform to IS : 207.

9.10 Casement Window Handles

These shall be made of cast brass, steel protected against rusting, aluminium, pressed brass or as specified. Casement handles for single leaf window shutter shall be left or right handed and shall weigh as specified.

9.11 Casement Peg Stays

These shall be made of cast brass, steel protected against rusting, aluminium, cast alloy or as specified. The stay shall be made from a channel section and shall be 300mm long with steel peg and locking bracket. The peg stay shall have three holes to open the window in three different angles. The shape and pattern of stays shall be approved by the Engineer. The peg stay shall be minimum 2mm thickness in case of brass and aluminium and 1.25 mm in case of steel.

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9.12 Quadrant Stays

These shall be made of cast brass, aluminium alloy, CP iron or as specified. The shape and pattern shall be approved by the Engineer. It shall weigh as specified.

9.13 Fan Light Pivots

These shall be made of mild steel, cast brass or aluminium alloy or as specified and shall generally conform to IS : 1837.

The pattern and the shape of the catch shall be as approved by the Engineer and size and finish shall be as specified.

9.14 Fan light catch

These shall be made of mild steel, cast brass, aluminium alloy or as specified and shall generally conform to IS : 364. Steel springs of the catch shall be 0.90 mm dia, 6 coils, 12 mm internal diameter and 20 mm long. The pattern and the shape of the catch shall be as approved by the Engineer.

9.15 Steel Frames

These shall conform to IS:4351. The frames shall be manufactured from commercial mild steel sheets of 1.25mm thickness and are suitable for door shutters 30 to 40mm thick. The door frames are designated as per profile A, B and C.

Profile A Size 105x60mm : rebated for one set of shutters

Profile B Size 125x60mm : rebated for one set of shutters

Profile C Size 165x60mm : rebated for two sets of shutters.

Miscellaneous Items :

9.16 Putty



The material shall be homogeneous paste and shall be free from dust and other visible impurities. Putty shall conform to IS : 419 for wood work.

10.0 METAL DOORS, WINDOWS, VENTILATORS AND ROLLING SHUTTERS

10.1 General

Materials used in the fabrication of doors, windows, and ventilators shall be the best procurable and conforming to relevant Indian Standards.

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10.2 Steel Doors, Windows and Ventilators

Steel sections used for fabrication of doors, windows and ventilators shall be standard rolled steel sections specified in IS : 1038, IS : 1977, IS : 1361 or IS : 7452 respectively as appropriate or as specified in drawing and Schedule of Items. Rivets shall conform to IS : 1148.

10.3 Aluminium Door, Windows and Ventilators

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

10.4 Steel Rolling Shutters, Rolling Grills

These shall conform to IS : 6248.

10.5 M.S. Bolts etc.

M.S. bolts, nuts, screws, washers, peg stays and other mild steel fittings shall be treated for corrosion. Putty for glazing shall conform to IS : 419. Glass panes and glazing shall conform to the specification detailed under this series.

10.6 Hardware and fixtures shall be as specified in the drawings or Schedule of Items. All hardware and fixtures shall be able to withstand repeated use. Door closers shall be suitable for doors weighing 61 to 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 the closer 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.



10.7 The mastic for caulking shall be of best quality from a manufacturer approved by the Engineer. In general, the mastic for fixing of metal frames shall conform to IS : 1081 and/or as approved by the Engineer.

11.0 GLASS

11.1 General

Plain, ground, frosted or rough cast wired glass shall be used as shown on the drawing or as specified in the Schedule of Items. It shall be procured from a reputed source of manufacture and be of the best quality. All glass panes shall be free from flaws, specks, bubbles etc. Glass panes shall be of thickness 3mm or more as required. Weight of 3mm thick glass pane shall not be less than 7.5 Kg/sqm. The tolerance of glass panes, except wired glasses, in length and width shall be plus or minus 2 mm for 3 to 6.3 mm glass sheets.

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Tolerance in thickness of glass sheets shall be +/- 0.2mm for 3mm and 4mm thick glasses and +/- 0.3mm for 4.8, 5.5 and 6.3mm thick glasses.

11.2 Plain Transparent Glass

Plain transparent glass for glazing and framing shall conform to IS: 2835. It shall be free from flaws, specks, bubbles or distortions.

11.3 Ground and Frosted Glass

Glare reducing or heat absorbing glass shall be "Calorex" or approved equivalent and special care shall be taken to grind smooth and round off the edges before fixing.

11.4 Thickness

Glass shall have the following thickness, unless otherwise stated in the Schedule of Items or drawings

Upto 60 cms x 60 cms	...	3 mm
do- of larger size	...	4 mm and 4.8mm
Wired glass	...	5.5 mm
Rough cast wired	...	6.4 +/- 0.4 mm

11.5 Inspection

All glasses shall be subject to inspection on the site. Glass found to suffer from defects shall be rejected. Samples submitted for inspection shall be selected so as to be representative of the consignment.

12.0 PAINTS



12.1 General

All paints, varnishes, distemper or other surface coating materials shall be of approved quality conforming to the appropriate Indian Standard, wherever such standard is available, and be obtained from a manufacturer of repute. If there is more than one quality for one particular product, only first quality shall be used unless otherwise stated in the Schedule of Items.

12.2 Sampling and Testing

The Engineer may, at his discretion, require samples of paint to be tested. In such cases testing will be according to IS : 101 (Part 1 to 8).

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12.3 Storage

Paints, primers, distempers and varnishes shall be delivered in sealed containers. They shall be stored in cool dry condition to the satisfaction of the Engineer.

12.4 Paints for Priming

Ready mixed paints for priming coats of steel and iron work shall either comply with IS : 2074 "Ready Mixed Paint", "Red Oxide Zinc Chrome Priming" or Red Oxide metal primer as specified. For wood work it shall be pink/white wood primer as specified by the manufacturer of the synthetic enamel paints, conforming to IS : 3536.

12.5 Paints for finishing

Ready mixed oil synthetic enamel paint of approved manufactures shall be used unless otherwise specified. Paint shall be of first grade quality of the above manufacturers.

If for any other reason, thinning is necessary, the brand of the thinner recommended by the manufacturer, shall only be used with the specific permission of the Engineer.

Aluminium paint for general purpose shall be in Dual Containers. It shall be of manufacturers as for synthetic enamel paints above.

12.6 White wash



White wash shall be prepared from freshly burnt fat, white in colour lime slaked on spot, conforming to IS : 712 mixed and stirred with sufficient water to make a thin cream. Best and approved quality gum and ultra marine blue only shall be used in lime wash.

12.7 Colour wash

Colour wash shall be prepared by adding mineral colours, not affected by lime, to white wash.

12.8 Water proofing Cement Paint

Cement paints shall comply with IS: 5410 and shall be of approved brand and manufacture from approval list of vender. The shade shall be approved by the Engineer before its application.

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12.9 Distemper

Dry/synthetic washable distemper of approved brand and manufacture shall be used. The shade shall be approved by the Engineer before application of the distemper. and shall comply with IS : 427 and IS : 428.

12.10 Varnish

Varnish for the finishing coat shall be copal finish or synthetic class varnish of approved brand. Varnish for the under coat shall be flattening varnish of the same make as the top coats and shall be to the satisfaction of the Engineer.

12.11 Polish

French spirit polish shall be of an approved make conforming to IS: 348. In case it is to be prepared on site, the polish shall be made by dissolving 0.7 kg of best, shellac in 4.5 litres of methylated spirit without heating. To obtain required shade pigment may be added and mixed. Shellac shall conform to IS : 5467.

12.11.1 Wax polish for Wood work



The polish shall consist mainly of waxes and Organic solvents with or without water and shall be of smooth consistency, homogeneous, Semi-Solid mass and free from gritty materials. It shall not flow at ordinary temperature. It may be tinted with an oil soluble colour. The polish shall not crumble or dry too rapidly and shall produce non-tacky polished surface. The polish shall be amenable to smooth spreading on the furniture surface and the gloss shall appear on gentle rubbing with a soft polishing cloth.

The wax polish shall conform to IS : 8542.

12.11.2 Where wax polishing is to be prepared at site, it shall be prepared by heating two parts of "Bee Wax" two parts of boiled linseed oil over a slow fire. When dissolved but still warm, one part of turpentine is to be added. The boiled linseed oil, bees wax and turpentine used shall be of approved quality and complying with IS : 77, IS : 1504 and IS : 533 respectively.

12.12 Plastic (Acrylic) emulsion paint

Plastic emulsion paint of approved manufacturers paints only shall be used unless otherwise specified and shall comply with IS : 5411 (Part 1) & (Part 2) as applicable. Cement primer used for priming work both for oil bound distemper and plastic emulsion paint shall be of the same manufacture as that of distemper or plastic emulsion paint used. For dry distemper priming, whitening of approved quality shall be used.

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12.13 Creosote oil or Coaltar Creosote

It is primarily used for preservation of wood. It shall be a homogeneous liquid and shall liquify completely on being warmed to 38 degree C with stirring and shall remain liquid on cooling down to 32 degree C and on standing at that temperature for 2 hours.

The material shall conform to IS : 218. All persons handling the creosote oil should be fully aware of the hazards involved in handling . Skin should be protected from coming in direct contact and eyes should be protected by using safety goggles while handling the material.

12.14 Coaltar Black Paint

Coaltar paint film protects surfaces by serving as a barrier against the action of moisture and other corrosive agents. Coaltar black paint is generally used as a protective and anti corrosive paint of iron and steel as well as protection of other building surfaces. For this it has to be applied under proper condition and on suitably prepared surface. Coaltar should be applied by brush only and is not recommended for locations which are not likely to be well ventilated. Coaltar paint shall conform to IS : 290 .



The material is of two types : Type A Quickly drying and Type B Slow drying. It shall be a homogenous black solution type paint consisting of a base prepared by blinding suitable grades of Coltar pitch, washed free from ammoniacal liquor, tar acid bases etc. Consistency, permeability, thickness and surface preparation etc. shall be as per para 5 and A-2 of the above code.

12.15 Floor Polish - Paste

The polish shall consist mainly of waxes and organic solvents with or without water.

The paste floor polish shall be of smooth consistency, homogenous, semi-solid-mass and free from gritty material. It shall not flow at ordinary temperature. It shall be so constituted and prepared that on application by means of a clean cloth, it shall spread easily and evenly and shall give with minimum buffing a firm and glossy surface free from greasiness or tackiness. The polish film after spreadng with a cloth shall not take more than 10 minutes to dry. The polished floor shall neither be slippery nor show any resistance to easy walking.

Floor polish paste shall conform to IS : 8591.

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13.0 WATER PROOFING MATERIALS

13.1 Integral Cement Waterproofing Compounds

Integral cement waterproofing compounds, i.e. admixture for waterproofing purposes shall fully comply with the requirements of IS : 2645. Properties like permeability, setting time, compressive strength shall be in accordance with the requirements of this code when tested as per procedure laid therein. Calcium chloride content of the product used shall be made known to Engineer before use.

13.2 Bitumen

The bitumen bonding material for waterproofing shall conform to the requirements laid down in IS : 702 or IS : 93 or IS : 217 or IS : 454 depending upon whether industrial bitumen, paving bitumen or cutback bitumen is used. For selecting the particular type and grade of bitumen to be used the relevant item in Schedule of Items shall be referred to.

13.3 Bitumen Primer

Bitumen primer used for application to concrete and masonry surfaces and bitumen for the purpose of waterproofing shall conform to requirements given in IS : 3384 and pass tests in accordance with the procedure laid down in appropriate IS mentioned in Table-I of IS : 3384. Bitumen primer should be free from water and shall preferably be made from the same grade of bitumen as used in bonding.

13.4 Bitumen Felt

Bitumen felts used for water proofing purposes shall be as specified in IS: 1322. Physical properties shall conform to the requirements and tests shall be carried out as per procedure laid down in IS :1322 . Base, (whether fibre or Hessian), type and grade of felt shall be as mentioned in the relevant items under Schedule of Items. Unless otherwise stated, hessian base felt Type-3, Grade-2 shall be used.



13.5 Bitumen Mastic

Bitumen mastic used for water proofing of roofs shall have the physical properties as mentioned in IS : 3037 when tested with the procedure laid down in appropriate IS mentioned in IS : 3037.

13.6 Bituminous Compounds

Bituminous compounds when used for waterproofing of porous masonry, concrete floors, walls and roofs shall conform to the requirements of IS : 1580. Physical properties shall be governed by the requirements of this code when tested in accordance with the procedure laid therein.

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13.7 Surface Application Materials

Waterproofing material for application on mortar or concrete surface shall conform to IS: 9862 . The primer shall be suitable for spray or brush application. It shall have properties enabling it to penetrate through pores or cracks and fill them up, making the surface impervious.

13.8 Polymer based paints

The materials used shall be high polymer based chloride and sulphide free cement and waterproofing additions and epoxy based waterproofing paints as per manufacturer's specification and approved by Engineer.



13.9 Fibre glass R. P. Tissue

The fibre glass R.P. tissue is a thin flexible uniform mat, composed of glass fibre in an open porous structure bonded with a suitable inert material compatible with coal tar, asphaltic enamel and oil plastic based wall paint. The fibrous glass mat is reinforced with continuous filament glass yard at 3/8" (10mm) pitch in the longitudinal direction.

PHYSICAL PROPERTIES

- | | | |
|------|-------------------|--|
| i) | Weight | The average weight of fibre glass R.P. tissue shall not be less than 50 gms/sq.sm. |
| ii) | Thickness | The fibre glass R.P. tissue shall have a thickness not less than 0.4mm. |
| iii) | Tear Strength | The tear strength shall be not less than 900 grams in the transverse direction. |
| iv) | Breaking Strength | This shall have a minimum breaking strength of 13 lb/in (2.32kg/cm) in the longitudinal direction. |
| v) | Porosity | This shall have a porosity when related to pressure difference across the sample of not less than 0.022" (0.56mm) and not more than 0.76" (1.92mm) of water guage at an air velocity of 200fpm.(100cm/sec.). |
| vi) | Pliability | There shall be no cracking of the tissue mat when bent over a 1/8" (3.2mm) radius after immersing for 10-15min. through a 90 degree arc. |
| vii) | Temperature | The fibre glass tissue shall be Resistance |

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under a load of hot bitumen at 530 degree F (276 degree C) for one minute.

13.9.1 Primer

Primer shall conform to requirements laid down in IS : 3384. It is to be prepared by blending turpentine and blown grade bitumen in the ratio of 60:40 by weight.

13.9.2 Blown Materials

Blown grade bitumen shall be conforming to IS : 702 and residual grade bitumen conforming to IS:73 respectively. This shall be prepared by heating to correct working temperature.

13.9.3 Surface finish

Pea sized gravel/grit 6mm and down.



13.10 P.V.C. Membrane/Sheets

Polyvinyl chloride sheets for the purpose of water proofing and other underground use are specially developed sheets made from the compounded resin of grade MP/DP/CR-02 and shall be resistant to the passage of gross water and water vapour. It shall be corrosion resistant and resistant to a wide range of acidic and alkali reagents, saltpetre action, salt water and ultra violet rays etc. PVC sheets manufactured by approved and reputed firms shall only be used

The sheets shall consist of Knobs or Lugs jutting out of the sheets in a grid fashion so as to provide a perfect grip in the mortar and concrete. Sheet thickness, spacing of the knobs and their projection from the sheet shall be as specified in the item. The sheets shall be of maximum practicable length and width unless otherwise specified.

The adhesive used for jointing shall be of approved quality and of grade C-02.

The sample of the material shall be got approved before use.

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13.10.1 Properties

- i) Chemical Composition : Resin Plasticiser Inhibitor
Stabiliser UV Barrier.
- ii) Thickness : Not less than 0.25 mm
- iii) Rupture/Tensile Strength : Not less than 225Kg/cm²
- iv) Adhesive bond Strength : : Not less than 7.1 Kg/cm
[width]
- v) Elongation at Break : 130%

14.0 WATER BAR

14.1 General

Water bar for use in construction/expansion joints in concrete and reinforced concrete structures shall be of copper sheet, galvanised steel sheet, rubber or PVC as shown in drawing or described in the Specified Item It shall be subject to approval of Engineer.

14.2 Jointing

The water bar shall have dimensions as shown in drawing. Where water bars are required to be lengthened or otherwise jointed the joining shall be done in such a way as to achieve a perfectly watertight joint.



15.0 LEAD

15.1 General

Lead for joints in cast iron spigot and socket pipes shall be melted from pure soft pig lead conforming to Type-I of IS : 782. "Caulking Lead". Where lead wool is allowed for caulking, it shall be equal to or better than Type-II of IS : 782. Lead flashing shall conform to IS : 405 Part I&II.

16.0 BUILDING PAPER

- 16.1 Building paper shall be bitumen impregnated paper conforming to IS: 5134, or such other as may be approved by the Engineer.

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17.0 FILLING MATERIAL

17.1 General

Filling material shall conform to what is shown in drawing, described in the Schedule of Items or otherwise directed by the Engineer. Earth or sand for filling under floors shall correspond to those described elsewhere in these specifications.

17.2 Mastix Bitumen

Mastic Bitumen shall conform to IS : 3037 or IS : 5871 as appropriate.

17.3 Flexible Boards



Flexible boards for use in expansion joints shall correspond to the description given in drawing or the Schedule of Items or the instruction of Engineer.

18.0 DRAINAGE & SANITATION (INTERNAL)

18.1 General

All materials, pipes, specials, fittings, fixtures etc., to be used in the works shall be of best quality and class specified in relevant IS Code. Where specified these shall be of specific manufacture and quality and shall be procured from manufacturer or their accredited stockists and be marked with manufacturers' names and trade mark. Bidder shall submit to the Engineer samples of all materials, pipes, specials, fittings fixtures for approval before use in the works. Such approved samples shall be retained by the Engineer till completion of works. Pipes and Specials may be any or combination of following types:-

- i) PVC Pipes
- ii) Stone Ware Pipes
- iii) Sand Cast Iron Pipes for soil waste & Ventilation
- iv) CI Pipes for rain water
- v) R.C.C Pipes

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18.1.1 High density PVC pipes and fittings

This shall conform to IS : 4984 and IS : 8008 (Part 1 to 7) unless otherwise specified.

18.2 PVC Waste Pipe

This shall conform to IS : 4985 unless otherwise specified.

18.3 Stoneware Pipes & Fittings

All stoneware pipes, bends, gully traps and sewer traps shall be of the best salt glazed variety inside and outside, hard burnt dark grey colour, perfectly sound, free from fire cracks and imperfection of glaze, truly circular in cross section, perfectly straight, of standard nominal length and depth of socket and barrel. These shall be of approved manufacture and shall comply with the requirement of IS: 651. These pipes shall be of grade AA unless otherwise specified.

18.4 Sand Cast Iron Pipes & Fittings conforming to IS : 1729

All soil waste and vent pipes and fittings used in the work shall be cast iron and shall conform to IS: 1729. The pipes shall have spigot and socket ends, with bead on spigot end and shall be with or without ears. The pipes shall be free from cracks and other flaws. The interior of the pipe and fittings shall be clean, smooth painted inside and outside with DR Angas smiths solution or other approved anti-corrosive paint.



The standard weights and thickness of pipe shall comply with the requirements of IS: 1729. The tolerance on wall thickness and weight shall be minus 15 percent and minus 10 percent respectively. Pipes weighing more than the nominal weight given below may be accepted provided they comply in every other respect.

Nominal size	Weight per piece in Kg. excluding ears		
	Overall length		
	1500 mm	1800 mm	2000 mm
50	9.56	11.41	12.65
75	13.83	16.52	18.37
100	18.14	21.67	24.15
150	26.70	31.92	35.66

Specials and Fittings shall include bends, offsets, branches of various types, junctions etc., as required for the work which shall be provided according to drawings and directions of the Engineer. B.M. trap shall have water seal as per I.S. provisions.

The specials and fittings shall be provided with access doors where so specified or directed by the Engineer. The access door fittings shall be of proper design so as not to form cavities in which the filth may accumulate.

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Doors shall be provided with 3 mm thick rubber insertion packing, and when closed and bolted they shall be water tight. The access doors shall have MS studs and bolts or screws or bolts and nuts.

18.5 Cast Iron Pipes pipes : Rainwater pipe

18.5.1 Pipes shall be of approved manufacture, true, smooth and cylindrical, their inner and outer surfaces being as nearly as practicable concentric and shall conform to IS : 1230. These shall be sound and uniform casting, free from laps, pin holes or other imperfections and shall be neatly finished inside and outside. The ends of pipes shall be reasonably square to their axis.

18.5.2 Dimensions

CI rain water pipes shall be of the dia specified and shall be in full lengths of 1.8 metres including socket ends of the pipes, unless shorter lengths are required at junctions with fittings. The pipe lengths shall in each case be with sockets. The pipes shall be supplied without ears unless otherwise specifically mentioned.

The pipes supplied shall be factory painted with a tar based composition both inside and outside which shall be smooth and tenacious unless specified otherwise.

Every pipe shall ring clearly when struck all over with a light hand hammer. When shorter pipes are cut from full lengths they shall be cut with a hacksaw.

Where the pipes are to be embedded in masonry they shall be of Class of pipes as are used for soil and vent pipes. For the weights of different sizes of these pipes, the specifications under SCI and vent pipes may be referred to.

18.5.3 Fittings the pipes and fittings shall be of approved manufacture and shall conform to IS:1626. These shall be homogeneous and free from cracks and other defects. The pipes shall be straight, smooth and regular in thickness.



The diameter of the pipe shall be as specified. The fittings like heads, bends of different degrees, offsets of different projections, shoes and junctions shall be of the type, diameter and size as required for the work. The pipes shall be used in full lengths as far as possible.

18.6 Sanitary appliances

Sanitary appliances like I.W.C/E.W.C pans, wash basin, urinals and sinks etc. shall be made of vitreous china or fire clay as specified. These shall be of Hindustan Sanitary ware or Parry ware make unless otherwise specified and to be approved by the Engineer. These shall conform to A class quality of IS : 2566 (Part 1 to 15) and IS : 771 (Part 1 to 15) respectively.

18.6.1 European Pattern W.C.

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Unless otherwise specified, these shall comprise of :

- a) Coloured glazed earthenware wash down closet set with 'S' or 'P' trap of standard size.
- b) 'Duco' spray painted 10 litres mosquito proof low level Ceramic or M.S flushing cistern with valveless siphon, 15 mm ball cock, C.P. brass unions & couplings for the 32 mm dia flush pipe, 20 mm dia overflow PVC pipe with mosquito proof cover etc.
- c) 'Duco' spray painted 1 1/4" (32 mm) dia G.I. telescopic flush pipe with buffer clamp, holder bat clamp and 38mm dia PVC pipe or 35/40mm O.D. high density polythene flush pipe with buffer clamp, holder bat clamp.
- d) Approved quality W.C. seat and cover, bar hinges, screws bolt, rubber buffers conforming to IS : 2548 (Part 1&2).
- e) 15 mm PVC connection pipe with brass couplings at both ends and 15 mm brass CP cock.
- f) Hard wood wooden blocks or other suitable fixing arrangement with screws and detofix for fixing WC in floor and putty joint with flush pipe and soil pipe.

18.6.2 Indian Pattern W.C. (Orissa Pan)

Unless otherwise specified these shall comprise of :-

- a) Colour glazed earthenware WC pan back entry type(Large Size).(Orissa pan)
- b) Colour glazed earthenware 'P' or 'S' trap with or without vent.
- c) 10 litres low level approved make mosquito proof flushing cistern with valveless siphon, 15 mm ball cock, galvanised iron chain handle, cast iron brackets with wall plugs, brass unions and couplings for flush pipe, 20 mm dia overflow PVC pipe with mosquito proof cover etc.,
- d) 32 mm dia GI telescopic or 35/40 mm O.D high density PVC flush pipe with holder bat clamps.
- e) 15 mm PVC connection pipe with brass couplings at both ends and 15 mm brass stop cock.

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18.7 Wash Hand basin

Unless otherwise specified these shall comprise of :-

- a) Colour glazed earthenware basin with 2 nos. Concealed Cast Iron Brackets with wall plugs.
- b) 1 no. 15 mm C.P. brass pillar tap(heavy duty).
- c) 32 mm C.P. brass waste fitting, C.P. brass chain and rubber plug.
- d) 32 mm PVC waste pipe with brass couplings/32 mm C.P. bottle trap.
- e) 15 mm PVC connection pipe with brass couplings and 15 mm brass stop cock.

18.8 Flat Back Lipped Urinal

Unless otherwise specified these shall comprise of:-



- a) Colour glazed earthenware urinal basin back type.
- b) CI/M.S mosquito proof high level automatic flushing cistern of capacity as specified in the Schedule of Quantities with all accessories, cast iron brackets with wall plugs, brass unions and coupling for flush pipe, 20 mm dia overflow pipe with mosquito proof cover.
- c) 25 mm dia CP brass flush pipe and spreaders with wall clips and brackets.
- d) 15 mm PVC connection pipe with brass couplings joint at both ends and 15 mm brass stop cock.
- e) 32 mm C.P. brass outlets complete with PVC waste.

18.9 Mirror Frames

Mirror frame where specified shall be of fibre glass of approved shape, size, colour and make.

18.9.1

Mirror shall be of superior glass with edges rounded off or leveled as specified. It shall be free from flaws, specks or bubble and its thickness shall not be less than 5.0 mm. The glass for the mirror shall be uniformly silver plated at the back and shall be free from silvering defects. Silvering shall have a protective uniform covering of red lead paint.

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18.10 Toilet Shelf

18.10.1 Glass shelf unit shall consist of an assembly of glass shelf, anodised aluminium / CP brass guard rail and supporting brackets. The shelf shall be of glass of best quality with edges rounded off and shall be free from flaws, specks, bubbles and of thickness not less than 5.0 mm. The shelf shall have guard rail, resting on rubber washers on glass plate.

18.10.2 Ceramics shelf shall be of shape, size and design as specified in the Schedule of Items.

18.11 Towel Rail

Towel rail shall be of CP brass / anodised aluminium with two brackets of same material, diameter and length as specified.

18.12 Soap Container

Soap container shall be of C.P brass, PVC with cp brass brackets of approved make and design.

18.13 CP Flush Valves for EWC

The CP flush valve for EWC shall be of "Jaquar" brand of Jaquar & Co., 'ACCO' brand of Asia Continental Metallwaren Fabric or equivalent quality.

18.14 CP Flush Valve for Urinals

CP flush valve for urinal shall be of "Jaquar" brand of Jaquar & Co., 'ACCO' brand of Asian Continental Metallwaren Fabric or of equivalent quality.



18.15 Gully Trap

Each gully trap shall have one C.I. grating 150 mm x 150 mm and one water tight pre-cast R.C. cover 300 x 300 x 40 mm thick with 1:1 1/2:3 mix concrete (one cement: one and half sand : 3 stone chips 20 mm down) including neat cement finish.

18.16 CI Manhole Covers & Frames

These shall be of light or medium duty (LD or MD) as specified in Schedule of Items and of cast iron with raised chequered design, lifting key and key hole and shall be coated with black bituminous base material,. Light duty covers and frames shall be of either rectangular type, single seal, pattern 1 and 2 having minimum weight of cover and frame 38 Kg and 25 Kg. respectively or with double seal, minimum weight of cover and frame being 52 Kg. These may be of square type also. Single seal with clear openings of 455 and 610 mm with minimum weight of cover and frame being 20 Kg and 38 Kg respectively, double seal of same openings shall have minimum Wt. of cover and frame 30 Kg and 55 Kg respectively. Medium duty covers and frames shall be either of circular type with 500 and 560 mm clear openings and minimum Wt. of cover

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and frame 116 Kg and 128 Kg respectively or of rectangular type with minimum Wt. of cover and frame 144 Kg.

The C.I. manhole covers and frames shall conform to IS : 1726.

18.17 Flushing Cisterns

Manually operated high level and low level flushing cisterns are of 5 litre and 10 litre capacities, both single flush and dual flush type. The cisterns shall conform to IS : 774 and be made of Cast Iron, Vitreous China or enamelled pressed steel. The cisterns shall be mosquito-proof.

The thickness of the body including cover shall be not less than 5 mm for Cast Iron and 6 mm for Vitreous China Cisterns. Flush pipe shall have internal diameter of 32 plus or minus 1 mm for high level cisterns and 38 plus or minus 1mm for low level cisterns. For high density polyethylene and unplasticised PVC pipes the outside diameter of the pipe shall be 40 mm. In case of PVC plumbing pipes the outside diameter of the pipes shall be 40mm for high level and 50mm for low level cisterns. Steel flush pipes shall be hot dip galvanized electroplated or vitreous enameled.

The flush pipe shall be securely connected to the cistern outlet and made airtight by means of a coupling nut. Float valve shall conform to IS : 1703 or IS : 12234. Polyethylene float valve shall conform to IS : 9762.

Cast Iron Cisterns shall be painted and finished in accordance with recommendation made in IS : 1477 (Part 1&2) or shall have a coating of enamel.

In general, Materials Construction and operational and performance requirements shall be as specified in para 3, 4 and 6 of IS : 774.

18.18 Plastic Seats & Covers for Water Closets



These shall conform to IS : 2548 (Part 1&2) and shall be either of thermo-set or of thermo-plastic quality.

Thermo-set Seats and Covers are moulded from phenolic plastics (Type A) or Urea Formaldehyde (Type B). Thermo-plastic Seats and Covers are also of Type A, moulded from Polystyrene or Type B, moulded from Polypropylene.

Underside of the seats may be either flat or recessed and colour shall be as agreed. Table Dimensions of the seats and covers shall be as per Table-I of the Code (both Part 1&2). Hinging device may be either of the following materials :

- i) Bronze or Brass with Nickel Chromium Plating
- ii) Mild Steel with Nickel Chromium Plating
- iii) Aluminium alloy with anodic coating
- iv) Suitable plastic with reinforcement.

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19.0 WATER SUPPLY & PLUMBING (INTERNAL)

19.1 General

This section deals with the specification of material for pipes, fittings, fixtures etc., to be used in water supply works.

All materials, pipes, fittings, fixtures to be used in the works shall be of the best quality and of the class specified in various clauses herein under. Where specified these shall be of specific manufacture and quality and shall be procured from the manufacturer or their accredited stockist and be marked with manufacturers name and trade marks. The Bidder shall submit to the Engineer samples of all pipes, fittings, fixtures for approval before being used in the works. Such approved samples shall be retained by the Engineer till completion of works.

Pipes and pipe fittings may be of any or combination of following types:



- i) Wrought iron galvanised pipe
- ii) PVC pipes
- iii) Cast iron pipes
- iv) Steel pipes coated with bitumen composition inside and galvanised outside.
- v) Reinforced concrete pipes
- vi) Asbestos cement pipes
- vii) Pre-stressed concrete pipes

19.2 Galvanised Iron Pipes and Fittings

Generally pipes for installations in buildings shall be medium quality malleable steel galvanised pipe 'B' class for cold water supply and 'C' class for hot water supply, having threaded ends with socket at one end.

The details of standard medium quality "B" class pipes and sockets regarding nominal bore thickness and weight in kg/m are given below:-

Pipe Dia Nominal Bore	Dimension of Pipe		Thick- -ness	Dimension of ordinary socket		Wt. of Pipe plain end
	Max. (outside dia)	Min.		Outside dia (approx.)	Min. length	

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mm	mm	mm	mm	mm	mm	Kg/m
15	21.8	21.0	2.65	26.90	34	1.21
20	27.3	26.5	2.65	33.70	36	1.57
25	34.2	33.5	3.25	42.00	43	2.42
32	42.9	42.0	3.25	51.00	48	3.11
40	48.8	47.9	3.25	57.00	48	3.59
50	60.8	59.7	3.65	70.00	56	5.07
65	76.6	75.3	3.65	88.00	65	6.49
80	89.5	88.0	4.05	101.60	71	8.43

Note :- Manufacturing tolerances shall be permitted on tubes and sockets in addition to above as per IS : 1239 (Part 1&2) .

The galvanised iron pipes shall be of approved make and conform to IS:1239 (Part 1&2) and of tested quality. The GI pipes shall be of threaded ends with a socket at one end only. The fittings for GI pipes shall be either galvanised wrought iron or galvanised malleable iron.

19.3 R.C.C, Asbestos, Prestressed Pipes and Fittings



These shall be of approved manufacture and quality and shall conform to IS : 458 , IS : 1592 , IS : 9627 & IS : 784 respectively.

19.4 Cast Iron Pipes and Fittings

The cast iron pipes shall be of approved manufacture and quality and shall conform to IS: 1536 "Centrifugally Cast (Spun) iron pressure pipe and/or IS : 1537 ". Vertically Cast Iron pressure pipe for water, gas and sewage. CI fittings shall conform to IS : 1538 (Part 1 to 23) .

19.5 Steel Pipes

This shall conform to IS: 1239 (Part 1&2) and IS : 3589. Steel pipes shall be coated with bituminous composition inside and galvanised outside.

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19.6 Bib Tap and Stop Tap

Bib tap and stop tap for water services shall be of brass screw down type and shall conform to IS: 781. Minimum finished weight of bib and stop taps shall be as given below:

No. of size (mm)	Bib taps (kg)	Stop tap (kg)
10	0.30	0.35
15	0.40	0.40
20	0.75	0.75
25	1.25	1.30
32	-	1.80
40	-	2.25
50	-	3.85

The taps shall be tested under internal hydraulic pressure of at least 20 kgf/cm² and maintained at the pressure for a period of at least two minutes during which period it shall neither leak nor sweat.

19.7 Valves



Unless otherwise mentioned in the Technical Specification globe and check valve of nominal sizes 80 to 100mm and conforming to IS : 778 shall be used . Valves shall be of class 1 and class 2, suitable upto a temp. of 45 degree C and can sustain non shock working pressure upto 1.0 and 1.6 MPA respectively. They shall have screwed or flanged ends. All the metal parts shall be of brass/brass alloy except hand wheel of Cast Iron or other approved quality.

19.8 Shower Rose

The shower rose shall be of heavy quality chromium plated brass with flat bottom, of diameter 100 mm or as specified with uniform perforations.

19.9 Storage Tank

Storage tank shall be either pressed steel, Galvanised iron, R.C.C or PVC of specified sizes, capacities, make, manufacture as specified in Schedule of Items. It shall have facilities for connecting inlet, outlet overflow and washout pipes and a top cover. Where tanks are to be fabricated by the Bidder the fabrication/R.C.C detailed drawings shall be got approved by Engineer.

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19.10 Miscellaneous items

19.10.1 Half round channel

This shall be made of vitreous china channel with or without outlet/stop end as specified in Schedule of Items and shall be of approved manufacture.

19.10.2 Urinal partition

This shall be made of vitreous china or R.C.C. with mosaic finish or marble as specified and shall be of approved make and quality.

20.0 EXTERNAL SEWERAGE & DRAINAGE

Unless otherwise specified CI pipe and specials, caulking lead, SW pipe, RCC pipe shall conform to the following.

20.1 C.I. Pipes

- i) C.I. pipe shall conform to IS : 1536 or/and IS : 1537 of class as specified in Schedule of Items.
- ii) C.I. pipe fittings shall conform to IS : 1538 (Part 1 to 23) as specified in Schedule of Items.
- iii) Bolts and nuts shall be hexagonal bolts and nuts conforming to IS : 1363 (Part 1 to 3).

20.2 Washers

Spring washers conforming to IS : 3063 shall be used near the pumps to take care of vibration. In other places plain washers conforming to IS : 2016 shall be used.

20.3 Gaskets



Gaskets shall be reinforced rubber sheet or compressed fibre board conforming to IS : 638 of thickness between 1.5mm to 3mm or as specified.

20.4 Caulking Lead

Lead for the spigot and socket joints shall conform to IS : 782.

20.5 Salt Glazed Stone Ware Pipes

Salt glazed stone-ware pipes used shall conform to IS : 651 and shall be laid as per IS : 4127 . The pipes shall be of grade AA unless otherwise specified.

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20.6 Steel Pipes

Steel pipes and fittings used for encasing shall conform to IS : 1239 (Part 1&2) medium Class upto 150 mm dia and as per IS : 3589 for pipes of dia 200 mm and above. For pipes of dia 200 mm and above fittings, if required shall be fabricated from pipes itself.

20.7 Cast Iron Manhole Covers & Frames

These shall be of medium or heavy duty (M.D. or H.D.) as specified in Schedule of Item and of Cast Iron with raised chequered design, lifting key and key hole and shall be coated with black bituminous base material. Medium duty covers and frames shall be either of circular type with 500 mm clear opening and minimum weight of cover and frame 116 Kg and 128 Kg respectively or of rectangular type with minimum weight of cover and frame 144 Kg.

Heavy duty covers and frames shall be either of circular type with clear openings of 500 and 560 mm and 170 and 208 Kg weight respectively or of double triangular type with clear openings of 500 and 560 mm and 229 and 255 Kg weight respectively.

The CI manhole cover and frames shall conform to IS : 1726.

21.0 ROAD

21.1 General



Roads shall be understood to include road bed, the wearing surface, berms, foot-paths, kerbs, culverts and bridges.

21.2 Soling Stones

Material for soling shall be natural stone boulders or crushed blast furnace slab. Stones for soling shall be of height equal to thickness of the soling with tolerance of plus or minus 25mm and shall not have a base area of less than 250 sq.cm. nor more than 500 sq.cm. and the smallest dimension of any stone shall not be less than half the largest dimension. Stones shall be tough, angular, durable and generally free from flat, elongated, soft and disintegrated particles. They shall also be free from dirt or other objectionable matter and be obtained from quarries approved by the Engineer.

Crushed slag obtained from air-cooled blast furnaces slag shall be angular, of reasonably uniform quality and density and generally be free from any thin, elongated, and soft pieces, dirt or other objectionable matter. The density of slag should not be less than 1.12 gm/cc and glassy material shall not exceed 20%. Water absorption when determined in accordance with IS:2386 (Part-III) . "Methods of Tests for Aggregates for Concrete : Specific Gravity, Density Voids, Absorption and Bulking", shall not exceed 10%.

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21.3 Coarse Aggregate for Water Bound Macadam

Coarse aggregate for water bound macadam shall be natural gravel, crushed stone obtained from approved quarries or crushed blast furnace slag. Crushed stone shall be hard, durable, tough and of uniform quality, generally free from flat, elongated, soft and disintegrated particles. It shall have sharp edges and also not have excess of dirt and other objectionable matter. When tested as per IS: 2386 (Part-IV) for Los Angeles Abrasion Value or Aggregate Impact Value, the limiting values shall be 50% and 40% respectively for base course and 40% and 30% respectively for surfacing course. The flakiness index shall not exceed 15% when tested in accordance with IS: 2386 (Part-I) "Methods of Test for Aggregates for Concrete : Particle size and Shape". Crushed slag aggregates shall meet the requirements given for soling stones from blast furnace slag.

Size and grading requirements of coarse aggregates shall be as specified in Table-2 of IRC : 19 "Standard Specification and Code of Practice for Water Bound Macadam". The grading number of the table shall correspond to the following layer thicknesses :

Grading Number	Size Range	Layer Thickness
1	90 mm to 40 mm	More than 90 mm
2.	63 mm to 40 mm	90 mm to 75 mm
3.	50 mm to 20 mm	75 mm to 50 mm

21.4 Screenings



Screenings used for filling voids in coarse aggregates for water bound macadam shall generally be of the same material as the coarse aggregate. Non-plastic materials such as Kankar nodules, moorum or gravel (other than river bore rounded aggregates) may be used, provided that the liquid limit and plasticity index are below 20 and 6 respectively. The fraction passing 75 microns sieve shall not exceed 10%. Size and grading of screenings shall be as specified in Table-3 of IRC-19 . Type-A screening shall be used for grade number 1 coarse aggregate. Type-B screenings shall be used for grade number 3. Either Type-A or Type-B screenings may be used for grade number 2.

21.5 Stone Chips for Bituminous Surfacing

Coarse aggregate shall consist of crushed stone, crushed slag or crushed gravel (Shingle) retained on 2.36 mm sieve. The aggregates shall be clean, strong, durable and fairly cubical, free from disintegrated pieces, organic and other objectionable matter. The aggregates shall preferably be hydrophobic and of low porosity. The mechanical properties and grading shall be in accordance with IRC-29 "Tentative Specifications for 4 cm Asphaltic Concrete Surface Course", having aggregate impact value 30%, Flakiness Index 25% and graded between 20mm and 2.36 mm.

21.6 Sand

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Sand for use as fine aggregate in bituminous surfacing shall consist of crushed screenings, natural sand or a mixture of both, passing a 2.36mm sieve and retained on 75 micron sieve. It shall be clean, hard, durable, uncoated and dry, free from injurious, soft or flaky pieces and organic deleterious substances.

21.7 Binder

Binding material for water bound macadam shall consist of fine grained material such as stone dust, kankar modules or moorum. The plasticity index shall be between 4 to 9 when water bound macadam is to be used as surface course and upto 6 when used as sub/base or base course.

21.7.1 Paving Bitumen

It shall conform to IS : 73 and shall be of the specified type and grade. The material shall be homogeneous and shall not foam when heated to 175 degree C. Various properties like specific gravity, flash point, softening point, penetration etc. shall be as given in the above code.

21.7.2 Bitumen Cut Back

Bitumen cut-back shall conform to specification given in IS : 217 . It shall be of three types, Rapid Curing (RC), Medium Curing (MC) and Slow Curing (SC). These shall comply with the requirements specified in Table - 1, 2 and 3 respectively of the above code.

The above three types of cutback bitumens shall be classified into different grades on the basis of Kinematic viscosity. Rapid curing type shall be used with aggregates containing practically no fine aggregates passing through 2.36 mm sieve. Medium curing bitumen shall be used with aggregates containing less than 20 per cent of fine aggregates passing through 2.36 mm sieve. Slow curing type shall be used with aggregates containing more than 20 per cent of fine aggregate passing through 2.36 mm sieve.

Medium curing bitumen of 30 grae i.e. MC 30 shall be used as primer. Manufacturer shall indicate source and type of the bitumen.

21.8 Kerbs

Kerbs may be of stone or concrete as may be shown in drawing or otherwise directed by Engineer.



21.8.1 Stone kerbs

Stones shall conform to the dimensions and shapes given in drawing.

Exposed faces shall be dressed to lines.

21.8.2 Concrete kerbs

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Shape and dimension shall conform to the drawing. They shall be pre-cast and the road side top corner shall be given a chamfer.

21.9 Galvanized Steel Barbed Wire for Fencing

These shall be of two types A&B. In both types Barbs shall have 4 points formed by twisting two point wires, each two turns. In type A (lowa type) twisting is done around both line wings and in type B (Glidden type) around one line wire, in both cases making altogether four complete turns. It shall conform to IS : 278 and shall have the diameter of line and point wire as described in schedule of item. Galvanized mild steel wire shall conform to IS : 280.

Line and point wire shall be circular in section, free from scales and shall be uniformly galvanized. Line wire shall be in continuous length and shall not contain any welds other than those in rod before it is drawn.

21.10 Galvanized Steel Chain Link Fabric

It will conform to IS : 2721. It shall be of width, mesh and wire dia as per description of Item. For chain link fabric having width upto 2.00 M, of all mesh sizes, two line wires shall be provided. Whereas for width of 2.40 M and mesh size exceeding 50mm three line wires shall be provided. These shall be provided at top and bottom of the fabric, but wherever three line wires have been specified, these shall be provided at top, bottom and middle of fabric.

The mesh wire and line wire of the fabric shall be manufactured from Galvanised steel conforming to IS : 280. It will have zinc coating of type medium as given in IS : 4826 . " Specification for Hot dipped galvanized coatings on round steel wires". Unless otherwise mentioned in the description of item fabric with both ends twisted shall be used.

The galvanised steel pipe posts shall consists of 80 mm and 50 mm nominal diameter. The pipe posts shall conform to IS : 1161 and shall be of medium grade and galvanised.



22.0 LIST OF MATERIALS FOR WHICH APPROVAL OF BRANDS / MANUFACTURER IS REQUIRED BY THE BIDDER:

The list of materials for which approval of brands / vendors is required by the Bidders from NTPL are given in Vol. IIA – Chapter 15.00. The Bidder shall furnish the names of the brands / manufacturer for the materials given in the list.

23.0 MATERIALS NOT SPECIFIED

Any materials not fully specified in these specification and which may be offered for use in the works shall conform to the relevant standards & codes.

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PART II (WORKMANSHIP)

1.0 GENERAL

1.1 Standard

A high standard of workmanship in all trades will be required. The Bidder shall ensure that only skilled and experienced workmen are employed.

1.2 Supervision

The Bidder's supervising staff shall be fully qualified and experienced in the types of work being carried out under their supervision and shall be capable of ensuring that work is executed efficiently and as per specification.

1.3 Temporary works

Where required, the Bidder shall furnish such details of his temporary works as may be called for by the Engineer and the Bidder shall satisfy the Engineer as to their safety and efficiency. The Engineer may direct that temporary works, which he considers unsafe or insufficient, shall be removed and replaced in a satisfactory manner.

1.4.0 Codes

1.4.1

The years of publication against various standards, referred in this specification, correspond to the latest standards as on date of preparation of this specification. During use of this specification in future, the latest publication as on date shall be referred to. Where standards are not yet published by the BIS or IRC, adoptable British Standards or other International Standards shall apply.

In case of any conflict in meaning between these specifications and those of BIS or IRC, or British/International Standards, the provisions of these specifications shall prevail.



1.5 Base lines and bench marks

The Bidder shall establish and maintain, to the satisfaction of Engineer, the base lines and bench marks, based on which the works are set out. Where such base lines and bench marks are provided by the Engineer, the Bidder shall maintain these throughout the period of construction without causing any disturbance to them.

1.6 Setting out

The Bidder shall set out all the works to be executed by him, in line with the standard base lines, levels, position and bench marks and truly as per drawings within the accepted tolerance limits at no extra cost to Owner. The Bidder shall be solely responsible for the setting out of all the works, to be executed by him and the approval of such setting out by the Engineer shall in

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no way absolve the Bidder his responsibility for carrying the work to the true lines, levels and positions as per drawings.

1.7 Dewatering

The Bidder shall carry out all the works, in dry and workable condition and maintain the same in dry condition till the final handing over of works at no extra cost to the Owner. For this the Bidder shall make all the necessary provisions of dewatering, wherever necessary, to the entire satisfaction of the Engineer.

1.8 Safety of existing work

Before taking up any construction adjoining other property or existing work, the Bidder shall take all steps necessary for the safety and protection of such property or work at no extra cost to the owner.

1.9 Protection of existing services

The Bidder shall take all precautions necessary to prevent damage to or interference with underground or overground services such as cables, drains, piping or piles, whether shown on drawings or not. Equipment etc., mounted in position shall be protected against falling debris etc., by means of tarpaulin or such other material at no extra cost to the owner.

1.10 Handing over of work site

On completion of work, the Bidder shall remove all rubbish, debris, surplus materials, temporary work etc., from the site. The site shall be handed over in a tidy and workmanlike manner at no extra cost to the owner.

2.0 EARTH WORK



2.1 Scope

This chapter deals with earth work and excavation for civil works in site, formation/oversite leveling, foundations, cutting and grading for roads/pavement and railways, canals, embankments other than water retaining embankments trenching for drainage and other buried services and the like.

2.2 General

The Bidder shall carry out the excavation strictly to the lines and levels, in conformity with the drawings or instructions of the Engineer.

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2.3 Setting out

Before commencement of earthwork block levels of existing ground shall be taken by the Bidder jointly with the Engineer, plotted and signed in token of acceptance of ground levels. Excavation shall not be commenced until the initial ground levels have been recorded and accepted. Reference lines, bench marks and base lines shall be set out by the Bidder for control of earthwork operation. Setting out shall be done with pegs, blocks, bamboo poles or rails, marking boundaries or centre lines, as the case may be, and the same maintained for reference and future checking. Chainage stones at regular intervals shall be set up for embankments. All setting out operations shall be got checked and approved by Engineer. However, such checking and approval by the Engineer shall in no way absolve the Bidder of his responsibilities for carrying out the work to the true lines, levels and positions as per drawing, and in case any error is noticed at any stage in the bidder's work, it shall be corrected/rectified by him without any cost to the Owner.

2.4 Site clearance and demolition

The site shall be cleared of all trees, stumps, roots, brush wood, bushes and other objectionable materials. Useful and saleable material, if any, shall be the property of the owner and shall be stacked properly as directed by the Engineer. The areas to be covered with embankments shall be stripped of top soil to required depths to expose acceptable founding strata. Top soil unsuitable for use in embankment construction and other fills shall be disposed off as directed. All combustible materials shall be stacked and burnt in locations sufficiently remote to eliminate all danger of fire hazards. All old concrete, brick works and drains which interfere with construction works shall be dismantled with the approval of the Engineer taking all necessary precautions prescribed in safety specification. Top soil which is suitable for use in construction work shall be stockpiled for later use. Other objectionable materials such as trash, debris, stones, brick, broken concrete, scrap metal etc., shall be disposed off as directed by the Engineer.



2.5 Classification of soil

The Engineer will decide the class of any particular soil. Classification of soil shall be as under and the decision of the Engineer shall be binding on the Bidder :

A) Ordinary Soil

Soils which yield to ordinary application of pick and shovel, phawra rake or other ordinary digging implements (including earth moving equipment such as bulldozer, shovels without resorting to blasting) without offering much resistance, shall be classified as ordinary soil. This includes organic soil, turf, sand, gravel, loam clay, mud, peat, black cotton soil, soft shale and loose moorum etc.

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B) Hard Soil

This comprises of all soils that cannot reasonably be excavated by the above mentioned digging implements, but can be excavated with close application of pick axe or scarifiers or jumpers to loosen. This includes compact moorum, stiff clay, hard shale, cobble stone etc.,

C) Soft /Decomposed Rock

This comprises of rock or boulders which may be quarried or split with crow bars, pavement breakers etc., This include lime stone, sand stone, weathered rocks and hard conglomerates etc .and existing structures embedded in earth and tarred macadam roads, pavements, met in the excavation. The fact that bidder resorts to blasting for his own reasons shall not mean that the rock is hard and classified as hard rock.

D) Hard Rock

This comprises of rocks which require blasting for excavation. Where blasting is prohibited, excavation has to be carried out by chiseling, wedging or any other agreed methods.



2.6 Method of excavation

The Bidder may carry out excavations, filling and compaction by any method considered most suitable, and befitting the site conditions subject to any stipulations contained in the contract and the specifications. All excavations shall be required to be kept completely free from water, from whatever source it may come, during the construction. No foundation work shall be taken up until the surfaces are properly drained.

2.7 Excavation of soils other than hard rock

Excavation shall be carried out in the most expeditious and efficient manner to the lines and levels as indicated in drawings or as directed by Engineer. Prior approval of the Engineer shall be taken for the method to be adopted for excavation including dimensions, side slopes, dewatering, shoring etc., Such approval shall not make the Engineer responsible for any consequent damage or loss caused. All precautions shall be taken to preserve the material below and beyond line of excavation in soundest condition. All damages done beyond limits of excavation shall be made good by the Bidder at his own cost in a manner approved by the Engineer. All excavated materials shall be removed to spoil heaps, dumping yards or transported for filling as may be necessary. When soil heaps are formed for future use, heaps shall be protected from washing away due to rain or surface run off. The sides of excavation shall be maintained in stable condition by adequate stepping and batter. To prevent entry of surface water and accumulation of subsoil water in excavated areas, suitable drainage arrangements as may be needed and directed by Engineer, shall be provided and maintained.

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Pumped out water shall be drained off properly avoiding damage to other existing works. If any pipelines, cables or service lines are likely to be exposed, excavation around these services shall be carried out manually and all such services shall be adequately supported and protected at no extra cost.

Excavation shall be carried out in any material encountered including road surfaces, pavements, buried parts of old foundations, pits or other structures. Excavated materials shall be placed beyond 1.5 metres of the edge of the excavation pit/trench or half the depth of the pit/trench whichever is more or further away as directed by the Engineer. Sumps made for dewatering must be kept clear of the foundations.

In firm soil the sides of the trenches shall be kept vertical upto a depth of 2.0m from the bottom and for a greater depth, trench shall be widened by allowing steps of 50cm on either side after every 2.0m depth from the bottom, so as to give a vertical side slope of 1/4 : 1. Where the soil is soft, loose or slushy, the width of the steps shall be suitably increased or sides suitably sloped or suitable shoring and strutting provided as directed by the Engineer. For trenches deeper than 2.0m, the Bidder shall obtain detailed instruction from the Engineer in writing regarding the stepping, sloping of sides or shoring and strutting to be done. For these bye-works, no extra cost will be paid to the Bidder.



2.8 Excavation in hard rock

Where hard rock is met and blasting is considered necessary for its excavation, the Bidder shall intimate the Engineer in writing. Excavation in hard rock shall be done either by blasting or chiseling or by such other agreed methods as may be required. Levels of hard rock surface shall be taken and got approved by Engineer before start of excavation. Blasting shall be permitted only when proper precautions are taken for protection of persons, works and property. The Bidder shall obtain the necessary licence for procuring, storing and using explosives.

Blasting operations shall be carried out by a licensed Blaster. The quality and quantity of explosives, size and spacing of holes depth of holes etc., shall be such that they will neither open seams nor damage or shatter the rock beyond the specified lines of excavation. A tolerance of 150 mm will however be allowed beyond the excavation lines. As excavation approaches final stages, the depth of holes and the amount of explosives used shall be reduced progressively to avoid over breakage or damage to founding strata. Any fissures, cracks and voids below prescribed depth of excavation shall be corrected by removing loose pieces, shattered or affected rock and replaced by lean concrete of M-5 grade or (1:5:10) cement concrete in the case of foundations. Where excavated surface is to receive structural concrete, the surface shall be cleaned of dust and other objectionable materials.

In cases where blasting, though otherwise required, is prohibited because of any reason, the excavation shall be carried out by chiseling, wedging or such

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other agreed methods. All materials excavated from blasting, chiseling or any such methods shall be stacked for measurement as directed by Engineer.

2.9 Cutting and filling for site leveling

Excavation and filling operations for site leveling shall be so planned and executed, that transportation and re-handling are minimised. The sides of excavation and fills shall be maintained in stable condition by adequate batters, stepping and dewatering. Materials not desirable shall be disposed off in area indicated by Engineer. When it is required to blend the material, it shall be done by selective excavation and filling operation. Wells, ponds, cesspools and water logged areas shall be emptied of water and deslushed before filling. Filling shall be done in horizontal layers not exceeding 300mm in thickness as specified or as directed by the Engineer. All clods shall be broken before placing the fill. Earth moving equipment shall be allowed to ply over the fill to permit compaction. Adequate allowance shall be made for subsidence of fill material. Levels shall be taken and excess or shortfall shall be made good by appropriate cutting or filling.

2.10 Excavation for trenches

Excavation for trenches shall be carried out in materials encountered to enable laying of service lines or drainage channels or any other desired purpose. Excavation shall be done to lines and levels shown in drawings and shall be done providing adequate measures for stability. Vertical wooden sleepers or light rails shall be erected at uniform levels at places where changes of direction and gradients occur. Centre lines shall be marked on horizontal sleepers or rails, laid across the trenches. Depths of excavation and pipe invert levels shall be checked by means of boning rods of appropriate lengths. Trench beds shall be trimmed and rammed with sprinkling of sand or moorum to required gradients for continuously supporting the pipelines. Trenches shall be locally deepened and widened to receive sockets and permit joints to be inspected.



Timbering

In case of trenches, tunnels, channels, drains, manholes, chambers, basement and other places where the soil is not capable of being retained without the support, timbering as directed by the Engineer shall be resorted to. It shall be the responsibility of the Bidder to take all the necessary steps to prevent the sides from collapsing.

2.11 Excavations for foundations

Excavation for foundation shall be done to the lines and levels indicated in the drawings. Excavated material shall be transported and stored at convenient spots for reuse in back filling of foundations and other fills. Surplus material shall be transported, spread and levelled at dumping areas. Side slopes of excavation and/or shoring shall be adequate from consideration of stability and working space. When so required and authorised by Engineer, the sides

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of excavation shall be protected with proper shoring, strutting, sheeting and sand bags etc., These shall be removed only when work in the pit is completed, with the approval of the Engineer. When it is felt that removal of supports may result in side collapse or settlement of adjoining ground or endanger adjoining structures and foundations, they shall be left permanently in position. The last 150 mm of excavation shall be done and the bottom trimmed to the required levels only when concreting is imminent. If at any point the natural ground is disturbed or loosened for any reason, it shall be consolidated by tamping or rolling or made up with concrete of M-5 grade, or (1:5:10) cement concrete if so ordered by the Engineer at no extra cost. Where the soil encountered at depths indicated in drawings is loose or weak, it shall be further excavated to levels of firm strata as may be directed by the Engineer and filled with lean concrete of M-5 grade/(1:5:10) cement concrete or sand as directed. If the bottom of excavation has been left exposed not through neglect or fault of the Bidder and it has become deleteriously affected by atmospheric action and water, such portion of deteriorated foundation material shall be removed and made good by lean concrete of grade M-5/(1:5:10) cement concrete or sand as directed and such extras will be paid for.



2.11.1 For deep excavation in the proximity of existing buildings, foundations, streets, railway tracks, underground cabling, gas piping, water and drainage lines, and the like, adequate appropriate precautions shall be taken to protect such structures or works from damage, displacement or settlement, either as an immediate result of the excavation or as after effect, discernible with the passage of time. The method of protection of existing structures and services may include sheet piling, shoring, strutting slinging or any other method including dewatering. Payment for such protective work shall be governed by the description given in the Schedule of Items for the particular work.

2.11.2 For excavation adjoining existing piles care shall be taken to ensure that no pile under any circumstances is exposed from the top for a height exceeding 2 metres. No strutting shall be done against exposed piles, nor exposed piles ever used for tying guy ropes or supports either temporarily or permanently.

2.12 **Excess excavation**

All excavation done beyond the specified limits or directions of Engineer shall be considered as excess excavation. They shall be made good as prescribed below by the Bidder at his cost:

- i) Excess excavation in case of site leveling shall be made good by filling and compacting with material same as the surrounding material. Degree of compaction shall be at least the same as the surrounding material.
- ii) Excess excavation in case of trenches shall be made good by filling and compacting with selected earth to the same compaction as the surrounding material or as directed by Engineer. This shall be done in

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layers not exceeding 150 mm thick, moistened and thoroughly compacted by tamping.

- iii) Excess excavation in case of foundation beyond required depths shall be made good by filling with lean concrete of M-5 grade/(1:5:10) cement concrete.

2.13 Disposal of excavated materials

Excavated materials that are unsuitable for use in construction works or in excess of construction requirements shall be disposed off in dumping yards or in locations indicated by Engineer. Waste piles/heaps shall be located in such places where they will not interfere with natural flow of rain water access or transport or with the access to nearby structures. When required, they shall be levelled and trimmed to such lines and levels as indicated by Engineer.

2.14 Back filling of trenches

Trenches shall be backfilled after pipes or service lines are tested and approved. Filling shall be done with earth in 150 mm thick layers free from unwanted material and well rammed. Soft material shall be used in bottom of trenches upto a level of 150 mm above the top of pipes before backfilling with other fill materials. All clods and lumps shall be broken before placement. Care shall be taken not to disturb, break or damage the pipes during backfilling and compaction process.



2.15 Backfilling of foundations

Backfilling of foundations shall be done using suitable soils from excavations. Soil shall be free from organic matter and other materials which would affect the stability of the fill and shall be free from boulders, brick bats wood pieces and other injurious materials, lumps and clods. Before commencement of backfilling of foundations. all shoring and formwork, bits of timber, cement bags and all other rubbish shall be removed. Hydro-insulation, Bitumen painting or application of anti-corrosive protective and anti-termite treatments shall have been completed. Backfilling operation shall not commence without approval of Engineer. Backfilling shall be carried out in well compacted layers of 150 mm thickness. Each layers shall have near optimum moisture content. Layers will extend to the entire width of excavation and shall be sprinkled with water during compaction process. Ramming shall be done to achieve firm compaction. Backfill shall be trimmed and finished to lines and levels indicated in the drawings and/or as directed by the Engineer. Mechanical equipment like vibratory roller, vibro earth rammer or vibratory compactor shall be used for compaction.

2.16 Filling under floors

Material for filling under floors shall be soil free from harmful minerals, vegetable matter etc., and shall not be expansive soils. Filling shall be done

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in well compacted layers not exceeding 150 mm in thickness. Each layer shall be compacted to 95% Standard Procter Density. Sufficient soaking shall be done before compaction. The entire area to be covered by flooring shall be finally dressed and trimmed to required levels. Mechanical equipment like vibratory roller, vibro earth rammer or vibratory compactor shall be used for compaction.



2.17 Load bearing fills

Load bearing fills include embankments for roads and railways and such other earth fills above ground levels provided for protection of fuel oil tanks, pads for storage tanks, drain, bunds and the like. Fill materials shall either be selected earth obtained from excavations for site leveling, trenches and foundations or from selected borrow areas as may be required. Soils selected for filling in embankments shall be of uniform quality and free from boulders, organic materials and other objectionable matter. Soils having high silt and clay content and having laboratory maximum dry density less than 1.44 gms per c.c. shall not be used for load bearing fills. For fills greater than 3 m in height soils shall have laboratory density not less than 1.52 gms per c.c. Soils for top 500 mm of fills for roads and railways shall have laboratory density not less than 1.65 gms per c.c. and shall not have marked swelling and shrinkage properties.

Foundation preparation for embankments shall be done as prescribed under site clearance. The founding strata shall be compacted as much as possible by rolling or tamping before placement of fill material. The water content of founding strata should be same as that specified for embankment fill. Any pockets of loose material or depressions left in founding strata as a result of clearing operation shall be filled and compacted with the same material as the surrounding founding strata. When an embankment is to be placed on steep sloping ground the surface of the ground shall be trenched in steps or trenched or broken up in such a manner that the new materials bonds well with the founding strata.

Fill material shall not be placed until foundation has been inspected and approved by Engineer. Material shall be placed in even, continuous, horizontal layers over full width of embankment in well compacted layers not exceeding 200 mm thickness. Each layer shall be compacted by means of smooth rubber tyred rollers, sheep-foot rollers, tractors, tampers or other mechanical means as may be found suitable for the location. Before rolling, the water content shall be checked and corrected by sprinkling with water or adding dry material or aeration as may be required. This shall be followed by mixing and the layer left for soaking before compaction. The water content shall be within plus or minus 2% of Standard Proctor Optimum. Density of compacted layers shall be determined by sand replacement method. Average compacted density shall be at least 95% of Standard Proctor Density. The number of tests to be conducted for determination of moisture content and density shall be as prescribed by the Engineer. Side slopes of embankments shall be formed along with the main embankment. No side dumping shall be done for the formation of slopes. When required the width

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of each layer shall be constructed slightly in excess of required width and slopes trimmed to remove loose edge materials and completed to lines shown in drawings or as directed by the Engineer. Subgrades for road works shall be thoroughly wetted sufficiently in advance of placing of any base course and it shall be ensured that it is firm and moist for at least 50 mm below the surface. Should the subgrade for any reason be loose or have density less than required, it shall be recompacted and refinished. Excessive loss of moisture in the subgrade shall be prevented by sprinkling and/or scaling. No traffic or hauling equipment shall be permitted to ply on finished subgrade and any damage caused to such portion shall be made good by the Bidder at his own cost.

2.18 Turfing

The slopes of embankment shall be dressed to line and slightly roughened to bond and hold a surface dressing consisting of 150 mm humus layer of soil. The entire surface shall then be covered with turf consisting of blocks or strips of grass of approved species. The sod shall include a net of roots and earth at least 75 mm thick. The sod shall be laid on slope in close contact and then tamped in place so as to close and fill the joints between blocks.

Immediately after placing the turf, slope shall be thoroughly wetted and kept wet for a sufficient period to assure plant growth. Watering shall be continued until the grass takes root firmly and the whole area presents a uniform appearance. In the event that the plant growth has not taken place within the period of maintenance such areas or patches shall be redone by the Bidder at his own cost.



2.19 SITE GRADING EMBANKMENT CONSTRUCTION BY EARTH

- (A) Wherever the above work grading is to be done this shall be compacted in layers not exceeding 200 mm compacted thickness each, at its Optimum Moisture Content (OMC), by Vibratory Roller, so as to achieve a Field Dry Density not less than 97 % of Maximum Dry Density (MDD) obtained in Modified Proctor Compaction Test as per IS: 2720 (Part-8) . Both Edges of each layer shall be laterally confined by 1.0 m wide cover of cohesive / semi cohesive approved earth, which shall be compacted simultaneously along with individual layer. Similarly top most layer of fill shall be covered by a similarly compacted layer of cohesive / semi cohesive layer of approved earth.

The Vibratory Roller to be used shall be of self propelled type, with two pneumatic drive wheels at rear axle & one cylindrical smooth steel vibrating drum at front axle having capacity of exerting a static linear operating load of minimum 28 kg/cm in the rolling drum attached with front axle. It shall have the option for dual frequency & dual amplitude within a amplitude range of 0.60 mm to 1.80 mm and frequency range of 30 to 36 cps while operating with vibration.

The thickness of loose fill material to be spread, number of roller passes, frequency & amplitude of vibration and roller speed, required to achieve the

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specified compacted thickness and density shall be established at site by trial run.

Each roller pass shall overlap its adjacent pass by a minimum width of 0.30 m. Rolling for each layer shall start from edge of embankment. The middle-third portion of embankment width shall be compacted after compaction of both edges.

In locations, where compaction by means of Vibrating Roller is undesirable or impractical viz. adjacent to existing structures or in confined areas, soil shall be compacted by suitable Vibratory Earth Rammer or Vibratory Plate Compactor in layers not exceeding 150 mm compacted thickness.

(B) Filling for Embankment/ Grading



The material to be used shall be selected material capable of being compacted to the requirements stated herein below and approved by the Engineer, obtained directly from excavation for area grading / embankment from nearby areas where excavation work by the same agency is in progress, from temporary stacks of excavated spoils or from borrow pits or Ash dump in selected areas designated / approved by the Engineer.

If any material is rejected by the Engineer, Bidder shall remove the same forthwith from the site . Surplus fill material shall be deposited / disposed of as directed by the Engineer after the fill work is completed.

No earth fill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by the Engineer.

Before commencement of work, the existing top soil shall be removed upto a depth as indicated in BOQ item / drg or as directed by the Engineer in order to clear the surface of undesirable materials. After this the filling operation shall be performed with filling material in layers not exceeding 200 mm compacted thickness. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as given below and got approved by the Engineer.

- a) Each layer of fill material cohesive in natural, shall be compacted by vibratory Roller at **OMC** so as to achieve 95% of maximum dry density obtained in modified proctor compaction test.
- b) Each layer of fill material of non-cohesive nature, shall be compacted in saturated condition by vibratory roller so as to achieve minimum 70% relative density unless otherwise permitted / directed by the Engineer. Each layer shall be compacted with approved machine (mechanical plant) and usually manual compaction shall not be allowed unless specifically permitted by the Engineer. The original ground formation and each fill layer shall be compacted by vibratory rollers.

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- i) When the optimum moisture content of soil is relatively high, a pneumatic tyred roller (type pressure 3.0 - 3.5 kg/sq cm) shall be considered to give better performance for mechanical compaction.
- ii) When the optimum moisture content of soil is relatively low, a vibrating roller shall be considered to give better performance for mechanical compaction.

Since the degree of compaction depends on the moisture content of the soil/ash, a close watch shall be kept on this aspect and corrections done to bring moisture content near to optimum. The adequacy of the compaction and moisture content of the soil shall be determined by performing field density tests and other tests as and when directed by the Engineer and shall conform to the stipulations laid down in IS : 2720 (part 28).

Field compaction test shall be carried out after compaction of every layer of filling and also after the fill to the entire height has been completed.

When density measurements reveal soft areas in the construction, further compaction shall be undertaken at the bidder's cost as directed by the Engineer. If the required compaction is then not achieved the material in the soft area shall be removed and replaced by approved material and compacted in accordance with this specification all to the bidder's account.

The fill shall be carried out to such dimensions and levels as indicated on the drawings after the stipulated compaction. The fill will be considered as incomplete if the desired compaction has not been obtained.

(C) Filling in Disposal Area

Excavated materials if not used in area filling, will be disposed of in designated disposal areas as directed or as indicated in the drawings. The earth shall not be dumped haphazardly but shall be spread in horizontal layers not exceeding 500 mm in thickness and nominal compaction done to the satisfaction of the Engineer.



All clods shall be broken before placing the fill. Earthmoving machinery including dumpers, dozers and trucks shall be allowed to ply over the fill to permit compaction to take place.

In wide areas rollers may be employed and nominal compaction done to the satisfaction of the Engineer.

(D) Compaction Control :

The density of each layer or compacted soil shall be ascertained by testing a number of samples. For this purpose the necessary arrangements for soil

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testing at the site shall be made by the Bidder in accordance with these specifications and as directed by the Engineer.

All density testing shall be carried out on a lot by lot basis. A lot shall be considered to be a portion of work which is essentially homogeneous with respect to material type general appearance response during compaction, moisture condition during compaction, compaction process and state of underlying material.

All fill testing shall be carried out in accordance with the recent editions of relevant Indian Standards. The location of the fill of each test sample shall be recorded and presented along with the test results,

Each test lot shall be classified as cohesion less or cohesive. The classification shall be determined by the Engineer based upon particle size distribution and Atterberg limit .

For cohesion less fill material, a representative laboratory sample obtained from three field samples for each test lot shall be tested to determine its maximum and minimum dry density. These reference values of dry density shall be used to compute the density index (relative density) of each of the field density test samples taken from the test lot.

For cohesive fill material, a representative laboratory sample obtained from three field samples from each test lot shall be tested to determine its maximum dry density and optimum moisture content (OMC). These reference values of dry density and moisture content shall be used to compute the dry density ratio of each of the field density test samples taken from that test lot.

The degree of compaction shall be determined by considering the mean density of the samples in each test lot. The mean dry density shall be equal to or exceed the minimum specified density, In no individual case shall density be less than the minimum value specified by more than 2 percent, otherwise further rolling shall be done at the appropriate locations.

The bidder shall lay a further layer or fill only after compaction or a particular layer has been found and approved by the Engineer.



(E) TESTING AND ACCEPTANCE CRITERIA

Soil Testing

The following tests shall be undertaken by the Bidder and results and reports shall be submitted to the Engineer for approval. Test failures are to be immediately notified to the Engineer and rectified approval taken .Each layer of material shall be tested for compaction.

Each layer is to be tested in a manner that is representative of its full depth. The Engineer may at his discretion instruct the Bidder to increase or decrease the frequency of testing.

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- a) Minimum two sets of laboratory tests per 8000 cum of soil coming out of the borrow pits for determination of maximum dry density & corresponding optimum moisture content by modified protector compaction Test . Test to be done in accordance with IS ; 2720 (Part-viii) as applicable.
- b) Minimum two sets of test per 1000 sqm of plan area for determination of field moisture content just prior to compaction of area filling by Rapid moisturemeter at field. Test to be done in accordance with IS: 2720 Part - II).
- c) For each compacted layer, minimum one test per 1000 sqm of compacted area for determination of field dry density as per IS : 2720(part 28).

Acceptance Criteria

Excavation

On completion of excavation, the dimensions of the area will be checked as per the drawings after the area is completely dewatered. The work will be accepted after all undercuts have been set right and all over excavations filed back to required lines, levels and grades by compacted filling material . Over excavation of the sides will be made good by the Bidder. The excavation work will be accepted after the above requirements are fulfilled & all temporary approaches encroaching inside the required dimension of the excavation have been removed.

Area Filling/Embankment construction

The degree of compaction required will be as per the stipulations laid down in appropriate sections of this specification. The actual method for measuring the compaction achieved will be as decided by the Engineer. The work of area filling will be accepted after the Engineer is satisfied with the degree of compaction achieved.



Backfilling

General

The material used for backfilling shall consist of material, approved by the Engineer obtained directly from nearby areas where excavation work by the same agency is in progress from temporary stacks of excavated spoils or from borrow pits from selected areas designated by the Engineer. The material shall be free from lumps and clods, roots and vegetations, harmful salts and chemicals, organic materials, etc.

In certain locations, the Engineer may direct sand fillings. The sand should be clean, well graded and be of quality normally acceptable for use in concrete.

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Filling and Compaction in Pits and Trenches around Structures

As soon as the work in foundations has been accepted and measured, the spaces around the foundation structures in pits and trenches shall be cleared of all debris, brick bats, mortar droppings, etc., and filled with earth in layers not exceeding 250 mm in loose thickness each layer being watered, rammed and properly compacted to achieve a dry density of not less than 90% of proctor's dry density at optimum moisture content as per IS : 2720 Part-VII) where backfilling with cohesive soil and sandy silt containing high percentage of silt. For back filling with sand having little or no silt, each layer shall be compacted to a relative density of 75% as per IS : 2720 part XIV. Earth shall be rammed with approved mechanized compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the Engineer. The final surface shall be trimmed and levelled to proper profile as shown in the drawing and as desired by the Engineer.

Since the degree of compaction depends on the moisture content of the soil, a close watch should be kept on it and corrections done to optimize the moisture content.

The plinth shall be filled with earth in layers not exceeding 250 mm in loose thickness, watered and compacted as specified with approved compaction machine or manually, if specifically permitted by the Engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted, in order to avoid any settlement at a later stage. The finished level of the filling shall be trimmed to the slope intended to be given to the floor.

Filling in Trenches for Water Pipes and Drains



Earth used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not bigger than 150 mm size in any direction, mixed with fine material consisting of disintegrated rock, moorum or earth as available, so as to fill up the voids as far as possible and then the mixture used for filling. The types of bedding & pipe surround material shall tie as specified in the drawings.

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed.

Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150 mm, watered rammed and compacted taking care that no damage is caused in the pipe below. Filling of trenches shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur,

In case of excavation of trenches in rock, the filling upto a depth of 300 mm or the diameter of the pipe whichever is more, above the crown of pipe or barrel shall be done with fine material such as earth, moorum, disintegrated rock or

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ash according to the availability at site. The remaining filling shall be done with rock filling of boulders of size not exceeding 150 mm mixed with fine material as available to fill up the voids: watered, rammed and compacted.

Surplus material from excavation which is not required for backfilling will be disposed of in designated disposal areas. The spoils shall not be dumped haphazardly but should be spread in layers approximately 250 mm thick when loose and compacted with the help of compacting equipment. In wide areas rollers will be employed and compaction done to the satisfaction of the Engineer at the optimum moisture content which shall be checked and controlled by the Bidder.

In certain cases the Engineer may direct disposal without compaction which can be done by tipping the spoils from a high bench neatly maintaining always a proper level and grade of the bench.

3.0 ANTI-TERMITE TREATMENT

3.1 Scope

The scope of work includes setting up a chemical barrier against attack by subterranean termites while the building is under construction.

3.2 Execution

3.2.1 General

Unless otherwise specified all work shall in general be executed as specified in IS : 6313 Part-II and as per approved specification of the agency having special know-how for the job.

All necessary work to ensure uniform distribution and proper penetration of treating solution shall be done according to the instruction of the Engineer.

Soil treatment shall not be done when it is raining or when the soil is wet with rain or subsoil water. Once formed, the treated soil barrier shall not be disturbed.



3.2.2 Chemicals and rate of application

Chemical like chlorpyrifos 20% EC (Conforming to IS 8963) in 1% emulsion shall be applied by pressure pumps, uniformly over the area treated. (1 part chemicals + 20 parts water = 1% emulsion).

3.2.2.1 Treatment of pits, trenches & basement excavations

Foundations, basements etc. may either be fully enveloped by the chemical barrier or the treatment may start 500 mm below ground level. The bottom surface and sides of excavation (upto a height of about 300mm) for column pits, walls, trenches and basements shall be treated with emulsion @ 5 liters

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per sq.m. of surface area. Backfills around columns, walls, etc., shall be treated @ 7.5 liters per sq.m. of the vertical surface. Treatment shall be done in stages following the compaction of earth in layers. The treatment shall be carried out after the ramming operation is done by rodding the earth at 150mm centers closed to the wall surface and spraying the emulsion in the specified dose.

3.2.2.2 Treatment of top surface of plinth filling



Holes 50 mm to 75 mm deep at 150 mm centres both ways shall be made with crow-bars on the surface of compacted plinth fill. Emulsion at the rate of 5 litres per sq.m of surface shall be applied prior to laying soling or subgrade. Special care shall be taken to maintain continuity of the chemical barrier at the junction of vertical and horizontal surfaces.

3.2.2.3 Treatment of doors, windows & soil surrounding pipes, Wastes and conduits.

Special care shall be taken at the points where pipes and conduits enter the building and the soil shall be treated for a distance of 150 mm and a depth of 75 mm at the point where they enter the building. All the wooden door/window frames on the ground floor of the buildings shall be treated with the insecticidal solution.

3.2.2.4 Treatment of expansion joints

These shall receive special attention and shall be treated in a manner approved by the Engineer.

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3.3 Acceptance Criteria

The Bidder shall give a 10 year service guarantee in writing supplemented by a separate and unilateral guarantee from the specialised agency for the job to keep the building free of termites for the specified period at no extra cost to the Owner.

4.0 CONCRETE PLAIN & REINFORCED

4.1 Scope

This chapter covers the workmanship, special requirements & regulations with which the bidder must comply to achieve the following two objectives :

- (a) The provision, at all locations on the site, of dense workable concrete, having the specified characteristic strength.
- (b) The placing of concrete at all elevations, well compacted by vibrations, in well aligned and well fixed formwork ensuring the internal and external dimensions of structures as per drawings and maintaining the size, shape number and locations of reinforcements, inserts etc., as specified in the drawings providing the surface finish after stripping off the formwork to ensure the structural configurations as per drawings as well within the specified tolerance limits, curing and guaranteeing the characteristic strength, all as specified.

4.1.1 The mixing, placing, compacting, curing and finishing of concrete shall be done according to IS: 456 "Code of Practice for Plain and Reinforced Concrete".

4.2 Materials



For materials, reference to Part - I (Materials) shall be made.

4.3 Grades of Concrete

The grades of concrete unless otherwise specified shall be in accordance with the following table. The grade of concrete to be used in each section of work will be shown in the drawings or in the schedule of items :

Grade of Concrete	Characteristic Strength i.e. Compressive Strength of 15 cm cubes at 25 days (N/mm ²)	Nominal Maximum Aggregate Size (mm)
M-5A	5	40
M-5B	5	40
M-7.5A	7.5	40



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Grade of Concrete	Characteristic Strength i.e. Compressive Strength of 15 cm cubes at 25 days (N/mm ²)	Nominal Maximum Aggregate Size (mm)
M-7.5B	7.5	40
M-10A	10	40
M-10B	10	40
M-10C	10	20
M-10D	10	12
M-15A	15	40
M-15B	15	40
M-15C	15	20
M-15D	15	12
M-20A	20	40
M-20B	20	40
M-20C	20	20
M-20D	20	12
M-25C	25	20
M-25D	25	12
M-30C	30	20
M-30D	30	12
M-35C	35	20
M-35D	35	12
M-40C	40	20
M-40D	40	12

Notes : A,B,C,D mentioned along with grade of concrete correspond to the maximum size of coarse aggregate being 63mm, 40mm, 20mm & 12mm respectively.

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Unless otherwise specified in the drawings or schedule of items the maximum nominal size of coarse aggregates for different grades of concrete shall be as under :

a)	For concreting in very narrow space or in very small thickness	12 mm
b)	For all reinforced concrete work except in massive foundations	20 mm
c)	For all ordinary plain concrete & massive reinforced foundations (Refer table)	40 mm

4.4 Mix Design



4.4.1 General

At the commencement of the contract the Bidder shall make preliminary tests to determine the proportions by weight of cement, fine aggregates, coarse aggregates and water necessary to produce required grades of concrete. The mix proportions shall be selected to ensure that workability of the fresh concrete is suitable for the conditions of handling and placing and when concrete hardens, it shall have the required strength, durability and surface finish. The Bidder shall get approval of Engineer to such proportions before he starts concreting. However, such approval shall not relieve the Bidder of his responsibility to produce concrete having compressive strengths as laid down in the foregoing Table.

No departure from the approved proportions will be permitted during the works unless and until the Engineer gives written authorisation for any change in proportion. The Engineer shall have authority at any time to check whether the mixing of concrete is being carried out according to the approved proportions.

- 4.4.2 For the all major and important R.C. works and for all special works, the design of mixes shall be made by the Bidder at his own cost, for each grade of concrete as well as for various workability. The design of mixes shall be made according to I.S. 10262 or any other approved standard methods.
- 4.4.3 The concrete made by designing the mix is termed hereinafter as "Design Mix Concrete".
- 4.4.4 The cement content for various grades of concrete shall be based on design mix. However, irrespective of requirement of cement found out from design mix, cement content of concrete shall not be reduced below the quantities specified as under .

Grade of concrete	Minimum cement content per Cu.m finished concrete
M-15	290 kg

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M-20	320 kg
M-25	380 kg
M-30	not less than 400
M-35	not less than 400

4.5 Water/Cement Ratio

- 4.5.1 Where a particular water/cement ratio is stipulated in the design or drawing along with the characteristic grade of concrete the design of mix shall be carried out by adjusting the other variable factors to obtain the characteristic strength of concrete with stipulated water/cement ratio.
- 4.5.2 In the structures where the impermeability and shrinkage of concrete have an important bearing on the durability and serviceability of the structures, such as water retaining structures, basements, underground premises, tunnels, pump houses, exposed structures near sea side or deserts, prestressed structure, thin precast members etc. the water cement ratio shall be kept low and preferably not exceeding 0.45.
- 4.5.3 The water cement ratio, as achieved in the Mix Design, or as specified in the drawings shall be adhered to strictly and shall not be varied without the permission of the Engineer.

4.6 Workability

- 4.6.1 The workability of fresh concrete shall be such that the concrete is just suitable for the conditions of handling & placing so that after compaction it becomes completely consistent and homogeneously surrounds all the reinforcement and completely fills the formwork.
- 4.6.2 The workability of fresh concrete at the place of batching/mixing shall be measured by compacting factor test and at the place of disposition by means of slump test. During the finalisation of Trial Mixes, the relationship between compacting factor and slump test shall be established for each grade of concrete as well as for various levels of workability. The workability tests shall be carried out in accordance with IS:1199.
- 4.6.3 Normally, in the condition of low water cement ratio as well as for medium/high workability, the workability shall be achieved by increasing the cement content, in consistent with added water.
- 4.6.4 In cases where the cement content is to be limited to reduce the heat of hydration, and the water/cement ratio is also to be kept low to reduce the permeability or due to other requirements the desired workability may be achieved with use of limited doses of plasticiser or air entraining agent. In such cases the method of mixing and dosage of the plasticiser/air entraining agent shall be according to the manufacturer's specification and with the approval of the Engineer.

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4.6.5 The usual limits of consistency for various types of structures are given below :

Limits of consistency

Degree of Workability	Slump in mm with Standard - Cone		Use for which concrete is suitable as per IS : 1199
	Minimum	Maximum	
Very low	0.0	25.0	Large mass concrete structure with heavy compaction equipment, roads and the like.
Low	25.0	50.0	Uncongested wide and shallow R.C.C structures
Medium	25.0	75.0	Deep but wide R.C.C structures with congestion of reinforcement and inserts
High	75.0	125.0	Very narrow and deep R.C.C structures with congestion due to reinforcement and inserts

Note : Notwithstanding any thing 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.



4.7 Durability

The durability of concrete, depending on the exposure condition, is to be taken into account while designing the mix. For given aggregates, the cement content should be sufficient to make sufficiently low water cement ratio and Appendix A of IS: 456 shall be taken as guideline for durability considerations.



4.8 Trial Mixes

4.8.1 After approval of the Mix Design by the Engineer, the Bidder shall make in presence of Engineer the Trial Mixes for each grade of concrete as well as for required workability.

4.8.2 Before starting the trial mixes, necessary preparatory works like sieve analysis of the aggregates, determination of densities of different ingredients and moisture contents in the aggregates, shall be completed according to the I.S. Codes 383 and 2386.

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- 4.8.3 Each trial mix shall be handled and compacted by the method which the Bidder proposes to use for that mix in the works and the mixes shall not show tendency of inadequate compaction by the method proposed.
- 4.8.4 The compacting factor and the slump of each trial mix shall be determined immediately after mixing and the values shall not exceed the maximum value obtained in the mix design.
- 4.8.5 Six numbers of 150 mm test cubes shall be made from each trial mix. These shall be cured and tested in accordance with relevant I.S. codes. In order to have the specified characteristic strength in the field, the concrete mix as designed in the Design Mix shall have higher average compressive strength depending on the degree of quality control at site. If the size and special requirement of the work so warrants, the trial may be extended to cover larger ranges of mix proportions as well as other variables such as alternative source of aggregates, maximum size and grading of aggregates and different type and brands of cement.
- 4.8.6 Before commencement of the concreting works of particular grade of concrete, the Bidder must complete the work of trial mixes and subsequent testing of the test cubes obtained therefrom the design of the Approved Mix for that particular grade of concrete.
- 4.8.7 The entire cost of all the trial mixes including all the preparatory works for trial mixes, preparation of test cubes and their testing shall be borne by the Bidder.
- 4.9 Nominal Mix Concrete**
- 4.9.1 Nominal mix concrete may be used for all concrete of Grade M-10 and below. If design mix concrete cannot be used for any reason for Grade M-15 & M-20, nominal mix concrete may be used with the permission of Engineer, Nominal mix concrete shall not be used, in any case for Grade of concrete above M-20.
- 4.9.2 The proportioning of materials for nominal mix concrete shall be in accordance with Table-3 of clause 8.3 of I.S. 456. The stipulations of Clauses 8.3.1 & 8.3.2 of IS: 456 shall also be taken into consideration.
- 4.10 Volumetric Mix Concrete**
- Where concrete is specified in volumetric proportions such as 1:4:8, 1:3:6, 1:2:4, 1:1 1/2:3 etc., coarse and fine aggregates shall be measured by volume and cement by weight. The water cement ratio shall be within 0.45 to 0.60 depending upon the workability.
- 4.11 Batching of Concrete**
- 4.11.1 Cement**

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Cement shall always be batched by weight. A separate weighing device shall be provided for weighing cement. Where the weight of cement is determined by accepting the weight per bag, number of bags shall be weighed separately to determine the average net weight of cement per bag and the same shall be checked regularly

4.11.2 Aggregates

4.11.3 For both Design Mix concrete and Nominal Mix concrete, the aggregates (coarse and fine) shall be batched by weight.

4.11.4 In particular cases, or where in the opinion of the engineers weigh-batching is not possible proportioning by volume batching may be allowed by the Engineer, provided the Bidder guarantees the uniformity of aggregates through out the period of construction. For this purpose, the Bidder shall submit to the Engineer sufficient data indicating the weight/volume relationship of aggregates for different types of concrete and after such approval, periodic checks on the weight/volume relationship of the aggregates shall be made by the Bidder to the satisfaction of the Engineer. Where aggregates are moist and volume batching is adopted, allowance shall be made for bulking in accordance with I.S. 2386 (Part-III).



4.11.5 Suitable adjustments shall be made for the variation in the weight of aggregates due to variation in their moisture contents.

4.12 Water

4.12.1 Water may be measured either by weight or by volume. When measured by volume, it shall be by well calibrated conical shaped jar or vessel or from a calibrated tank fitted to the mixer.

4.12.2 Adjustment of water due to moisture contents in coarse and fine aggregates

It is very important to maintain the water cement ratio constant at its correct value. For the correct determination of amount of water to be added in the concrete mix, to maintain the water cement ratio constant, the amount of moisture content in both coarse and fine aggregates shall be taken into consideration, be as frequently as possible, the frequency for a given job being determined by the Engineer according to weather conditions.

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4.12.3 Determination of moisture content in the aggregates

Determination of moisture content in the aggregates shall be according to I.S. 2386 (Part-III). Where tests are not conducted, the amount of surface water may be estimated from the following table :

Aggregates	Surface water carried by Aggregates	
	% by weight	Lit / m ³
Very wet sand	7.5	120
Moderately wet sand	5.0	80
Moist sand	2.5	40
Moist gravel & stone chips**	1.25 - 2.5	20-40

** - Coarser the aggregate, less the water it will carry.

4.12.4 Admixtures

Any solid admixture, to be added, shall be measured by weight, but liquid or semi-liquid admixture may be measured by weight or volume.

4.12.5 Accuracy of batching

The accuracy of batching shall be within the following tolerance:

Cement within plus or minus	2%	by weight.
Aggregate within plus or minus	5%	by weight.
Water within plus or minus	0.5%	by weight.

4.13 Mixing & Transportation of concrete

4.13.1 Mixing of Concrete



4.13.1.1 Machine mixing

Concrete shall always be mixed in mechanical mixer. Water shall not, normally, be charged into the drum of the mixer until all other ingredients are already in the drum and mixed for at least one minute. Mixing shall be continued until there is uniform distribution of materials and the mass is uniform in colour and consistency. The mixing time from the time of adding water shall be in accordance with IS: 1791 but in no case less than 2 minutes or at least 40 revolutions.

4.13.1.2 Hand mixing

When hand mixing is permitted by the Engineer 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

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10% extra cement shall be added to each batch at no extra cost to the Owner.

4.13.2 Transportation of concrete

4.13.2.1 Concrete shall be transported from the place of mixing to the place of placing concrete as rapidly as practicable by such means which will prevent the segregation or loss of any of the ingredients and maintain the required workability. No water shall be mixed with the concrete after it has left the mixer.

4.13.2.2 Where concrete is transported over long distances, the Bidder shall provide suitable means by which different grades of concrete are readily identifiable at the place of final deposit.

4.13.3 Actions before placement of concrete

4.13.3.1 Programme of works

At the beginning of every fortnight, the bidder shall give his detailed concreting programme for that fortnight to the Engineer. Such programmes, shall specify all information such as the locations where concrete is to be poured, type/grade of concrete, volume of concrete to be poured, number and Type of vibrators proposed to be used as well as proposed to keep as standby, number of skilled technicians and supervisors proposed to be engaged, the proposed time and period of pouring etc.

4.13.3.2 Checking & approval



Before placement of concrete, the bidder shall get all the form works, reinforcements, inserts, conduits, openings, surface preparation etc., checked and approved by the Engineer. To facilitate such checking, the bidder shall complete all his works according to the drawings and specifications well in advance before placement of concrete at least 36 hours for all major/important/complicated works and 24 hours for all minor/ordinary/simple works. The checks are purely in the interest of the work and to draw the bidder's attention to his contractual obligations to execute the works according to the drawings/specification and do not relieve the bidder from his responsibility in getting the end results for the quality & strength of concrete and for maintaining the shape, level & dimensions of the finished concrete, as well as the inserts, openings, other features within the tolerance limits.

4.14 Preparatory Works/Surface Preparation

4.14.1 For concrete directly on earth foundation

4.14.1.1 Earth foundation on which direct placement of concrete is specified, shall be rammed and consolidated as directed by the Engineer such that it does not crumble and get mixed with concrete during or after placement. If the foundation is quite wet, the same shall be kept dry and then sufficiently

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consolidated, if necessary, a thin top layer of the wet soil shall be removed and replaced by sand or other suitable materials as directed by the Engineer without any extra cost to the Owner. Care shall also be taken that earth from the sides also does not get mixed with the concrete, during or after placement, before it has sufficiently set and hardened.

- 4.14.1.2 The earth foundation, over which concrete is to be placed direct, shall not be kept abandoned at the specified level and concrete shall be placed immediately following the final preparation of the formation otherwise suitable measures shall be taken, as directed by the Engineer without any extra cost to the Owner.

4.14.2 For construction joints

All such joints shall have continuous square bond grooves to produce a substantial and water-tight key. Where the placement of concrete has to be resumed on a surface which has hardened, it shall be roughened, cleaned by wire or bristle brushing, compressed air, water jet etc., and thoroughly wetted. For vertical construction joints a neat cement slurry shall be applied on the surface immediate before the placement of concrete. For horizontal joints the surface shall be covered with a layer of freshly mixed mortar about 10 to 15 mm thick composed of cement and sand in the same proportion as the cement and sand in the concrete mix and applied immediately before placing of the concrete. On this surface (i.e. on the surface of joints) a layer of concrete not exceeding 150 mm in thickness shall first be placed and shall be well rammed against old work, particular attention being paid to corners and close spots. To ensure water tightness, care shall be taken to punn concrete properly against the old surface.

4.14.3 (a) On vertical surfaces of masonry

When the concrete is placed on the vertical surface of masonry (as in the case of thin concrete fins projected from the vertical masonry surface), a groove of dimension as directed by the Engineer shall be cut in the masonry to ensure a proper bond and the surface shall be cleaned thoroughly. Before the placement of concrete, the surface shall be kept moist by spraying water at least for the period of 2 hours and a thick coat of cement slurry shall be applied immediately before the placement of concrete.



b) Over walls

Building paper over average 12mm thick cement sand bearing plaster of 1:4 mix with neat cement finish shall be provided at the bearings of slabs over walls as directed by the Engineer.

4.14.4 Inside the formwork (cleaning, surface preparation etc.,)

The interior of the form works, where the concrete is to be placed, shall be thoroughly washed by high pressure water jet or air jet to completely clean

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the entire volume from all sort of dirt, grease/oil, foreign and deleterious materials etc. The reinforcement shall be completely clean and free from all sorts of dirt, grease/oil, rust, foreign/deleterious materials etc., Before placement of concrete, the form works coming in contact with concrete, shall be coated with form oil or raw linseed oil material or provided with any approved material to prevent adhesion of concrete to the form work, but utmost care shall be taken so that such oily material do not come in contact with the reinforcement.

4.15 Placing and Compaction of Concrete

- 4.15.1 The concrete shall be placed and compacted before setting commences & should not be subsequently disturbed. No water shall be mixed with the concrete after it has left the mixer. Method of placing should be such as to preclude segregation. Approved mechanical vibrator shall be used for compacting concrete, and concrete shall not be over vibrated or under vibrated. No concrete shall be placed until the place of deposit has been thoroughly inspected and approved by the Engineer. All inserts and embedments properly secured in position and checked and forms properly oiled. No concrete shall be placed in the absence of the Engineer.
- 4.15.2 Concrete shall be placed on clean bed having the designed level. The bed shall be cleaned of all debris and other objectionable materials. Seepage water, if any, shall be controlled or diverted.
- 4.15.3 Concreting shall not be carried on during rains unless all precautions have been taken by the Bidder and necessary permission has been given by the Engineer. Suitable measures shall be taken to control the temperature of concrete.
- 4.15.4 Where plums are permitted in massive concrete, they shall be washed and carefully placed. No stone shall be closer than 30 cm to an exposed face, nor nearer than 15 cm to an adjacent stone.
- 4.15.5 Concrete shall not be dropped from a height of more than 2m except through a chute, the design and type of which shall be subject to approval of the Engineer.
- 4.15.6 The concrete shall be placed, spread and compacted by approved mechanical vibrator. Vibrators shall not be used for pushing concrete to adjoining areas.
- 4.15.7 For members involving vertical placing of concrete (eg. columns, walls etc.), each lift shall be deposited in horizontal layer extending the full width between shutterings and of such depth that each layer can be easily and effectively vibrated and incorporated with the layer below by means of compaction.
- 4.15.8 For member involving horizontal placing of concrete (e.g. slabs, beams etc.) the concrete shall be placed along the line of starting point in such quantities as will allow members to be cast to their full depth along the full width

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between side shuttering and then gradually brought towards the finishing point along its entire front parallel to the starting line. Vibration and surface finish shall follow behind the placement as closely as possible.

- 4.15.9 Utmost care shall be taken to avoid the displacement of reinforcements/embedded parts or movement of formwork or damage to faces of the form work or transmission of any harmful vibration/shocks to the concrete which has not yet hardened sufficiently.
- 4.15.10 All members shall be concreted at such a rate that no cold joint is formed and fresh concrete is placed always against green concrete which is still plastic and workable.
- 4.15.11 Should any unforeseen occurrence results in a stoppage of concreting for one hour or such other time as might allow the concrete, already placed, to begin to set before the next batches can be placed, the Bidder shall make at his own cost, suitable tongue, and groove construction joint, as approved by the Engineer. Any additional reinforcement required as directed by the Engineer shall also be provided by the Bidder at his own cost. Before placement of new batches of concrete over that construction joint, the surface preparation according to this specification stipulated earlier, shall be done by the Bidder at his own cost.
- 4.15.12 The concrete shall be worked well up against whatever surface it adjoins and compacted to such a degree that it reaches its maximum density as a homogeneous mass, free from air and water holes and penetrates to all corners of moulds and shuttering and completely surrounds the reinforcement. All measures shall be taken to make the shape, size, and location of the finished concrete including its embedments, holes, openings etc., well within the accepted tolerance limit.

4.16 Construction Joint & Cold Joints

4.16.1 Construction joints

- 4.16.1.1 Normally, the construction joints including crank inducing joints shall be constructed as per locations and details indicated on the drawings.
- 4.16.1.2 Where the location of the joint is not specified in the drawings, it shall be in accordance with the following guide lines :

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(a) In Columns

- (i) In case of Projection from basement slab, 300 mm from the top of base slab or 75 mm from the top of the haunches whichever is higher.
- (ii) In framing of beam at different elevation, 75 mm below the lowest soffit of the beam and in case of projection from beams and slabs 75 mm from the top surface of the beam/slab or at the top surface of beam/Slab whichever facilitates formwork.
- (iii) For columns under flat slabs 75 mm below the lowest soffit of the slab.

(b) In walls (horizontal construction joints)

(i)	Walls projecting from base slab	:	300 mm from top of base slab
(ii)	Walls supporting the suspended slab	:	75 mm from the lowest soffit of the slab

Note :

In the case of water retaining structures and structures under the influence of ground water, approved water bars of suitable size shall be provided to make the joint completely water-tight.

(c) In beams



Beams shall be cast, as a rule, without a joint. But if provision of a joint is unavoidable, the joint for simply supported beam shall be vertical and at the middle of the span ; in continuous beam, the same shall be at the point of minimum shear force.

(d) In suspended slabs

- (i) In slab of small span, there shall be no construction joints.
- (ii) In slabs of large span and continuous slabs, construction joint, if allowed by the Engineer shall be vertical at the middle of span and at the right angles to the principal reinforcement.

(e) In walls (Vertical construction joint)

As a rule, walls shall be cast monolithically without any vertical construction joint, unless specified in the drawing. However, for a long wall, the Engineer may allow vertical construction joint and the same shall be at the place of minimum shear force. In water retaining structures and in structures under the influence of ground water

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approved water bars of suitable size shall be provided to make the joints completely water tight.

(f) In slabs resting on ground

(i) For Plain concrete

Concreting shall be done in alternate panels not exceeding 10 sq.m in area. The largest panel dimension shall be 5 m.

(ii) For nominally reinforced slab

The area of pour shall not exceed 40 sq.m and the maximum panel dimension shall not exceed 8m.

(i) For the basement slabs which act as structural member

There shall be no construction joint.

(g) In ribbed beam

The beams shall be cast monolithically with the slab in one continuous operation.

4.16.1.3 In all construction joints the reinforcements shall pass through as per drawings and the same shall not be disturbed in any way.



4.16.1.4 The vertical construction joints shall be provided by insertion of board keeping provision for passage of reinforcement/fixtures / embedments. All construction joints shall be made to form a tongue and groove joint.

4.16.2 Cold joint

An advancing face of a concrete pour, which could not be covered before expiry of initial setting time for unexpected reasons, is called a cold joint. The Bidder shall remain always vigilant to avoid cold joints. If however, a cold joint is formed due to unavoidable reasons, the following procedures 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 over the old surface and the fresh concrete along with the old concrete shall be vibrated systematically and thoroughly.
- (b) In case the concrete has hardened a bit more than (a), but can still be easily removed by a light hand pick, the surface shall be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. Then a rich mortar layer

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of 12 mm thickness, shall be placed on the cold joint and then the fresh concrete shall be placed on the mortar layer and vibrated thoroughly, penetrating deep in to the 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 rise in spite of extensive vibration, a tongue and groove joint shall be made by removing some of the older concrete and the joint shall be left to harden at least for 12-24 hours. It will then be treated as regular construction joint and the surface preparation of the same, before placement of concrete, shall be as described in the appropriate clauses of these specifications.

4.17 Requirements for Concreting in Special Cases

4.17.1 Concreting in deep lifts

Placing of concrete in lifts exceeding 2 M in columns and walls is in the category of deep lifts.



- 4.17.1.1 Before commencement of work, the bidder shall submit for the approval of the Engineer, the details of the methods he proposes to adopt for concreting.
- 4.17.1.2 The placement of concrete shall preferably be by tremie, chute or any other approved method.
- 4.17.1.3 In structures of heavy/complicated reinforcement or in complicated form works, the bidder shall provide sufficient number of windows in the form works as directed by the Engineer to check the placement and compaction of concrete in different stages. Such windows shall be closed as soon as the concreting reaches the bottom level of the same.

4.17.2 Concreting under water

When it is necessary to deposit concrete under water, the special requirements, over and above those of this specification shall be in accordance with Clause 13.2 of IS: 456.

4.17.3 Cold weather concreting

When conditions are such that the ambient temperature may be expected to be 4.5 C degree or below during the placing and curing period, the work shall conform to IS: 7861 (Part-II).

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4.17.4 Hot weather concreting

When concreting in very hot weather the Bidder shall take all precautions as stipulated in IS: 7861 (Part-I) and stagger the work to cooler parts of the day to ensure that the temperature of wet concrete used, specially in massive structure, does not exceed 38 degree 'C'.

Positive temperature control by methods like pre-cooling, post cooling or cooling of concrete by circulating cold water through small embedded pipe lines inside concrete, if required, shall be specified and shall be undertaken.

4.18 Finishes to Exposed Surfaces of Concrete

The Bidder is to include in his quoted rate for concrete, the provision of normal finishes in both formed & unformed surfaces as and where required by the Engineer without any extra cost to the owner. Some common finishes are indicated below:

4.18.1 Surface which do not require plastering

Surface in contact with casings shall be brought to a fair and even surface by working the concrete smooth against casings with a steel trowel while it is being deposited and also by working over the surface with a trowel immediately after the removal of the casings or centerings, removing any irregularities and stopping air holes, etc. Use of mortar plaster is not permissible for correcting levels, removing unevenness etc. However, if, in the opinion of the Engineer, such plastering is unavoidable then the thickness of plaster shall in no case exceeds 5 mm and the plastering shall be in cement and sand mortar.(1:3).

4.18.2 Exposed surfaces which need plastering

Surfaces of beams/columns flushing with the block work or other structures where intended to plaster, shall be hacked adequately as soon as the shuttering is stripped off so that proper bond with the plaster can develop.



4.18.3 Surface for non-integral finish

Where a non-integral finish such as floor finish is specified or required, the surface of the concrete shall be struck off at the specified levels and finished rough.

4.18.4 For monolithic finish

Where no more finishing course is to be applied as in the case of basement floor, industrial flooring or the screed concrete flooring etc, the concrete shall be completed and struck off at the specified levels and sloped with a screed, board and then floated with a wooden float. Steel troweling is then started after the concrete has hardened enough to prevent the excess of fines and

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water to rise to the surface but not hard enough to prevent proper finishing. Troweling shall be such that the surface is flat, smooth and neatly finished.

4.19 Curing of Concrete

4.19.1 General

The purpose of curing is to prevent loss of moisture from the concrete itself so that the cement inside the concrete is sufficiently hydrated which of course is slow and prolonged process. As soon as the concrete has hardened sufficiently the curing shall be started. To cure the concrete properly and sufficiently is also the sole responsibility of the bidder.

4.19.2 Different methods of curing

Any one of the following methods may be used for curing as approved by the Engineer.

- (a) Curing by direct water.
- (b) Curing by covering the concrete with absorbent material and kept damp.

4.19.3 Curing by direct water

This is done either by ponding or spraying water.

(a) Ponding



Ponding is widely used for curing slab and pavements. Earth bunds are formed over the slabs and water is pumped or poured into them and the same is replenished at interval to make up for the loss of evaporation. As this type of curing is one of the best methods, 10 days of curing after final setting is sufficient.

(b) By spraying water

Curing is done by spraying water by suitable means at approved time intervals. While spraying, it shall be ensured that the complete area is covered. In order to avoid cracking, cold water shall not be applied to massive members immediately after striking the form work, while the concrete is still warm. Alternate wetting and over drying shall be avoided.

Curing by spraying water shall be continued at least for 18 days after final setting.

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4.19.4 Curing of concrete with absorbent material kept damp

The entire concrete surface is covered either with hessian, burlap, sawdust, sand, canvas or similar material and kept wet continuously for at least 12 days after final setting.

4.20 Testing of Concrete

4.20.1 General

The Bidder shall carry out, entirely at his own cost, all sampling and testing in accordance with the relevant I.S. standards and as supplemented herein. The Bidder shall get all tests done in approved Laboratory and submit to the Engineer, the test result in triplicate within 3 days after completion of the test.

4.20.2 Consistency test (tests of fresh concrete)

4.20.2.1 At the place of deposition/pouring of the concrete, to control the consistency, slump tests and/or compacting factor tests shall be carried out by the Bidder in accordance with I.S. 1199 as directed by the Engineer.

4.20.2.2 The results of the slump tests/compacting factor tests shall be recorded in a register for reference duly signed by both the Bidder and the Engineer. That register shall be considered as the property of the Owner and shall be kept by the Bidder at site in safe custody.



4.20.2.3 The results of the slump tests/compacting factor tests shall tally, within accepted variation of plus or minus 12% with the results in the respective design mix, in case of mix design concrete and with the values indicated in the table under clause 6.1 of IS: 456 in case of nominal mix concrete.

4.20.2.4 For any particular batch of concrete, if the results do not conform to the requirements as specified in 4.20.2.3 or do not conform to any requirement of this specification, the Engineer has the right to reject that batch and the Bidder shall remove the same immediately from the site, at no cost to the Owner.

4.20.3 Strength test of concrete

4.20.3.1 While placing concrete, the Bidder shall make 6 nos. of 15 cm test cubes from particular batches of concrete as desired by the Engineer. The frequency of taking test cubes shall be either according to clause 14.2 of IS: 456 or as directed by the Engineer.

4.20.3.2 The cubes shall be prepared, cured and tested according to IS: 516 Out of 6 nos. of test cubes 3 shall be tested for compressive strength at 7 days after casting and the remaining 3 at 28 days after casting.

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4.20.3.3 A register shall be maintained at site by the Bidder with the following details entered and signed by both the Bidder and the Engineer. That register shall be considered as the property of the Owner.

- (a) Reference to the specific structural member
- (b) Mark on cubes
- (c) The grade of concrete
- (d) The mix of concrete
- (e) Date and time of casting
- (f) Crushing strength at 7 days
- (g) Crushing strength at 28 days
- (h) Any other information directed by the Engineer.

4.20.4 Acceptance criteria for test cubes

The acceptance criteria of concrete on strength requirement shall be in accordance with the stipulations under clause 15 of IS: 456.

4.20.5 Non-destructive tests on hardened concrete



4.20.5.1 If there is doubt about the strength or quality of a particular work or the test results do not comply with the acceptance criteria as stipulated under clause 15 of IS: 456, non-destructive tests on hardened concrete like core test and/or load tests or other type of non destructive tests like ultrasonic impulse test etc. shall be carried out, as may be directed by the Engineer, by the Bidder at entirely his own cost.

4.20.5.2 The core tests and load tests shall comply with the requirements of clause 16.3 and 16.5 of IS: 456 respectively. In case of other types of special tests like ultrasonic impulse test etc., the stipulation of clause 16.6 of IS: 456 shall be applicable.

4.20.6 Concrete below specified strength

In case of failure of test cubes to meet the specified requirements the Engineer may take one of the following actions:-

- 1) Instruct the Bidder to carryout additional test and/or works to ensure the soundness of the structure at Bidder's expense.
- 2) Reject the work and instruct that section of the works to which the failed cubes relate shall be cut out and replaced at Bidder's expense

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and the resultant structures affected due to such rejection shall be made good at bidder's expense.

- 3) Modification/remedial measures if approved by the engineer to be carried out at bidder's expense.
- 4) Accept the work with reduction in the rate in appropriate item subject to the provisions of clause 15 of IS 456 provided it is technically acceptable. The reduction in the rate shall be as given below :-
 - i) When test strength of the sample is above 90% of the characteristic strength, payment shall be made 10% less than the contract rate.
 - ii) When test strength of the sample is between 80-90% of the characteristic strength, payment shall be made 25% below than the contract rate.

4.20.7 Concrete failed in non-destruction tests

In case the test results of the core tests or load tests in a particular work do not comply with the requirements of respective clause (16.3 for core test and 16.5 for load tests) of IS: 456 the whole or part of the work concerned shall be dismantled and replaced by the Bidder as may be directed by the Engineer at no extra cost to the Owner and to the satisfaction of the Engineer. No payment for the dismantled concrete including relevant form work, reinforcement, embedded fixtures etc. shall be made. In the course of dismantling if any damage occurs to the adjacent structure or embedded item, the same shall be made good, free of charge by the Bidder, to the satisfaction of the Engineer.



4.21 Steel Reinforcement

4.21.1 Material

Material shall be as specified in the respective . The specifications of materials shall be as per Part-I.

4.21.2 Storage

Steel reinforcement shall be stored in such a manner that they are not in direct contact with ground. Bars of different classifications and sizes shall be stored separately. In cases of long storage or in coastal areas, reinforcement shall be stacked above ground level by at least 15 cm, and a coat of cement wash shall be given to prevent scaling and rusting at no extra cost of the owner.

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4.21.3 Bending and placing

Bending and placing of bars shall be in conformity with IS: 2502 "Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement" and IS: 456 "Code of Practice for Plain and Reinforced Concrete".

4.21.4 Welding of Reinforcement

Welding of mild steel reinforcement bars conforming to IS:432 (Part-I) shall be done in accordance with IS: 2751 "Code of Practice for Welding of Mild Steel Bars used for Reinforced Concrete construction" with additional precaution that for lap welded joints the throat thickness of weld beads shall be at least 3 mm or 0.6 times the nominal size of weld (which is the radius of bar) whichever is more.

Welding of cold worked high strength deformed bars conforming to IS: 1786 shall be done using electric arc welding process using low hydrogen electrodes (Ferro Weld- I or Ferro Weld-II or equivalent). Oxy-acetylene welding shall not be used.



Butt welding of bars upto 32 mm diameter for vertical splices shall be done either by single bevel groove weld or double bevel groove weld, with bevel angle 45 degree. Butt welding of bars upto 32 mm diameter for horizontal splices shall be done either by single Vee-groove weld or double Vee-groove weld with chamfered angle of 45 degree to 60 degree. The diameter of welded joint shall be 1.2 times the diameter of bar. Edge preparation for butt welding shall be done by shearing, machining and grinding. Oxy-acetylene flame shall not be used for cutting. Chamfered faces shall be smooth finished by hand file if required.

Lap welding of bars upto 20 mm diameter shall have a minimum bead length of 12 times the diameter of bar or 200 mm whichever is more arranged on one or both sides. The throat thickness of weld beads shall be 5 mm or 0.75 times the nominal size of weld (which is the radius of bar) whichever is more. In case of unsymmetrical lap weld with weld bead on one side only, the maximum length of each weld bead shall be 6 times the diameter of bar or 100 mm (whichever is more), separated by an equal length in between weld beads. Splice bars used in symmetrical weld joint shall have same diameter as the parent bars. Lap joint with single splice bars shall have weld beads on both sides.

Lap welding of bars above 20 mm shall be done using splice plate or splice angle. Thickness of splice plate shall not be less than 0.65 times the diameter of bar and width shall not be less than twice the diameter of bar. The size of splice angle shall be such that its area of cross section is at least 1.62 times the area of bar being spliced.

More than one third of the bars shall not be welded at any one section and welded joints shall be staggered at a distance of 50 times the diameter of

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bars. Welding shall not be done at bends or curved parts of bars and it shall be located at least at a distance of 50 times the diameter of bar from bends.

Tests

Test pieces of welded bars shall be selected and tested in accordance with the provisions of IS: 2751. The number of tests will be as laid down in IS: 2751 or such larger number as the Engineer may decide having regard to the circumstances.

4.21.5 Cleaning

All steel for reinforcement shall be free from loose scales, rust coatings, oil, grease, paint or other harmful matters immediately before placing the concrete. To ensure this, reinforcements with rust coatings shall be cleaned thoroughly before bending/placement of the same.

4.21.6 Placing in position

All reinforcements shall be accurately fixed and maintained in positions as shown on the drawings and by adequate means like mild steel chairs and/or concrete spacer blocks as required. Bars intended to be in contact at crossing points, shall be securely tied together at all such points by 20G annealed soft steel wire or by tack welding in case of bars 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.

4.21.7 Clear cover



Clear cover shall be as specified in the drawings. If nothing is specified in the drawing the clear cover shall be in accordance with the relevant clause of IS: 456.

4.21.8 Light structural work and embedded metallic parts, conduits

4.21.8.1 Fabrication of metallic parts & light structural works

Fabrication of all structural steel work shall be done in accordance with IS: 800 "Code of Practice for use of Structural Steel in General Building Construction". Workmanship shall match to the best practice in modern structural shops. Greatest accuracy shall be observed in the manufacture of every part and all identical parts shall be strictly inter-changeable. Steel work shall be shop fitted and shop assembled as far as practicable to minimise site work and to meet transport restrictions. All materials shall be straight and if necessary before being worked shall be straightened or flattened by pressure and shall be free from twists. Shearing or flame cutting may be used and the resulting edges shall be clean and straight. Flame cut edges shall be

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planed/cleaned by chipping or grinding. Sheared members shall be free from distortion at sheared edges. Welding and welded work shall conform to IS: 816 "Code of Practice for use of metal arc welding for General Construction in Mild Steel". Mild steel electrodes conforming to IS: 814 "Specification for covered electrodes for metal arc welding of mild steel shall be used.

4.21.8.2 Transportation and Storages

All pieces shall be properly identified and bundled for transportation to work site. Care shall be exercised in the delivery, handling and storage of material to ensure that material is not damaged in any manner. Materials shall be kept free of dirt, grease and foreign matter and shall be stored properly on skids or any other suitable supports to avoid contact with ground, damage due to twisting, bending etc.

4.21.8.3 Erection of light structural work

Erection of light structural work shall be carried out in accordance with the provisions of IS: 800. No component which is bend or twisted shall be put in place until the defects are corrected. Components seriously damaged during handling shall be replaced. No riveting, permanent bolting or welding shall be done until proper alignment has been completed. Whenever field welding is to be done it shall be in accordance with the requirements of shop fabrication. Shop paints shall be removed before field welding for a distance of at least 50 mm on either side of the joints.

4.21.8.4.1 Erection of embedded metallic parts, inserts, conduits



Bolts and inserts shall be securely fixed in position as shown in the drawings, before commencement of concreting. Bolts shall be checked for accuracy in alignment on both the axes. Limits of tolerance in alignment and level shall be as shown in the drawing or described elsewhere in these specifications.

Where bolts are housed in sleeves, special care shall be taken after concreting is over and has partly set to ensure that the bolts move within the sleeves. The annular space of the sleeve shall be plugged with suitable stoppers to prevent the ingress of water, grout, dust, rubbish or other foreign material into it, both during and after concreting. Opened conduits shall be plugged similarly. Where channels, Unshapely profiles or other similar inserts are required to be placed in concrete, special care shall be taken to keep the grooves of such profiles free from the ingress of concrete, slurry etc., by suitable packing material, if necessary.

All threads for bolts and inserts shall be greased at intervals and kept covered to prevent damage.

4.21.8.4.2 Necessary templates, jigs, fixtures, supports shall be used as may be specified or required or directed by the Engineer free of cost to the Owner.

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Exposed surfaces of embedded materials shall be painted with one coat of anticorrosive paint or bituminous paint, as desired, without any extra cost to the Owner. If welding is to be done subsequently on the exposed surfaces of the embedded parts, the painting for a length of 50mm beyond each side of the weld line shall be cleaned off.

4.22 Shuttering

4.22.1 General

All shuttering, formwork, supports and staging shall be designed by the Bidder and be subject to approval by the Engineer. The Bidder shall submit drawings and calculations to the Engineer for scrutiny when called upon to do so. The shuttering shall be designed for a live load of 400 Kg/m² in addition to the weight of the green concrete, or such other load as the Engineer may specify. The Bidder shall be responsible for the correctness and strength of the formwork including its supports and centering and approval by the Engineer will not relieve him of his responsibilities.

4.22.2 Material

The staging and supports may be of round or sawn timber or tubular or other shapes in steel. Round timber shall preferably extend over the full height in one piece. These shall be securely jointed or otherwise fastened and spaced at suitable intervals as the design may warrant and shall be suitably braced at regular intervals horizontally and diagonally.

The form work shall be of steel plate on steel frame, wooden boards with steel sheet lining, or plywood or seasoned timber board. Where ornamental and curved surfaces are required the material shall be very good seasoned timber or plywood which can be shaped correctly.



4.22.3 Fixing

The shuttering shall conform to the shapes, lines, levels and dimensions shown in the drawing. It shall be fixed in perfect alignment and securely braced so as to be able to withstand, without appreciable displacement, deflection or movement of any kind, the weight of all construction, movement of persons and plant. It shall be so constructed as to remain rigid during the placing and compacting of concrete without shifting or yielding and shall be sufficiently water tight to prevent loss of slurry from the concrete.

All props shall be supported on sole plates and double wedges. At the time of removing props these wedges shall be gently eased and not knocked out. The form work shall be so designed that the sides are independent of the soffits and the side forms can be removed easily without any damage or shock to the concrete.

4.22.4 Wrought shuttering

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Wrought shuttering shall be such as to produce a first class fair face on the concrete free from board marks or any other disfigurements. This shall be used for exposed surfaces where specified or directed by the Engineer. It may be made of heavy quality plywood or steel sheets having smooth, plain surface.

The joints in shuttering shall be arranged in a regular pattern approved by the Engineer. Wrought shuttering shall be aligned within a tolerance of 3 mm.

4.22.5 Rough shuttering

Rough shuttering shall be used for all surface of concrete walls, footings etc., which are not exposed in the finished work or which are to receive plaster and as directed by the Engineer. It may be made of timber, ordinary plywood or steel sheets.

4.22.6 Special provision

4.22.6.1 Wherever concreting of narrow member is required to be carried out within shutters of considerable depth, temporary openings in the sides of the shutters shall, if so directed by the Engineer, be provided to facilitate cleaning, pouring and consolidation of concrete.



4.22.6.2 In liquid retaining structures and structures below ground water level, through bolts for the purpose of securing and aligning the form work shall not be used.

4.22.6.3 Forms shall be given an upward camber, if so desired by the Engineer, to ensure that long beams do not have any sag. The camber may be 1 in 250 or as the Engineer may direct.

4.22.6.4 The joints in form work shall be sealed by adhesive tapes or by other means, to prevent any leakage of slurry or mortar if so directed by the engineer.

4.22.7 Preparation for concreting

Before any concreting is commenced the shuttering shall be carefully examined for dimensional accuracy and safety of construction. The space to be occupied by concrete shall be thoroughly cleaned out to remove rubbish, debris, shavings and saw dust. The surface in contact with concrete shall be coated with an approved substance such as mould oil or other non-staining mineral oil to prevent adhesion. Where necessary the surface shall be wetted to prevent absorption of moisture from concrete. Care shall be taken to avoid the reinforcements coming in contact with shutter oil.

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4.22.8 Removing

4.22.8.1 Removal of forms shall never be started until the concrete has thoroughly set and aged to attain sufficient strength to carry twice its own weight plus the live load that is likely to come over it during construction

4.22.8.2 Removal of forms shall not entail chipping or disfiguring of the concrete surface. Shuttering shall be removed without shock or vibration and shall be eased off carefully in order to allow the structure to take up its load gradually.

4.22.8.3 Under normal circumstances (generally where temperatures are above 21 degree 'C'), and where ordinary portland cement is used shuttering may be struck after the expiry of the following periods :-

i)	Walls, columns & vertical faces	24 to 48 hours as may be directed by the Engineer.
ii)	Bottom of slab upto 4.5 m span	7 days
iii)	Bottom of slab above 4.5 m span, bottom of beam and arch, rise upto 6 m span	14 days
iv)	Bottom of beam and arch rise over 6 m span	21 days

These periods may be increased at the discretion of the Engineer. Special care shall be taken while striking the shuttering of cantilevered slabs and beams, portal frames etc.,



4.22.8.4 Before removing the form work, the Bidder must notify the Engineer to enable him to inspect the condition of the finished concrete immediately after the removal of the form works.

4.22.9 Bidder's responsibility

Any damage resulting from faulty preparation, premature or careless removal of shuttering shall be made good by the Bidder at his own expense.

4.22.10 Irrecoverable shuttering

In cases where the shuttering cannot be removed without damaging the structure itself or where removal of shuttering is rendered impossible due to the nature of construction or where the Engineer may so instruct, such shuttering shall be classified as irrecoverable shuttering. However, such abandoning of shuttering will be permitted only in situations where it will not remain exposed or otherwise cause damage of any kind.

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4.22.11 Metal Forms

Where permanently left-in-place metal forms or deck are shown in drawings or otherwise ordered to be provided by the Engineer, they shall satisfy the requirements with regard to load carrying capacity. The metal forms shall be obtained from a reputed manufacturer, whose performance guarantee shall be obtained and submitted to the Engineer. Designs and drawings giving full details shall be submitted to the Engineer in advance for approval.

4.23 Damp Proof Course Concrete

4.23.1 Thickness

It shall be as specified in the drawings or in the items.

4.23.2 Mix

The grade of mix shall be as specified in the drawing or schedule of quantities. If nothing is specified, the mix shall be 1 part of cement : 1 1/2 part of coarse sand : 3 parts of stone chips. The stone chips shall be 12 mm down graded.

Approved water proofing admixture shall be mixed with cement as per manufacturer's specifications. The water cement ratio shall be as low as possible to increase the impermeability of concrete and in no case more than 0.5.

4.23.3 Preparation of base surface

The base surface shall be well roughened by chipping and brushing with steel brush and shall be cleaned of all dirt, dust, grease, oil and all other foreign & deleterious materials. Then the surface shall be well moistened with water.

4.23.4 Placing and compaction

Just prior to placement of D.P.C. Concrete, a thick coat of cement slurry shall be applied on the base surface. The placement shall be as specified for the concrete in beams. The concrete shall be well compacted to make it dense.

4.23.5 Finishing



When the concrete has set enough but remains still green, the top surface shall be marked in regular pattern by steel trowel so as to have proper bond with the future work.

4.23.6 Curing

The D.P. course shall be kept continuously moist at least 10 days.

4.24 Grout

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4.24.1 Scope

The scope covers the grouting under base plates, grouting between the joints of precast concrete, grouting the pockets/holes/opening etc.

4.24.2 Grouting under base plates

Grouting under base plates of equipments/structures shall be of cement mortar 1:2 for thickness upto 25 mm. For thickness exceeding 25 mm, concrete of grade specified in the drawing or minimum M-20 grade using 10 mm down graded aggregates shall be used. The grout shall be placed in position well rammed until the whole space is completely filled with concrete. No vibrators shall be used. Quick setting cements shall be used in the preparation of mortar or concrete, where so specified.

The grout shall either be "dry" concrete or mortar or "wet expanding" concrete or mortar as the Engineer may direct. A dry grout shall have a slump not exceeding 6 mm. It shall be rammed under the horizontal surface with the aid of suitable tools. A "wet expanding" grout shall have a slump of at least 125 mm but not exceeding 225 mm. To this shall be added an expanding admixture approved by the Engineer and in accordance to the Manufacturer's instructions.

4.24.3 Grouting the pockets/holes in concrete

Depending upon the size of the pockets/holes in the concrete, the mix of the grout shall be either of concrete or of cement sand mortars. Normally the grade of such concrete/mortar shall be M-20 unless specified otherwise. In filling the holes of foundation bolts and expanding admixture of approved type shall be used as per manufacturer's specification.



4.24.4 Workmanship

4.24.4.1 The surface of the concrete over which grouting is to be applied shall be thoroughly prepared to provide a clean rough surface. If necessary, chipping shall be carried out on such surface to make it completely rough. Then the surface shall be wetted. Bolt pockets shall be cleaned immediately before the base plate is placed in position. Before grouting the surface shall be thoroughly cleaned with compressed air/water jet.

4.24.4.2 Before placement of grout, the surfaces (except in the case of bolt holes) shall be wetted with cement slurry. In case of bolt holes/pockets water from such pockets shall be thoroughly removed by some suitable means and no cement slurry shall be applied.

4.24.4.3 Hand mixing is not permitted and the grout shall always be machine mixed. If however in some special cases where the quantity of grout is so small that it

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cannot be machine mixed, hand mixing may be allowed but the same shall be done under the strict supervision of an experienced supervisor of the Bidder.

- 4.24.4.4 The grout shall be placed within 30 minutes of being mixed. The grout shall be poured and then worked into position by suitable means until the space is completely filled. The Bidder shall take all possible measures during grouting so that the grout fills the space completely and thoroughly. Where the gap is very small or unapproachable for the placement of concrete, the Bidder shall grout by pressure grouting and in that case the mix may be of cement sand mortar of the appropriate grade but in any case the water cement ratio shall be as low as possible. Neither "Dry" grout (having slump 6mm or less) nor expanding wet grout shall be grouted with any type of vibrating machine

4.24.5 Curing

After 10 hours of grouting, the same shall be covered with wet gunny bags and the surface shall be kept continuously moist at least for 10 days.

4.25 Concreting in Water Retaining Structures

General requirements

The basic specifications as regards 'mix' design, placing, compacting, curing etc. shall conform to the requirements as specified herein before in this Chapter. Over and above the materials and workmanship shall conform to the stipulations of IS: 3370 (Part-I & II) to make dense and impervious concrete. As specified herein before all the construction joints shall be provided with approved water bars. The expansion and construction joints, if any, shall be provided with the requirements as specified in the drawing or as directed by the Engineer.

4.26 Application of Live Load



The designated live load shall be allowed on any structure only after 28 days, after proper curing is carried out on the last concrete poured in structure.

4.27 Foam Concrete

This shall be of average 50mm thickness or as specified or as shown on the drawings. This may be laid in in-situ in suitable panels or in precast blocks. The insulating properties shall be such that the thermal conductivity shall not exceed 0.125 Kcl m/m²h/degree C. The weight of the insulating material shall be from 0.5 to 0.75 gm/cm³, strength not less than 5 Kg/sq.cm or (0.5N/sq.mm.). In general, the main ingredients of Foam Concretes are cement, fly ash and foaming agent and the work shall be carried on by specialised Agencies/Companies. Before starting the laying of foam concrete sample shall be prepared at site and got tested for approval of the Engineer.

The foam concrete laid shall be sufficiently strong to take the usual work loads and standard loads expected on the roof. Any damaged portion shall be

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removed and replaced forthwith. Approval of the Engineer shall be taken before laying the waterproofing over the insulation.

While laying the foam concrete, sample batches of mix shall be kept for test if so desired by the Engineer.

5.0 MASONRY

5.1 General

This specification deals with masonry and allied works in foundation, plinth and superstructure.

5.2 Materials

For specifications of materials Part-I shall be referred.

5.3 Selection of Mortars

Mortar for masonry shall conform generally to IS: 2250 "Code of Practice for Preparation and Use of Masonry Mortars", and proportion shall be as specified in the drawing or in the Schedule of Items.

5.4 Cement Mortar

5.4.1 Cement mortar shall be prepared by mixing cement and sand in specified proportion. It is convenient to take unit of measurement for cement as a bag of cement weighing 50 Kg equivalent to 0.035 cubic metre. Sand is measured in boxes of suitable size (say of 40 x 35 x 25 cm). It shall be measured on the basis of dry volume. In case of damp sand, the quantity shall be increased suitably to allow for bulkage in accordance with IS:2386 (part-III) or by any approved method.



5.4.2 The mixing of the mortar shall be done preferably in a mechanical mixer. This condition may be relaxed by the engineer taking into account the nature, magnitude and location of the work.

If mixed in the mixer, cement and sand in the specified proportion shall be fed in the mixer and mixed dry thoroughly, water shall be then added gradually and wet mixing continued for at least 3 minutes. In case of hand mixing also after mixing dry on a water-tight masonry platform, water shall be added and the mortar turned over and over, backward and forward several times.

5.4.3 Fresh mixed mortar, in case becoming stiff due to evaporation of water may be retempered by adding water as frequently as needed to restore the requirement of the consistency but this shall be permitted only upto a maximum of 2 hours from the time of addition of cement in the mortar.

5.5 Brick Work

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5.5.1 Storage and handling bricks

Bricks shall not be dumped at site. They shall be carefully handled and carefully stacked in regular tiers to avoid breakage and defacement of bricks and prevent contamination by mud or other materials. The supply of bricks shall be so arranged that as far as possible at least two days' requirement of bricks is available at site at any time. Bricks selected for different situations of work shall be stacked separately.

5.5.2 Soaking & Cleaning bricks

Bricks required for masonry shall be cleaned to be free from dirt, dust and sand and fully soaked in clean water by submerging in vats before use, till air bubbling ceases. The bricks shall not be too wet at the time of use. After soaking they shall be removed from the tank sufficiently early so that at the time of laying they are skin dry and stacked on a clean space.

5.5.3 Setting out

The building lines shall be set out by the Bidder as per clause 7 of IS: 2212 and got checked by the Engineer.



5.5.4 Laying of bricks

5.5.4.1 Brickwork in general shall be as per IS 2212. Bricks shall be laid in English bond, unless otherwise specified, with frogs upward over a full bed of evenly laid mortar, and slightly pressed and tapped into final position to the lines levels and shape as shown in the drawing fully embedded in mortar. All joints including inside faces shall be flushed and packed. Not more than 8 courses shall generally be laid in a day. The first course itself shall be made horizontal by providing enough mortar in the bed joint to fill up any undulations. The horizontality of courses and the verticality of wall shall be checked very often with spirit level and plumb bob respectively.

5.5.4.2 Horizontal joints shall be truly horizontal and vertical joints shall line up in every alternate course. The joints shall not exceed 10 mm in thickness and shall be well finished and neatly struck. The joints shall be kept uniform throughout the brick work. All the brick joints of the face works shall be neatly raked out to a minimum depth of 15 mm with the help of raking tools and the faces of brick wall cleaned with wire brush to remove any splashes of mortar before the close of the day's work, while the mortar is still green and the last brick layer shall be cleaned with wire brush and the frogs free from mortar.



5.5.4.3 Walls coming in contact with R.C.C. structures shall perfectly be bonded with M.S. inserts or lugs where shown on drawings and the sides butting against the R.C.C structures neatly and efficiently flashed and packed with rich mortar & cement slurry at no extra cost (cost of M.S. inserts or lugs used shall be measured and paid separately under relevant items). Where such lugs are not required to be provided, brick work shall be built tightly against

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columns, slabs or other structural parts, around door and window frames with proper distance to permit caulked joint. Where drawings indicate structural steel column or beam to be partly or wholly covered with brick work, bricks shall be built closely against all flanges and webs, with all spaces between steel and brick work filled solid with mortar not less than 10 mm thick.

- 5.5.4.4 Damaged or broken brick or brick bats shall not be used in brick work. Cut bricks may be used to complete bond or as closers or around irregular openings.
- 5.5.4.5 Bricks shall not be thrown from heights to the ground, but shall be handled carefully and put gently in position to avoid damaging their edges.
- 5.5.4.6 Selected bricks of regular shape and dimension shall be used for face work.
- 5.5.4.7 Making of grooves, sleeves and chases shall be done, during the construction, to the lines, levels and position as shown in the drawing or as instructed by the Engineer. Such sleeves shall slope outward in external walls so that their surface cannot form channels for the easy passage of water inside.
- 5.5.4.8 Fixtures, plugs, frames, pipes, inserts etc., if any, shall be built in at the right places to the lines & levels as shown in the drawings while laying the course and not later by disturbing the brick work already laid.
- 5.5.4.9 Brick walls of one brick thick or less shall have one selected face in true plane and walls more than one brick thick shall have both the faces of wall in true plane.
- 5.5.4.10 All connected brick work shall be carried out simultaneously with uniform heights throughout the work, and in exceptional cases, with the approval of the Engineer, the brick work built in any part of the work may be lower than another adjoining wall/connected wall by a maximum of one metre and the difference in height of adjoining wall/connecting wall shall be raked back according to bond by stepping at an angle not steeper than 45 degree, without sacrificing the necessary bond, horizontality of layers, verticality of joints and the wall. Toothing shall not be allowed in brick work, for raking back. The top layer just below the R.C.C slab or beam shall be laid with frogs down over a layer of mortar on full width.

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5.5.4.11 Openings in brick work

Openings shall be made in brick work, which may be of any shape, size, at all levels, heights or depths, including round openings, as shown in the drawing or as directed by the Engineer, maintaining the necessary bond using a minimum of cut bricks. Openings in external face walls, the sills, jambs, soffits of opening may be rebated and the sill shall be sloped slightly for drainage of rain water.

5.5.4.12 All exposed brick work shall be rubbed down, thoroughly washed, cleaned and pointed as specified. Where face bricks of specific quality are used the same shall be rubbed with carborundum stone.

5.5.5 Half-brick masonry

5.5.5.1 Half-brick work shall be done in the same manner as for brick work except that all courses shall be laid in stretchers. Both faces shall be true to plane and the joints raked on both faces.

Where reinforcement is considered necessary or specified and shown in drawing, M.S. bars or hoop iron shall be provided as stipulated in the Schedule of Items or as directed by the engineer. The reinforcement shall be cleaned of rust and loose scale with a wire brush, and shall be laid straight on the mortar and lapped with the dowel bars provided in the column, securely anchoring them at their ends where the half-brick wall butts. The batching of mortar usually shall be in the proportion of 1:4 or as stipulated in the Schedule of Items. Half of the mortar for the joints shall first be laid and the other half laid after the reinforcement is laid in position, so that the reinforcement is fully embedded in position.

5.5.6 Brick on edge masonry



The work brick on edge masonry wall in superstructure shall be done in the same manner as mentioned for brick work except that it shall always be reinforced with wire mesh netting of approved variety as specified in the item and embedded in cement mortar at interval as specified in the Schedule of Items. The wire netting shall be continuously laid and securely anchored with the dowel bars provided & projecting from the walls/RCC structure or steel structures at their ends where brick on edge wall butts. The batching of mortar usually shall be in the proportion of 1:3 or as stipulated in the Schedule of Items.

5.5.7 Protection of brick work

The brick wall shall be protected and covered with gunny bags or

water proof sheets from the effects of inclement weather, rain, frost, etc., during the construction and until the mortar sets. Care shall be taken during construction that the edges of jambs, sills and soffits of openings are not damaged.

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5.5.8 Curing

All brick works shall be kept moist for 10 days after laying.

5.5.9 Scaffolding

5.5.9.1 Necessary and suitable scaffolding shall be provided at all heights to facilitate the construction of brick wall. Scaffolding shall be sound, strong and all supports and other members shall be sufficiently strong and rigid, stiffened with necessary bracings and shall be firmly connected to the walls securing them against swing or sway. Planks shall be laid over the scaffolding at required levels. Scaffolding shall preferably be of tubular steel, although the Engineer may permit other material, depending upon the circumstances.

5.5.9.2 Scaffolding shall be double, having two sets of vertical supports, particularly for the face wall and all exposed brick work. Single scaffolding may be used for buildings upto two storeys high or at other locations, if permitted by the Engineer. In such case the inner ends of horizontal members shall rest in holes provided in header course only. Such holes shall not be allowed in pillars under one metre in width, or immediately near the skew backs or arches. The holes thus left in masonry shall be filled with bricks set in rich mortar and the surface made good on removal of scaffolding.

5.5.9.3 If for any reason the Bidder is required to erect scaffolding in property other than that belonging to the Owner, including municipal corporation or local bodies, necessary permission shall be obtained by the Bidder from the appropriate authorities and necessary licensing fees if any shall have to be borne by him.

5.5.9.4 All scaffoldings once erected shall be allowed to remain in position, efficiently maintained by the Bidder, till all the finishing works required to be done are completed and shall not be removed without the approval of the Engineer.

The Bidder shall allow workmen of other trades to make reasonable use of the scaffolding without any extra cost.

5.6 Stone masonry



5.6.1 General

All aspects of the work shall be in conformity with the "Code of Practice for Construction of Stone Masonry, IS: 1597 (Part-I & II). Relevant clauses under brick work, such as setting out, making chases, openings, fixing frames and plugs, protection, curing, scaffolding etc., shall apply to stone masonry and concrete block masonry.

5.6.2 Mortar

The mortar used shall be as specified in the Schedule of Items or drawing.

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5.6.3 Holes and Plugs

Holes in stone walls shall be left for water supply, plumbing, sanitation, electrification, etc., where shown on drawings or ordered by the Engineer as the work proceeds. These holes shall, on completion, be made good to match with the adjoining wall. The Bidder shall provide and fix wooden plugs, water supply piping and electric conduit pipes etc. where so specified.

5.6.4 Random rubble masonry

5.6.4.1 Laying



All stones shall be wetted and cleaned of all dust and loose materials before laying. Stones shall be laid on their natural beds, fitted carefully to the adjacent stones to form neat and close joints fully packed with mortar and chips and spalls of stone may also be used wherever necessary to avoid thick mortar bed or joints. Walls shall be carried to plumb or to the specified batter. Stones may be brought to level course at plinth, window sills and roof levels and the leveling shall be done with concrete comprising of 1 part of the mortar as used for the masonry and 2 parts of 20 mm down graded hard stone chips at no extra cost. Bond shall be provided by fitting in closely the adjacent stones and by using bond stones running through the thickness of wall in a line from the face to back with at least one bond stone, or a set of bond stones, for every 0.5 sq.m. of the wall surface. Face stones shall extend and bond well into the backing. These shall be arranged to break joints as much as possible, and to avoid long vertical lines of joints.

5.6.4.2 Quoins

Quoins shall be of selected stones, neatly dressed with hammer or chisel to form the required angle and laid header and stretcher alternately. No quoin stone shall be smaller than 0.025cum (25dcum in volume and it shall also not be less than 300mm in length, 25% of them being not less than 500mm in length).

5.6.4.3 Joints

The stones shall be so laid that the joints are fully packed with mortar and chips and face joints shall not be more than 20 mm thick. When plastering or pointing is not required to be done, the joints shall be struck flush and finished at the time of laying, otherwise the joints shall be raked to a minimum depth of 20 mm by raking tool during the progress of work, when the mortar is still green.

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5.6.5 Coursed rubble masonry - First sort

5.6.5.1 Laying

All stones shall be wetted before use. The walls shall be carried up truly plumb or to specified batter. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical. The height of each course shall not be less than 15 cm nor more than 30 cm.

Face stones shall be laid alternate headers and stretchers. No pinning shall be allowed on the face. No face stone shall be less in breadth than its height and at least one third of the stones shall tail into the work for length not less than twice their height.

The hearting or the interior filling of the wall shall consist of stones carefully laid on their proper beds in mortar, chips and spalls of stone being used where necessary to avoid thick beds of joints of mortar and at the same time ensuring that no hollow spaces are left anywhere in the masonry. The chips shall not be used below the hearting stone to bring these upto the level of face stones. The use of chips shall be restricted to the filling of interstices between the adjacent stones in hearting and these shall not exceed 10% of the quantity of stone masonry. The masonry in a structure shall be carried up regularly but where breaks are unavoidable, the joints shall be raked back at an angle not steeper than 45 degree. Toothing shall not be allowed.

5.6.5.2 Bond Stones

Bond stone or a set of bond stones shall be inserted 1.5 to 1.8 metres apart, in every course.

5.6.5.3 Quoins

The quoins, shall be of the same height as the course in which these occur. These shall be at least 45 cm long and shall be laid stretchers and headers alternately. These shall be laid square on the beds, which shall be rough-chisel dressed to a depth of at least 10 cm. In case of exposed work, these stones shall have a minimum of 2.5 cm wide chisel drafts at four edges, all the edges being in the same plane.



5.6.5.4 Joints

All bed joints shall be horizontal and all side joints vertical. All joints shall be fully packed with mortar, face joints shall not be more than one cm thick.

When plastering or pointing is not required to be done, the joints shall be struck flush and finished at the time of laying. Otherwise, the joints shall be raked to a minimum depth of 20 mm by raking tool during the progress of work, when the mortar is still green.

5.6.6 Coursed rubble masonry - Second sort

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5.6.6.1 Laying

Shall be as specified in 5.6.5.1 except that the use of chips shall not exceed 15% of the quantity of stone masonry, and stone in each course need not be of the same height but more than two stones shall not be used in the height of a course.

5.6.6.2 Bond stone, quoins

Shall be as specified for first sort respectively.

5.6.6.3 Joints

All bed joints shall be horizontal and all side joints vertical. All joints shall be fully packed with mortar, face joints shall not be more than 2 cm thick.

When plastering or pointing is not required to be done, the joints shall be struck flush and finished at the time of laying. Otherwise, the joints shall be raked to a minimum depth of 20 mm by raking tool during the progress of work, when the mortar is still green.

5.7 Hollow concrete block masonry

5.7.1 Construction of hollow concrete masonry shall be done in accordance with procedures laid down in IS: 2572. General procedures for construction shall conform to IS: 2212 except for the following :

5.7.2 Storage, handling and preparation



The blocks shall be stored in stable stacks over planks or other supports with sufficient care taken to prevent ingress or moisture.

Blocks shall be handled carefully to avoid cracking. All damaged units shall be rejected and removed from site.

Blocks need not be wetted before or during placement. Unless the climatic condition so require, the top and sides may be slightly wetted.

5.7.3 Mortars

Mortar for use in hollow concrete block masonry shall be made from cement, slaked lime and sand unless otherwise specified. The mix preparation shall be as recommended in Table-I of IS: 2572. Preparation of mortar shall be in accordance with IS: 2250.

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5.7.4 Laying

Laying of block for first and subsequent courses and requirements of horizontal and vertical joints shall be as described in IS: 2572-1963. Use of hollow blocks in foundations shall be avoided. Use of blocks filled with sand and blocks filled with 1:3:6 concrete for foundation courses, plinths and basements shall be done with approval of Engineer. Closure blocks of superstructure shall have all openings battered with mortar. A course of solid concrete block masonry shall be provided under door and window openings or a 10 cm thick precast concrete sill block shall be provided under windows. This course shall extend at least 20 cm beyond the openings on either side. Solid blocks or hollow blocks filled with 1:3:6 concrete shall be used for jambs or fixing of hold fasts etc., Similarly solid blocks or U-shaped blocks filled with 1:3:6 concrete shall be used for roof course. They shall be finished smooth at top with 1:3 cement mortar and covered with a coat of crude oil, craft paper or oil paper for free roof movement.

5.7.5 Bond

Wherever two walls intersect, bond between at least 50% of the units intersecting shall be provided. If intersecting walls are laid separately pockets shall be left in the first wall at a maximum vertical spacing of 20 cm for the corresponding course of second wall to be built into these pockets.

Pilasters shall be of twice the thickness. Hollow blocks shall not be used for isolated piers unless they are filled with 1:3:6 concrete.

6.0 PLASTERING AND POINTING



6.1 Materials

The specification of materials shall conform to the requirements as specified in Part-I.

6.2 Plastering

6.2.1 General

Plastering shall be done in accordance with provisions of IS: 1661. Mix proportions of mortar for plastering and thickness of plaster shall be as given either in the drawing, or as per Schedule of Items or as directed by the Engineer. For special plaster work, necessary admixtures shall be added to mortar in required proportion as per manufacturer's specifications or as specified herein. The thickness mentioned in the Schedule of Items shall be minimum thickness.

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6.2.2 Preparation of surface

The surface to be plastered shall be cleaned of all extraneous matter and rubbish. In masonry the joints shall be raked to a minimum depth of 12 mm and cleaned with wire brush. Concrete surfaces to be plastered shall be roughened and hacked to form key for plastering. All plastered surfaces shall be finished smooth with a wooden float in one plane and all internal angles shall be finished slightly rounded. If desired by the Engineer, any unevenness shall be rubbed down by carborundum stones. The surface to be plastered shall be wetted evenly before the application of plastering. Trimming of projections on brick/concrete surfaces wherever necessary shall be done.

For one coat plastering the plaster shall be laid slightly thicker than the specified thickness and the surface then leveled with flat wooden float to the required thickness. For two coat plaster work, the first coat (usually half of total thickness) shall be applied as detailed above except that the surface shall be left rough and keys formed for the application of second coat. The second coat shall be laid on with a wooden float to the specified thickness and shall be applied a day or two after the first coat has set, but has not dried up.

Cement mortar for plastering work shall be used within 30 minutes after adding water to cement and should be kept agitated at intervals of 20 minutes.

If specified cement punning shall be done over the plastered surface by sprinkling neat cement powder evenly on the surface and rubbed smoothly with a trowel to give a fine coating. The plaster shall be kept wet for at least seven days and protected from extreme temperature and weather during this period

The arises of doors and windows shall have richer mortar 1:3 in a width of 75 mm on either side or as required at respective location.



- 6.2.3 Concrete beams, slabs, columns etc. framing into masonry are to be plastered along with masonry walls with these edges wrapped with chicken wire mesh of gauge 24. Overlapping of mesh shall be minimum 75 mm on either side of the edge of the concrete element. Minimum lap for chicken wire mesh shall be 50 mm.

6.3 Cement Pointing

- 6.3.1 Where shown on drawing, Schedule of Items, or as directed by the Engineer, exposed brick faces shall be cement rule pointed. The mortar shall be raked out of the joints to a depth of 12 mm. The dust shall be brushed out of the joints and the wall well wetted.

Unless otherwise specified the pointing shall be made with cement and sand mixed in proportion 1:3. The joints of the pointed work shall be neatly finished

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truly vertical and horizontal or as directed and the lines shall be kept wet till the cementing material has set and become hard. If required, the whole brick face shall be rubbed and polished with fine grade of carborundum stones. Particular care shall be taken to see that no brick face or brick edge is damaged during this work.

6.3.2 Flush pointing

The mortar shall be pressed into the joints and shall be finished flush and levelled. The edges shall be neatly trimmed with trowel and straight edges.

6.3.3 Ruled pointing

The joint shall be initially formed as for flush pointing and then, while mortar is still green, a groove of required shape and size shall be formed by running a forming tool straight along the centre line of the joint till a smooth and hard surface is obtained. The vertical joints shall also be finished in similar way. The pointing line shall be uniform in width and truly horizontal in case of floors and ceilings.

6.3.4 Cut or weather struck pointing

The mortar shall first be pressed into joints. The top of the horizontal joints shall then be neatly pressed back by about 3mm with the pointing tool so that the joint is sloping from top to bottom. The vertical joint shall be ruled pointed. The junctions of vertical joints with the horizontal joints shall be at true right angles.

6.3.5 Raised and cut pointing



This type of pointing shall project from the wall facing with its edges cut parallel so as to have a uniformly raised band about 6mm raised and width 10mm or more as directed. The pointing shall be finished to a smooth but hard surface. the superfluous mortar then shall be cut off from the edges of the lines and the surface of the masonry shall also be cleaned off all the mortar.

Curing

The pointing shall be kept wet for 7 days. During this period it shall be suitably protected from all damages.

6.3.6 Pointing on brick flooring

Specification for this shall be conforming to under sub head "Pointing".

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6.3.7 Pointing on random rubble stone masonry

In such pointing, the mortar shall be simply struck off with a trowel and the work left showing the natural irregularities in line and surface of the stones themselves. Other specifications shall remain same as per para 8.3 under sub head "Pointing".

6.4 Rough Cast Concrete Facing

6.4.1 The surface shall be prepared as for Cement plaster and then 2 cm backing coat of cement sand mortar 1:3 shall be applied. Subsequently, when the backing coat is in plastic state, a top coat 12 mm average thick cement and stone chips mixture in proportion 1:3 (stone chips 10 mm size and below) shall be applied by dashing the mixture on top with trowel to produce uniform rough texture. The mix shall again be dashed over the vacant spaces if any. The surface shall afterwards be cured for 10 days. After curing, the surface shall be brushed with hard wire brush to remove loose chips from the surface. A coat of cement wash shall then be applied, the cost of which shall be included in the rate of the item.

6.4.2 Rendered sand faced cement plaster

The surface shall be prepared as for cement plaster. The backing coat shall be 12 mm thick of cement plaster proportion 1:4 (1 cement and 4 sand) and keys shall be formed on the surface. After curing this coat sufficiently, the finishing coat 6 mm thick consisting of grey cement and screened coarse sand to required gradation (1:3) shall be applied and finished to the desired texture to the satisfaction of the Engineer. The surface afterwards shall be cured for 7 days.

6.4.3 Plaster moulding



Where specified, plaster moulding shall be strictly as per drawings and details, and shall run clean and true from proper templates and moulds, to the entire satisfaction of the Engineer. Rates shall include for brick or concrete cores and for any necessary dabbing in cement mortar or brick or metal lath curing and final finish as desired. Where desired, all angles in internal moulding work shall be covered to a radius of 50 mm or as directed without any extra charges.

6.4.4 Floating coat with neat cement

When the plaster has been brought to a true surface with the wooden straight edge, it shall be uniformly treated over its entire area with a paste of neat cement and rubbed smooth so that whole surface is covered with neat cement coating. Smooth finishing shall be completed with a trowel immediately and in no case later than half an hour of adding water to cement.

6.4.5 Pebble dash plaster

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Specification shall be same as that for rough cast concrete facing vide 8.4.1 except that pebbles or graded crushed stone, of size 10mm to 20mm or as specified/directed by the Engineer, shall be well washed and drained and then dashed/thrown wet on the plaster surfaces while it is still plastic, using strong whipping motion at right angles to the face of wall, pressed flat and filling uncover parts by hand so that finished surface represents homogeneous look. The finished surface shall be lightly tapped with a trowel to ensure good bond.

6.5 Punning with Lime or Plaster of Paris

6.5.1 Lime Punning

Lime punning shall be carried out with best quality approved lime. Lime shall be properly stirred, tempered with water to form a homogeneous mass and strained through fine cloth. The punning shall be laid and rubbed and troweled to an uniform smooth even finish using special trowels. Any unevenness shall be rubbed down with fine sand paper. The plaster must be dry before the lime punning is applied. The punning shall be kept wet for a period of 7 days. The lime paste shall be kept wet until use and no more quantity than can be consumed in 10 days shall be prepared at a time. No portion of the surface shall be left out initially to be patched up later on.



6.5.2 Plaster of Paris punning

This shall be provided by using the best quality of plaster of Paris from approved manufacturer. Unless otherwise specified same procedure as for lime punning shall be followed for getting uniform smooth finish.

7.0 FLOORING, PAVING & FACING

7.1 Scope

Flooring, Paving and facing includes flooring, skirting and dado of various types encountered in plants, buildings, pavements etc. as described under respective heads. For the items which have not been covered up in this chapter completely or covered up only partly, specifications suggested by the manufacturers for the materials, surface preparation, workmanship and all other byeworks etc., shall be strictly followed. In addition to this the entire job will have to be carried out as per direction of the engineer, which shall be final.

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7.2 Materials

Materials shall conform to Part-I of this series.

7.3 General

Flooring, skirting & dado may have to be done in discontinuous strips or areas to suit the needs of erection and commissioning of equipment. Flooring shall be done in close co-ordination with erection of equipment or other services and shall keep pace with the demands in respect of commissioning of individual equipment. No claims for extra shall be tenable for reasons of discontinuity of work or delay in having areas available for work.

Unless otherwise specifically included in the Schedule of Quantities or stated in the description of work, no extra shall be payable for works such as forming coves at internal angles, nosing at plinths, steps, window sills and stair treads, dishing in bath rooms, toilet & other places and cutting to line and fair finish to top edge of skirting and dado. Thickness mentioned shall be the minimum.

7.4 Sub-base

Flooring at ground level having sub-base of sand or earth as specified shall be laid in layers of 15 cm, watered and consolidated by rolling with hand roller or ramming with iron rammer and with butt ends of the crow bars. When filling reaches the required level, the surface shall be flooded with water for 24 hours, allowed to dry and then rammed and consolidated to avoid any settlement later. The thickness of the sub-base shall be as specified either in the drawing or in the Schedule of Items.



7.5 Subgrade

The surface shall be brought to the desired level before subgrade is laid, loose pockets shall be filled up and whole surface shall be consolidated by tamping. Vegetable growth and other decomposed matter, rubbish etc., shall be removed.

7.5.1 Hard core subgrade

Where hardcore subgrade is specified, stone/slag boulders/laterite boulders shall be laid closely stacked together, the longer edge being laid vertically. All interstices shall be filled with smaller particles of the same material or with gravel or red earth. The top surface shall be spread with loose moorum sufficient to cover the gap and to achieve uniform top surface. The surface shall then be adequately watered and rolled by roller.

Hard core shall be laid to form the desired slope in the finished floor.

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7.5.2 Brick Khoa subgrade

Over burnt bricks shall be used for getting brick khoa as per sizes described in Schedule of Items. The khoa shall be laid uniformly and rammed in dry and wet conditions so as to get a uniform compact surface.

7.6 Cement Concrete Flooring with Integral Finish

Cement concrete shall be mixed, laid, consolidated and cured as described in Chapter "Concrete". Laying of concrete shall be done in alternate panels. The size and division of panels shall be as per direction of Engineer. The mix or grade of concrete shall be as specified in Schedule of Items.

The finished surface may be rendered smooth by trowel finishing to provide an appearance of fine and smooth textured surface and in panels or in geometric pattern as specified in Schedule of Items or as directed by Engineer.

7.7 Concrete Flooring with Granolithic Finish (Artificial Stone Flooring)



Granolithic finish shall either be laid monolithically over base concrete or separately over hardened base concrete. The subgrade shall be either brick khoa/lime concrete/cement concrete, as specified. Flooring shall be laid and finished according to IS : 5491.

7.7.1 Thickness

Unless otherwise mentioned the thickness of flooring including topping shall be either 25 mm or 40 mm or 50 mm as shown on drawing/Schedule of Items. The net thickness of topping shall be 6 mm for 25 mm thick floor, 10 mm for 40 mm and 12 mm for 50mm thick floor. An additional allowance of 2mm in thickness of topping shall be made for cutting and grinding margin wherever polishing is specified in the item. The rate of the item will be inclusive of this.

7.7.2 Mix

For base or under bed course, the mix shall be 1:2:4 concrete, unless specified otherwise. The mix of the topping shall consist of 1 part cement : 1 part coarse sand : 1 part coarse aggregated by volume or 1 part cement and 1 part stone chips. The coarse aggregate shall very hard like granite and well graded and size of chips shall be 3mm for 6mm topping & 6mm to 3mm for 10mm or more thick topping. Minimum quantity of water to get workability shall be added.

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7.7.3 Laying

a) Laying of monolithic topping



The concrete base or underbed shall be laid as per specification "Cement Concrete" and levelled upto the required grade. The surface shall remain sufficiently rough to take the finish.

To prevent construction cracks, the panels shall be divided in square or rectangular pattern. For floor finish of 40mm thickness or above, the maximum panel area shall be 2.5 sq.m. with none of the sides exceeding 2.5m, however for lesser thickness these shall be 1.5sq.m. and 2.5m respectively. The dividing strip may be aluminium or glass or as specified and shall have the same depth as that of floor. Within about 2 to 3 hours of laying the base while it is still fully 'green' the topping shall be laid evenly to proper thickness and grade. The topping shall be pressed firmly and rigorously to form full bond with the base/underbed.

The laitance brought to the surface during compression shall be removed carefully without disturbing the stone chips. The surface shall then be lightly troweled to remove all marks and shall be left for sometime till moisture disappears from it. Fresh quantity of cement @ 2.2 Kg per sq.m. of the flooring shall be mixed to form a thick slurry and spread over the surface while concrete is still green. The cement slurry then shall be floated even & smooth. Polishing, if specified, shall be done with polishing machine and the portion where machine cannot be used manually to the satisfaction of the Engineer. If specified so the surface of the flooring shall be finished ribbed, chequered or laid in slope without any extra cost unless specified so in the item. On completion, the floor shall be kept flooded with water for 10 days and shall be adequately protected before it is sufficiently hard.

(b) Laying of topping separately on hardened base

The sub base shall be laid as in clause 7.7.3. The surface of the base concrete shall be thoroughly brushed and cleaned free from all dirt, mortar droppings and laitance etc.. Where the surface has hardened too much, chipping or hacking of the surface may be necessary. The surface shall then be wetted with water for several hours and surplus water mopped. Neat cement slurry at 2.75Kg/sq.m. of surface shall be brushed into the clean surface. The topping then shall be laid as described in clause 7.9.3.

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7.7.4 General

The junction of the floors with all plaster dado or skirting shall be rounded of with 1:1 cement sand mortar & polished, if specified or shown in drawing.

7.7.5 Curing

Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface had hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or ponding of water on the surface. The floor shall not be exposed to use during this period.

7.7.6 Grinding & finishing

Where grinding is specified, it shall start only after the finish has fully set. The grinding shall be done with carborundum stone of No. 60, then No. 80 and then 120 as per the method as specified in in-situ mosaic flooring. After final polishing, the floor shall be rubbed with oxalic acid and then wax polished.

7.8 Dado & Skirting Work (Grey Cement Skirting/Dado)

A backing coat of 12 mm thick and 15 mm thick shall be applied on walls after proper dabbng of the surface for a finished thickness of 18 mm and 21 mm thick respectively, with cement plaster of proportion 1:4 (1 cement and 4 approved quality sand) or as specified. Over this a top coat 6mm/7mm thick consisting of one cement to one stone chips 3 mm nominal size shall be applied. If grinding and polishing specified, the same shall be done as per granolithic flooring with carborundum stones.

7.8 Flooring & Facing with Redoxide of Iron (Red Artificial Stone Flooring)



It shall consist of an underbed or base course and topping over already laid & matured concrete subgrade.

7.9.1 Thickness

Unless otherwise specified the total thickness of the flooring shall be either 40 mm or 25 mm of which the topping shall not be less than 6 mm (net) for 25 mm thickness and 10 mm (net) for 40 mm thickness. The topping shall be of uniform thickness, the underbed may vary in thickness to provide necessary slopes. For vertical surfaces the total thickness shall be 18 mm, of which the topping thickness shall be 6 mm (net). Where grinding (cutting) & polishing is specified a minimum allowance of 2 mm shall be kept for cutting & polishing so that the net specified top thickness is achieved. All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm or as shown in the drawing.

7.9.2 Mix

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i) Course or base course

The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 part cement, 2 parts coarse sand and 4 parts 10 mm down graded stone chips by volume. For vertical and similar surfaces the mix shall consist of 1 part cement to 3 or 4 parts coarse sand by volume as specified in the item.

ii) Topping course

For the topping white cement and red oxide of iron pigment powder shall be dry mixed thoroughly (generally 10:1 by weight) to produce the desired colour when laid. The mix shall then be prepared with 1 part white cement (mixed with pigment) and 3 parts coarse sand by volume. The whole quantity required for each visible area shall be prepared in one batch to ensure uniform colour.

7.9.3 Laying



The underbed shall be laid in panels of maximum area 2.5 sq.m. each and no side shall be more than 1.5m long. For outdoor locations the maximum area shall be 2.0 sq.m. or as specified. The forms for the panels shall have perfectly aligned edges to the full depth of the total thickness of finish. Aluminium or glass dividing strips shall be used as forms. The underbed shall be laid compacted, levelled and brought to proper grade with a screed or float. The topping shall be placed after about 24 hours while the underbed is still somewhat 'Green' but firm enough to receive the topping. The surface of the underbed shall be roughhead for better bonding. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water to achieve a compact dense mass fully bonded with the underbed. The topping shall then be levelled up by troweling and finished smooth with a slurry made with already prepared cement and pigment mixture. About 2.0 kg of the mixture shall be consumed/per sq.m. for horizontal surface, and 1.0 kg for vertical surface.

7.9.4 Grinding & polishing

Where grinding & polishing specified, the same shall be done 36 hours after laying when the surface has hardened sufficiently. It shall be polished with polishing stone, in sequence of different grades of carborundum stones (first No. 60, then No. 80 & then No.120) till a smooth shiny surface to the satisfaction of the Engineer is achieved. After final polishing, the finished areas shall be rubbed with oxalic acid and then wax polished.

7.10 Terrazzo Flooring & Facing

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General

The terrazzo work shall be done by approved firm or specialists. Marble chips used for facing coat of terrazzo work shall be of best quality (from Dehradun or other approved source) and of uniform tint and colour and shall be approved by the Engineer before using in the work. All terrazzo work shall be polished on completion followed by a final wax polish of approved quality.

Terrazzo work shall be done either cast-in-situ or with precast tiles as specified in the Schedule of Quantities Unless otherwise specified thickness for cast-in-situ terrazzo work shall be 25 mm including base course and for tiles 20 mm excluding mortar bed.

7.10.1 Cast-in-situ terrazzo flooring

It shall consist of an underbed and a topping laid over an already matured concrete subgrade.

7.10.1.1 Thickness

Unless specified otherwise, the total thickness of the finished flooring shall be either 25 mm or 40 mm of which the topping shall be minimum 6 mm (net) for 25 mm and minimum 10 mm net for 40 mm flooring. A minimum allowance of 2 mm in the topping shall be kept for grinding and polishing so as to achieve the minimum specified thickness of topping. All junctions of vertical with horizontal planes shall be rounded neatly to uniform radius of 25 mm or as shown in the drawings.

7.10.1.2 Mix

i) Underbed course



The underbed for floors and similar horizontal surface shall consist of a mix of 1 part cement, 2 parts sand and 4 parts stone chips by volume. The sand shall be coarse. The stone chips shall be 10 mm down well graded. Only minimum water to be added to give a workable consistency.

ii) Topping

Topping shall consist of cement (grey or white) as specified with or without colour pigment, marble powder and marble chips. The proportion of cement and marble powder shall be 3 parts of cement to one part of marble powder by weight. The proportion shall be inclusive of any pigments added to the cement. The proportion to which pigments are mixed with grey or white cement to obtain various shades for the binder, shall be as specified in Table-I of IS : 2114.

The proportion of marble chips and cement marble powder mix shall be 7 parts of marble chips to 4 parts of cement marble powder mix

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mixed by volume. Care shall be taken to ensure an even and uniform disposition of the marble chips.

7.10.1.3 Laying

i) Laying of underbed

The underbed shall be laid in panels in the same manner as that for artificial stone flooring. The panels shall not be more than 2 sq.m. in area of which no side shall be more than 2.0 m long. Cement slurry @ 2.75 kg/sq.m. shall be applied before laying over cement concrete/RCC surface/ plastered surface.

Dividing strips made of aluminium or glass shall be used for forming the panels. The strips shall exactly match the total depth of underbed plus topping. In case of in-situ dado work, the sections shall not be more than 60 cm x 60 cm and the aluminium, glass or any other material strips provided similarly.



ii) Laying of topping

After laying, the underbed shall be leveled compacted and brought to proper grade with screed or float. The topping shall be laid after about 24 hours while the underbed is still somewhat 'green' but firm enough to receive the topping. A slurry of the mixture of cement and pigment already made shall be spread evenly and brushed in just before laying the topping. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water and to achieve a compact dense mass fully bonded with the underbed. The terrazzo surface shall be tamped, troweled and brought true to the required level by straight edge and steel floats in such a manner that maximum amount of marble chips come up and are spread uniformly over the surface and no part of the surface is left without the chips. Excessive troweling should be avoided in early stages lest too much cement may come up the surface leading to surface cracking and requiring more grinding to expose marble chip.

7.10.1.4 Curing

The surface shall be left dry for air curing for about 12 to 18 hours and then cured by allowing water to stand on the surface or by covering with wet sack for seven days.

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7.10.1.5 Grinding & polishing

Grinding and polishing shall be done either by hand or by machine. In case of manual grinding, the process of grinding shall begin after 2 days while in case of machine grinding the process shall start after seven days after completion of laying. First grinding shall be done with carborundum stone of 60 grit size. The floor shall then be washed and cleaned to remove mud and grindings, a grout of cement and colouring pigment in same proportion of the topping shall be applied to cover the pin holes. The surface shall be cured for 5 to 7 days and then ground with machine fitted fine grit blocks (No. 120). The surface shall be again cleaned and repaired as mentioned above and shall be cured for 3 to 5 days. Finally the third grinding shall be done with machine fitted with fine grit blocks (No. 320) to get even and smooth surface without pin holes. The finished surface should show the marble chips evenly exposed.

Where use of machine for polishing is not feasible/ possible rubbing and polishing by hand shall be done in the same manner as specified for machine polishing except that carborundum of coarse grade (No. 60, 80 and 120) for first, second & final polishing. After the floor is polished to the satisfaction of the Engineer, it shall be rubbed with oxalic acid and finally wax polished with 'Mansion' or similar approved floor polish to the entire satisfaction of Engineer. For good result, wax polishing shall be applied on the surface with the help of soft linen over a clean and dry surface and then the polishing machine fitted with bobs shall be run over it. Clean saw dust shall be spread over the floor surface and the polishing machine again operated so as to remove excess wax and leave glossy surface. Floor shall not be left slippery.

7.10.2 Terrazzo cast-in-situ facing, skirting and dado

The work shall be carried out in the same manner as that for terrazzo cast-in-situ floors except that the base or bedding course shall consist of 1:3 cement mortar (1 cement & 3 medium sand) of 12 mm or 15 mm or 20 mm thickness for total thickness 18 mm or 21 mm or 26 mm respectively. As specified earlier, the bedding course shall be laid in panel (not more than 60 cm x 60 cm) divided by glass/ aluminium strips. The topping shall be of 6 mm thick finished and shall be laid when the backing plaster is still green. Special care shall be taken to see that the surface are properly cured.

7.10.3 Terrazzo tile finished flooring/facing



The work will consist of manufactured terrazzo tile and an underbed.

7.10.3.1 Thickness

Unless otherwise specified, the total (net) thickness including the underbed shall be 40 mm for flooring and other horizontal surface and 32 mm for vertical surfaces like dado/skirting. The necessary allowance for cutting and grinding shall be kept to have the specified finished thickness.

7.10.3.2 Tiles : Terrazzo

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The tiles shall, unless specifically permitted in special cases, be machine made under quality control in a shop and shall be subjected to minimum hydraulic pressure of 140 kg. per sq. cm.

The tiles shall be composed of a backing and topping. The finished thickness of upper layers shall not be less than 5mm for size of marble chips upto 6m size and not less than 6mm for size of marble chips upto 20mm size.

The ingredients for topping shall be same as cast-in-situ terrazzo. The thickness of the topping, as specified above, shall be net after grinding & polishing. First grinding shall be given to the tiles at the shop before delivery.

The manufacturer shall supply along with the tiles the grout mix containing cement and pigment in exact proportions as used in topping of the tiles.

7.10.3.3 Mix : Underbed

The underbed for floor and similar horizontal surfaces shall be 1 part lime putty : 1 part surkhi : 1 part coarse sand or 1 part cement : 3/4 parts coarse sand mixed with sufficient water to form a stiff workable mass. The thickness of underbed for the flooring shall be 20mm unless otherwise specified. For skirting and dado and all vertical surface it shall be about 12 mm thick and composed of 1 part cement 3 parts coarse sand.

7.10.3.4 Laying



The underbed mortar shall be evenly spread and brought to proper grade and consolidated to a smooth surface. The base surface shall be roughened for better bond. Before laying the underbed, over the base/subgrade, a coat of cement slurry shall be applied over the subgrade. Before the underbed has time to set and while it is still fairly moist but firm, cement shall be hand dusted over it or cement slurry applied at 4.4Kg of cement per sq.m. and the tiles shall immediately be placed upon and firmly pressed by wooden mallet on to the underbed until it achieves the desired level. The tiles shall be kept soaked for about 10 minutes just before laying. The joints between tiles shall be as close as possible and not more than 1.5 mm wide.

Special care shall be taken to check the level of the surface and the lines of the joints frequently so that they are perfect. When tiles are required to be cut to match the dimensions these shall be sawn and edges rubbed smooth. The location of cut tiles shall be planned in advance and approval of the Engineer taken.

At the junction of horizontal surface with vertical surface the tiles on the former shall enter at least 12 mm under the latter.

After fixing, the floor shall be kept moistened allowed to mature undisturbed for 7 days. Heavy traffic shall not be allowed. If desired dividing strips as

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specified under Cl. 7.10.1.3 may be used for dividing the work into suitable panels.

7.10.3.5 Grinding and polishing

Procedure shall be same as in-situ terrazzo finished flooring. Grinding shall not commence earlier than 14 days after laying of tiles.

7.11 Glazed Tile Finished Flooring & Facing

This finish shall be composed of glazed earthen tiles with an underbed laid over a concrete or masonry base.

7.11.1 Thickness

Unless specified the total thickness shall be 21 mm for flooring & 18 mm for dado/skirting for the underbed.

The necessary cutting into the surface receiving the finish, to accommodate the specified thickness shall be done.

7.11.2 Tiles : Glazed

These shall conform to the requirement of IS : 777. The tiles shall be of earthenware, covered with glazed white or coloured, plain or with designs, of 149 mm x 149 mm or 99mm x 99mm nominal sizes and 5,6 & 7 mm thick unless otherwise specified. Specials like internal and external angles, beads, covers, cornices, corner pieces etc., shall match. The top surface of the tiles shall be glazed with a gloss or matt unfading stable finish as desired by the Engineer. The tiles shall be flat and true to shape. The colour shall be uniform, and fractured section shall be fine grained in textures, dense and homogeneous.

The coloured tiles, when supplied, shall preferably come from one batch to avoid difference in colour.



7.11.3 Mix : Underbed

The mix for the underbed shall consist of 1 part cement and 3 parts coarse sand mixed with sufficient water or any other mix if specified and shall be 12mm thick minimum or as specified.

7.11.4 Laying & finishing

The underbed mortar shall be evenly spread and brought to proper grade and consolidated to a smooth surface. Before laying the underbed, over the base/subgrade a coat of cement slurry shall be applied over the subgrade. Before the underbed has time to set and while it is still fairly moist but firm, cement shall be hand dusted over it and the tiles shall immediately be placed upon and firmly pressed by wooden mallet on to the underbed until it

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achieves the desired level. The joints shall be practically invisible and filled with non-staining white cement/white cement mixed with pigment for coloured tiles. Internal angles shall be provided with 'specials'. Drains shall be provided with 'specials'. The tiles shall be thoroughly cleaned after completion. The tiles shall be laid to the slope specified in the drawings and truly vertical on walls when used as skirting.

7.11.5 Curing & cleaning

After flush pointing the joints, the surface shall be cured for 7 days by keeping it wet. The surface shall be then cleaned with soap or suitable detergent, washed fully and wiped with soft cloth to prevent scratching before handing over.

7.12 Marble Flooring

7.12.1 Thickness

Unless specified otherwise the underbed shall be average 20 mm for flooring and 12 mm thick for vertical surfaces. The slabs may be 20 mm, 25 mm, 30 mm or 40 mm thick as specified.

7.12.2 Marble slab

The slabs shall be made from selected stock which are hard, sound, homogeneous and dense in texture and free from flaws, angles and edges shall be true, square, free from chipping and surface shall be plane. The slabs shall preferably be machine cut to the required dimensions. Tolerance of plus or minus 5 mm in dimensions and plus or minus 2 mm in thickness will be allowed. Unless specified the slabs shall be minimum 300 mm x 300 mm. The stone slabs shall come from specific regions and in specified quality with top surface fine chisel dressed. All sides shall also be fine chisel dressed to the full depth to allow finest possible joints.



The slabs shall be delivered to the site well protected against damages and stored in dry place under cover.

7.12.3 Mix : Underbed

The underbed, unless specified otherwise for floor and similar horizontal surfaces shall be 1 part lime putty : 1 part surkhi : 1 part coarse sand or 1 part cement : 4 parts coarse sand mixed with sufficient water to form a stiff workable mass and shall be on 20mm thick bed. For skirting and dado and all vertical surfaces it shall be 12 mm thick and composed of 1 part cement and 3 parts coarse sand.

7.12.4 Laying

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The sides and top surface of the slabs shall be machine rubbed with coarse sand stone and washed clean before laying. The underbed mortar shall be evenly spread and brought to proper level on the area under each slab. The slab shall be laid over the underbed, pressed and tapped down with wooden mallet to the proper level. The slab shall then be lifted and the underbed corrected as necessary and allowed to stiffen a little. Next, a thick cement slurry at 4.4 Kg of cement per sq.m. shall be spread over the surface. The edges of the slab shall be buttered with slurry of cement, grey/ white/mixed with pigment matching the colour of the stone slabs. The slab shall be gently laid and tapped with wooden mallet to bed properly to a very fine joint and to the required level. All surplus cement slurry shall be removed and the surface mopped clean with wet soft cloth. The laid finish shall be cured for 7 days by keeping it wet.

7.12.5 Polishing, finishing

Fine chiseling shall be done to remove the slight undulations that usually exist at the joints. The polishing and finishing shall be done as specified under terrazzo flooring. However, the joints shall be so fine in the case of stone slabs that grouting shall not be called for.



7.13 Marble in Facia or Dado

Marble tiles of approved shade, variety, size and thickness as specified in the item shall be used. They shall be of selected quality, dense, uniform and homogeneous in texture and free from cracks or other structural defects. The exposed face shall have no unsightly stains, veins and defects. They shall have uniform milky white or coloured shade or patterns of colours approved by the Engineer before ordering the tiles. The surface shall be fine polished and sides machine cut, true to square.

When a single course of marble slab is to be fixed as in dado etc., the slabs shall be fixed as described below :

Mortar pads of 1:3 C.M. (1 cement : 3 coarse sand) of uniform width shall be stuck on to the wall at close intervals and the marble slabs shall be pressed on to them firmly. The remaining cavities if any shall then be filled with thin grout of cement mortar of the same proportion. The sound coming, on gently tapping of the slab, will indicate if there are hollows. When the hollow cannot be filled with grout and the finished slab continues to give a hollow sound on tapping, the slab shall be removed and reset. For the facia work where more than one course is required the marble slabs shall be of matching stand and veins to form architectural pattern as per drawings and shall be fixed in the same way as described above except for the horizontal joints of the slabs, where adjacent slabs shall be held together by a brass pin passing through a hole drilled into the slabs. In addition, wrought iron/dowels shall be provided to anchor the slabs to the wall. The metal cramps shall be counter sunk into the joints of the slab and it shall be located about a metre apart subject to a minimum of one for each slab for each horizontal joint.

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The facing shall be fixed truly in plumb and in perfect line or curves as shown on the plans. The courses and joints shall be as directed by the Engineer. The surface shall be protected from sun and rain and cured for 10 days and shall be finally polished with carborundum stones as for skirting & dado of cast-in-situ terrazzo.

7.14 Flooring/Paving with Hardener like Ironite

This will consist of a topping (incorporating iron particles) to bond with concrete base while the latter is 'Green'.

7.14.1 Thickness

Unless otherwise specified in the Schedule of Items, the total thickness of the floor with metallic hardener finish shall be 40 mm or 50 mm of which the topping shall be 10 mm (net) for 40 mm & 12 mm (net) for 50 mm

7.14.2 Material (metallic hardener)

The hardening compound shall be uniformly graded iron particles free from non-ferrous metal impurities, oil, grease, sand soluble alkaline compounds or other injurious materials. When desired by the Engineer, actual samples shall be tested.

7.14.3 Mix

Unless otherwise specified, the mix for underbed shall be of 1:2:4 concrete and stone chips shall be 12 mm down grade. For topping the proportion of the metallic hardener shall be as specified or as indicated by the manufacturer. However, in absence of any such direction 1 part metallic hardener shall be mixed dry with 4 parts cement, by weight. To this mixture 6 mm nominal size stone chips shall be added in proportion of 1 part cement (mixed with hardener) to 2 parts of stone chips by volume and uniformly mixed. Minimum quantity of water shall be added to make it workable.



7.14.4 Laying & finishing

The under bedding course of base course shall be laid as per specification of laying underbed for Red artificial stone flooring. The surface shall be roughened by wire brush as soon as possible. The finish top coat shall be laid while the concrete base is still fairly 'green' within about 3 hours of laying of the later. The finish shall be of uniform and even dense surface without trowel marks, pin holes etc. This topping layer shall be pressed firmly and worked vigorously and quickly to secure full bond with the concrete base. Just when the initial set starts the surface shall be finished smooth with steel trowel.

7.14.5 Curing

The finished floor shall be cured for 7 days by keeping it wet.

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7.15 Chemical Resistant Tiles Flooring / Facing (Either of natural stone or prepared tiles)

This shall include all varieties of special tiles used for specific chemical resistance function and an underbed over already laid concrete or masonry. The Bidder shall get it done by specialised manufacturer & get guarantee of its performance.

7.15.1 Tiles

The chemical resistant tiles as detailed in the Schedule of Items shall be of the best indigenous manufacture unless otherwise specified and shall be resistant to the chemical described in the Schedule of Items. The tiles shall have straight edges, uniform thickness, plain surface, uniform non-fading colour and textures.

Usually the chemical resistant tiles shall not absorb water more than 2% by weight. The tiles shall have at least compression strength of 700 kg/cm². The surface shall be abrasion resistant and durable.

7.15.2 Laying

The mortar used for setting or for underbed the tiles shall be durable and strong. The grout which shall be to the full depth of tile shall have same chemical resistant properties as that of tiles. Joints shall be pointed if so desired. The setting and fixing shall be according to the manufacturer's specification approved by the Engineer.

7.16 Chemical Resistant in Situ Finished Flooring/Facing



Chemical resistant in situ finish shall be as called for in the Schedule of Items. About its performance the Engineer shall have to be fully satisfied by test results and examination of similar treatment already in existence. The Bidder shall get it done by a specialised manufacturer, get guarantee of performance from the organisation and pass it on to the owner in addition to his own guarantee.

7.17 Acceptance Criteria

The Bidders shall satisfy the Engineer specially for the workmanship of the following finished floor :

- (a) Level, slope, plumb as the case may be
- (c) Alignment of joints, dividing strip etc.
- (d) Colour, texture
- (e) Surface finish
- (f) Thickness of joints including the workmanship in joints.

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- (g) Details at edges, junctions etc.
- (h) Performance
- (i) Precautions specified for durability.
- (j) Effluent treatment plant

8.0 WOOD WORK

8.1 General

Wood work shall be neatly and truly finished to exact dimensions and details as per drawings, without patching or plugging of any kind. Rebates, roundings and mouldings as shown in drawings shall be made before assembling. Exposed work shall be finished smooth with well planed faces.

All assembly of shutters of doors, windows, ventilators and frames thereof shall be exactly at right angles. In the case of frames, the right angle shall be checked from the inside surfaces of the respective members.

All door and window frames shall be clamped together so as to be square and flat at the time of delivery. Door frames without sills shall be fitted with temporary stretchers.



Horns of frames and other parts that go into or butt against the masonry, shall be protected against moisture and decay with two coats of coal tar or other approved protective material.

All surfaces of the door, window and ventilator frames and shutters which are required to be painted ultimately shall be covered evenly by brush with a priming coat of approved primer. In the case of doors to be polished or varnished, a priming coat of approved polish or varnish shall be given before delivery. No primer shall be applied to the wood work until it has been inspected and passed by the Engineer.

8.2 Joinery

All heads, posts, transoms and mullions etc., of doors, windows and ventilators shall be made out of single pieces of timber only. The heads and post shall be through- tenoned into the mortices of the jamb posts to the full width of the latter and the thickness of the tenon shall be not less than 1.25 cm. The tenons shall be close fitting into the mortices and pinned with corrosion resisting metal pins not less than 8 mm diameter or with wood dowels not less than 10 mm diameter. The depth of rebate in frames for housing the shutters shall in all cases be 1.25 cm and the rebate in shutters for closing in double shutter doors or windows shall be not less than 2 cm. Unless otherwise specified, all joints shall be mortice and tenon joints with the ends of the tenons exposed to view. Joints shall fit truly and fully without fillings. The contact surfaces of tenons and mortices shall be treated, before putting together, with an approved adhesive conforming to I.S :848 and 851.

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8.3 Shrinkage & Tolerance

The arrangement, joining and fixing of all joinery work shall be such that shrinkage in any part and in any direction shall not impair the strength and appearance of the finished work.

The tolerance on overall dimensions shall be within the limits prescribed in IS : 1003 (Part 1 & 2).

8.4 Fixing

Door and window frames shall generally be built in at the time the walls are constructed. Alternatively, where permitted by the Engineer, the frames may be subsequently fixed into prepared openings for which purpose holes to accommodate the holdfasts shall be left at the time of construction. Where the frames are subsequently fixed into prepared openings in the wall such openings should be 25 mm more than the overall width of the door, window or ventilator frame to allow minimum 12mm plaster on each jamb. The height of the unfinished opening shall depend upon whether a threshold is required or not. While fixing the door care shall be taken to see that at least 6 mm space is left between the door and the finished floor. The M.S. clamps fixed to the frame shall be inserted in the holes and jammed in cement concrete M-15 or (1:2:4 mix) with 20 mm down graded stone chips after holding the frame in proper position to the line, level and plumb.

The size of the concrete block shall be 250 x 125 x 85mm unless otherwise specified.

8.5 Tarring



Timber in contact with earth, concrete, plaster or masonry shall be treated with boiling coal tar or 2 coats of wood preservative treatment like hot solignum or creosote oil etc. before fixing the frame in position.

8.6 Fittings

Unless otherwise specified, three holdfasts shall be fixed on each side of a door frame, one at the centre point, and the other two at 30 cm from the top and the bottom of the door frames. In the case of windows and ventilators, a pair on each side shall be fixed at quarter points of the frames. Unless otherwise specified the hold-fasts shall be of mild steel plate 40 x 3 x 225 mm long, fish tailed at one end and screwed to the frame in the formed rebates.

Generally, each door shutter shall be fixed to the frame with three hinges of approved manufacture, one at the centre and the other two approximately 24 cm from the top and bottom of the shutter. Each window shutter shall be fixed to its frame with two hinges at the quarter points.

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Locks, handles, door closers, stoppers etc., shall be fitted as shown in drawing or described in the Schedule of Items.

8.7 Doors, windows & ventilators etc.

Dimensions of the various components of doors, windows and ventilators shall be in accordance with IS : 1003 (Part 1&2) Table- III or as shown on the drawings. The work shall be carried out as per detailed drawing. The wooden members shall be planed, smooth and accurate. They shall be cut to the exact shape and size without patching or plugging of any kind. Mouldings, rebates, curves and roundings etc. shall be done as shown in the drawing before the pieces are assembled into the shutter.

The thickness of stiles and rails etc shall be as per IS: 1003 (Part 1&2) unless otherwise specified in the item of works. These shall be properly and accurately mortised and tenoned. Rails which are more than 180mm in width shall have 2 tenons. Stiles and rails shall be made out of single piece upto 200mm in width. In case more than one piece of timber is used for members exceeding 200mm width, they shall be joined with a continuous tongued and grooved joint, glued together and reinforced with rust proof metal dowels or headless pins. The tenons shall pass clear through stiles. the stiles and rails shall have a 12mm groove, unless otherwise shown in the drawing, to receive the panel. In case of double shutters the rebate at the closing junction of the two shutters shall be as per clause 5.5 of IS: 1003 or as shown in the drawing. Primer coat shall not be put before shutters are passed by the engineer.

8.8 Panelled Shutters

These shall conform to IS: 1003 (Part I). Timber panelled shutters shall be constructed in the form of timber frame work of stiles and rails with panel inserts of timber, plywood, block board, veneered particle board, hard board or asbestos cement board.



Stiles, rails and panels in door shutters shall be of the same species of wood.

Timber panels shall be of minimum width of 150mm. When made from more than one piece, the pieces shall be jointed with a continuous tongued and grooved joint, glued together and reinforced with metal dowels. No single panel shall exceed 0.5 m² in area. Timber panels shall be fixed only with grooves but additional beadings may be provided either on one side or both sides.

Unless otherwise specified thickness of panel for 35mm thick shutter shall be 15mm and for 40mm and above thick shutter, it shall be 20mm. For 25mm thick shutter, panel thickness shall be 12mm.

Apart from timber panels other materials like plywood, Block board, particle board, Hard board and Asbestos cement may also be used for panelling

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purpose and shall be fixed with grooves or beading or both as per provisions made in IS:1003 (Part-1).

Timber suitable for manufacture of door shutter have been grouped under class a,b,c & d in Table 1 of IS: 1003 (Part-1).



8.9 Glazed Shutters

The openings for glazed shutters shall be rebated and moulded out of solid timber. Plain sheet glass for panels shall be of approved quality as specified. Wherever specified, ground glass or frosted glass of approved quality shall be used in place of plain sheet glass. Unless otherwise specified glass panes shall be fixed by means of moulded beads and suitable MS panel pins. A thin layer of putty shall be applied between glass panes and sash bars and also between glass panes & beading.

8.10 Flush Door Shutters

Unless otherwise specified, flush door shutters shall have a solid/cellular core, a teak wood frame, and shall be faced with approved quality of plywood on both faces. The core and stock shall be made from well seasoned approved timber and treated with approved preservatives. The plywood faces shall be glued on to the solid/cellular core with waterproof glue under pressure and heat. The construction of flush doors shall be such that no difficulty should arise in fixing mortice locks, hydraulic door closers etc. The shutters shall be rebated in the case of the double leaf doors. Where specified flush doors shall be provided with vision panels, rectangular/ round or louvered.

If specified so, the flush door shall be solid block board core or solid particle board core construction. The workmanship and overall finish shall be of very high standard and shall conform to IS:2191 (Part 1&2) & 2202 (Part 1&2). The shutters shall be procured from approved manufacturer bearing IS certification mark only.

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8.11 Other types of shutters

8.11.1 Wooden hand rails

Wooden hand rails shall be of approved quality teak wood fixed to concrete or metal balustrade with concealed steel or metal lugs and bolts as per drg. Joints will be made with concealed crews and dowels. All bends, mitres, coves, moulds etc. will be strictly to proper profile and finally smoothened by sand paper. The hand rail shall be finished with wax or french polish or painting as per direction of the engineer.

8.11.2 Hardware fittings for door, windows & ventilators

All mortice or rim locks, latches, cabinet and wardrobe locks, hydraulic door closers, floor springs etc. shall be of Godrej, Everite make or of similar approved make. The rate shall include for all necessary screws, other adjuncts, fixing in position and is for the completed work. the finish shall be as specified in the schedule of quantities. Door, window and ventilator fittings shall be as per specifications already described. The rates for doors, windows and ventilator shutters shall include the cost of fixing the fittings, with the necessary screws to the shutters and the frame. The cost of fittings only shall be paid separately. Where specified in the schedule of quantities, the cost of fittings shall be included in the rates for doors, windows and ventilators shutters. In such case the bidder shall supply and fix the various fittings strictly to the standard laid down in the schedule of hardware fittings and no separate payment for this shall be made.

8.12 Inspection

The Bidder shall provide all facilities to the Engineer for the inspection of the goods at his premises. No primer shall be applied until the wood work has been inspected and passed by the Engineer. The Engineer shall have the option of rejecting any article or asking for replacement of any article found to be defective or not complying with the requirements of this specification and the relevant Schedule of Items.



9.0 METAL DOORS, WINDOWS AND ROLLING SHUTTERS

9.1 General

Doors, windows and ventilators etc., shall be truly square and flat, i.e. free from twist and warp. The general fabrication shall conform to IS:1038 & IS : 1361 as applicable.

9.1.1 Frames shall be constructed of sections which have been cut to length and mitred. They shall be morticed, reinforced, drilled and tapped for hinges and lock and bolt strikes. Where necessary, frames shall be reinforced for door closers. Flash butt welding or any other suitable method which gives the desired requirement, with mitred corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose "T" masonry anchors

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shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be supplied. Frames shall be brought to site with floor ties/weather bars installed in place. All frames shall be square and flat. Door thresholds shall be provided as shown on drawing. Doors without threshold shall have bottom tie of approved type.

9.1.2 The Bidder shall first submit for the approval of the Engineer, the name and address of the manufacturer whose metal casements and doors and windows he intends to use, together with typical drawings and specifications, describing the details of construction for each type of door/window/ventilator etc.

9.1.3 All steel doors, windows and ventilators shall be either galvanised or painted. All steel surfaces shall first be thoroughly cleaned free of rust, scale or dirt and mill scale by pickling or similar process and then shall be painted with one coat of an approved primer conforming to IS : 102 before despatch. Alternatively they may be galvanised by the "Hot Dip" zinc spray or electro-galvanizing process as described in IS : 1361.

9.2 Fixing

Doors, windows and ventilators shall not be built in at the time the walls are constructed but shall be subsequently fixed into prepared openings, as laid down in IS : 1081. Holes to accommodate the fixing lugs are to be left or cut, and the casements fixed after all the rough masonry and plaster work have been finalised. The lugs of the casement shall be jammed in cement concrete (15C Mark)/(1:2:4) mix after holding the casement in proper position, line and level.



The width of the clear unfinished opening in the wall should be 25 mm more than the overall width of the door frame to allow for plaster on each jamb. The height of the unfinished opening shall depend upon whether a threshold is required or not. While fixing the door, care shall be taken to see that at least 6 mm space is left between the door and the finished floor.

9.3 Fittings

Hardware shall be fixed as late as possible, preferably just before the final coat of paint is applied. It shall be fitted in a workmanlike manner, so that it may not work loose and in such a way that screws and pins are not marked and mutilated by hammers and screw drivers. It shall be tested for correct operation. Where specified, doors shall be fitted with a three-way bolting device which can be operated from outside as well as inside, and a locking system, which can similarly be operated from either side. Solid steel bolt handles shall be provided, one on the outside and one on the inside of each shutter. In case of doors provided with a service door, the lock shall be fitted on the service door. All materials shall be the best procurable and shall be approved by the Engineer.

9.4 Normal Steel Plate Doors

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Steel doors may be of the hinged type or sliding/ folding type, single shutter or double shutter, and of single-walled or double walled construction, as specified on the drawings or Schedule of Items. All doors shall be provided with a sturdy frame and hold fasts for fixing into the wall. Unless otherwise specified, the frame shall be prepared from mild steel angles of size not less than 65 x 65 x 6 mm electrically welded at the corners and the shutter shall be made from flat steel sheet of 18 gauge or 1.25mm thickness with a frame of mild steel angles not less than 50 x 50 x 6 mm all round, suitably braced. The whole shutter shall be of welded construction and shall be hung at the sides by means of three or four hinges as specified.

9.4.1 Double Plate flush door shutters

Door shutters shall be 45 mm thick, completely flush design and shall comprise of two outer sheets or 18G or 1.25mm thick steel sheets, rigidly connected and reinforced inside with continuous vertical 20G or 0.99mm thick stiffeners, spot welded in position at not more than 150 mm on centres. 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 by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and head, shall have proper level on lock stiles and rails and shall be reinforced at corners to prevent sagging or twisting. Pairs of double doors shall have meeting style edges bevelled or rebated. Where shown on drawing, or 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 hardware where necessary. Any drilling and tapering required for surface hardware shall be done at site. Where shown in drawing, provisions, shall be made for fixing glazing, vision panels, louvres etc. Glazing mouldings shall be of 18G or 1.25mm thick steel or extruded aluminium sections with profiles shown in drawing and suitable for fixing 6 mm glass. Louvre blades shall be V or Z shaped sections.



9.4.2 Single sheet door shutters

Single sheet doors shall be made from best quality 18g/1mm mild steel sheets, and shall present a flush surface on the outside. The inside shall be stiffened with a semi-tubular edge and central stiffening rail which shall convey the lock and other fixture. The frames shall be made from best quality steel sections. Wherever required or shown on drawings, provision for fixing glass panes, louvres etc., shall be made.

The manufacturing shall done as specified in "Double Plate Flush Door Shutters".

9.5 Pressed Steel Doors

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All pressed steel doors shall be obtained from an approved manufacturer. The frame and shutters shall be fabricated from cold rolled or pressed steel sections. Unless otherwise specified, the thickness of all sheets used for frames shall be not less than 5 mm. The shutters shall be made of sheet steel of 2 mm thickness for single shutter doors and double shutter doors with or without service door. The plates shall be adequately stiffened with suitably placed stiffeners

The double-walled door shutter shall consist of two plates each 2.5 mm thick, separated by a gap of 33 mm in between making an overall thickness of 38 mm or as shown in drawing. The plates shall be adequately stiffened by means of suitably spaced horizontal steel stiffeners.

9.6 Steel Windows, Sashes, Ventilators, etc.

These shall conform to IS : 1038 and IS : 1361 as appropriate and as shown in drawings. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, pivot arrangements for ventilators, etc.

- 9.6.1 Where composite unit openings are shown in drawings, the individual window units shall be joined together with requisite transoms and mullions. Where aluminium glazing beads are specified, they shall be extruded aluminium channel 9.5 mm x 1.6 mm (Indal Section No. 2209) unless otherwise shown in drawings.

All welds at the corner of casement shall be done by flash butt welding process or any other suitable method which gives the desired requirement and dressed flush on all exposed and contact surfaces.

9.7 Collapsible Gate (Steel)



Mild steel collapsible gates shall be obtained from an approved manufacturer. These shall be of mid bar type made out of double channels each 20 x 10 x 2 mm with 20 x 5 mm diagonals and shall be top hung with roller bearings, and fitted with locking arrangement.

Collapsible gates under 3.0 metre height shall generally have 3 sets of lattices and those over 3.0 metre height, 4 sets of lattices. Guide tracks shall be fitted at the top and bottom, of T-iron 40 x 40 x 6 mm with 40 mm dia bearings in every fourth double channel

9.8 Steel Rolling Shutters and Grills

- 9.8.1 Unless otherwise specified the shutters shall conform IS:6248. Laths for rolling shutters shall be made from tested bright cold rolled, annealed M.S. strips, not less than 0.9 mm thick for shutters upto 3.5 M wide and not less than 1.25 mm thick for shutters above 3.5 M wide and machine rolled at 75 mm rolling centres, interlocking with each other. The profile will be such as to

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prevent excessive deflection under specified wind load.

- 9.8.2 Rolling grills shall be constructed out of 6/8 mm dia rods at 35 mm on centres running horizontally flexible connected with vertical links spaced not more than 200 mm centres. Alternatively, rolling grills shall be made from perforated laths of approved design reinforced with 6 mm dia rods. End locks shall be heavy type and shall be provided at each end of alternate laths unless specified otherwise. Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. When shown in drawings, a flexible weather strip shall be applied to make tight contact with the floor. Guides shall be of such depth as to retain the shutter under a wind pressure of 150 kg/sq.m. or as specified. Shafts shall be of steel pipe of sufficient size to carry the torsional load with a maximum deflection of 1/360 th of span. Grease packed ball bearings or bushings shall be provided for smooth trouble free operation. Hoods shall be formed of not less than 20 gauge or 0.90 mm thick sheet mild steel, suitably, reinforced to prevent sag. Locks shall be slide bolt and hasp, or cylinder lock operable from both sides. Provision for securing hand chain with padlock, removable handle for hand cranks etc, shall be made as described in scheduled of items and as directed by the Engineer.
- 9.8.3 Laths for rolling shutters shall be made from tested bright cold rolled, annealed M.S. strips, not less than 0.9 mm thick for shutters upto 3.5 M wide and not less than 1.25 mm thick for shutters above 3.5 M wide and machine rolled at 75 mm rolling centres, interlocking with each other. The profile will be such as to prevent excessive deflection under specified wind load. Rolling grills shall be constructed out of 6/8 mm dia rods at 35 mm on centres running horizontally flexible connected with vertical links spaced not more than 200 mm centres. Alternatively, rolling grills shall be made from perforated laths of approved design reinforced with 6 mm dia rods.
- 9.8.3 End locks shall be heavy type and shall be provided at each end of alternate laths unless specified otherwise. Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. When shown in drawings, a flexible weather strip shall be applied to make tight contact with the floor. Guides shall be of such depth as to retain the shutter under a wind pressure of 150 kg/sq.m. or as specified. Shafts shall be of steel pipe of sufficient size to carry the torsional load with a maximum deflection of 1/360 th of span. Grease packed ball bearings or bushings shall be provided for smooth trouble free operation. Hoods shall be formed of not less than 20 gauge or 0.90 mm thick sheet mild steel, suitably, reinforced to prevent sag. Locks shall be slide bolt and hasp, or cylinder lock operable from both sides. Provision for securing hand chain with padlock, removable handle for hand cranks etc, shall be made as described in scheduled of items and as directed by the Engineer.

9.8.5 Manually operated shutters/grills

Manually operated shutters shall be easily operable by one person. The speed of operation shall be about 0.3 metres per second. In general,

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manually operated shutters shall be push pull type for openings upto 9 sqm in area. Larger shutters shall be either chain and gear operated or crank and gear operated. The crank/handle shall be removable. All shutters shall be lockable from one or both sides as described in Schedule of Item or as desired by the Engineer.

9.8.6 Priming coat of shop coat

Shutters shall be painted with one coat of red lead or zinc chromate primer after they are inspected and found in order and acceptable. Where specified, doors shall be galvanized and subsequently painted one coat of zinc chromate for adhesion of field coat.

9.8.7 Erection

Door shall be installed by the manufacturer or his authorised 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 prevailing Indian Electricity Rules.

9.8.8 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.

9.8.8.1 Field inspection

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



9.9 Guarantee

The Bidder 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.

9.10 Aluminium Doors, Windows, Frames

- 9.10.1 Anodised tubular aluminium doors shall be of approved make and shall be of size and design as per relevant drawing. Unless otherwise specified, the door frame shall be of 101.4mm x 44.6mm and shutter of 50mm tubular extrusions, 3mm thick. The opening arrangement shall be single action or double action as shown in drawing with spring hinges in floor. The glazing shall be 5.5mm thick plain glass panes fixed with necessary gaskets and aluminium beading strip. The door shall be provided with one security lock. The shutters shall be provided with 1.6mm thick 300x150mm push plates and 1.6mm thick 300mm wide kick plate of anodised aluminium for full width of door inside and outside.

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The door frames shall be polished and anodized with approved colour. The average thickness of anodic coating shall not be less than 15 microns as per IS: 1868. Door frame shall be provided with approved anchors @ 90 cm c/c maximum for fixing.

9.10.2 Aluminium windows



Aluminium windows and ventilators shall conform to IS:1948 or equivalent as approved by the Engineer. Fixed frame shall be manufactured from aluminium alloy conforming to ISS-HE-9 WP. The fixtures like handles, stoppers, stays, etc., shall also be anodized aluminium and shall be of approved make. Glazing shall be 4mm thick plain glass and shall be fixed with glazing clips and metal putty. It shall conform to IS:1081. Average anodizing coating to windows, ventilators and fixtures shall not be less than 15 microns as per IS : 1868.

- 9.10.3 All work shall be fitted and shop assembled to a first job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce a uniform colour throughout the work. 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 shape fit type without visible screws and shall be of sizes to accommodate glazing. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

10.0 GLAZING

10.1 General

Glazing shall be done with plain, frosted, ground glass or wired cast glass, laminated safety glass or toughened glass etc. as shown on drawings, described in the Schedule of Items or approved by the Engineer. The method of glazing adopted shall be such that movement of the structure, to which the securing is done, does not transmit strain to windows, doors or ventilators as the case may be. The work shall generally conform to IS:1081 "Code of Practice for Fixing and Glazing of Metal Doors, Windows & Ventilators". The material for putty shall consist of whiting and linseed oil, raw-mixed in such proportion as to form a paste conforming to IS : 419.

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10.2 Doors, Windows and Ventilators

Windows and ventilators shall be designed for putty glazing fixed from outside and glazed doors for fixing from inside. In addition, spring type glazing clips shall be provided at intervals of 30 cm, or as shown otherwise on drawings or described in the Schedule of Items. These shall be inserted into holes drilled in the shutters or frames as the case may be.

All glazing shall be puttied to the shutters of frames with good quality putty in addition to glazing clips. Glass panes shall not be placed directly against the metal/timber. A thin layer of putty shall be even spread over the glazing rebate and the glass pressed firmly against it. It shall be secured in position by means of teak wood beads for wooden shutters. Glass panes shall be set without springing & shall be bedded in putty and back puttied, except where moulding or gasket are specified. Putty etc. shall be smoothly finished to even lines. Figured glass shall be set with smooth side out. After completion of glazing work, all dirt stains, excess putty etc., shall be removed and the glass panes shall be left in perfectly acceptable condition. All broken cracked or damaged glass shall be replaced by new ones at the Bidder's cost.

10.3 Northlight Glazing

This shall consist of aluminium or steel glazing bars as shown on drawings or described in the Schedule of Item and be subject to approval of Engineer. The glazing parts shall be securely fixed in their frame and shall be weather-proof. All glazing shall be flashed to the surrounding so as to be weather-proof. Glass shall be fixed to the astragals with glazing clips and putty.



11.0 WHITE WASHING, COLOUR WASHING AND PAINTING

11.1 Scope

This chapter deals with white washing, colour washing, distempering, cement washing, emulsion painting, silicate painting etc., to concrete and masonry surfaces and painting to the wood works and steel works. For the items which have not been completed or partly covered in this chapter, specifications suggested by the manufacturers for the materials, surfaces preparation, workmanship and all bye works shall be strictly followed and shall be carried out as per direction of the Engineer.

11.2 Materials

Materials shall conform to Part - I

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11.3 White Washing, Colour Washing

11.3.1 General

Wherever scaffolding is required/necessary, it shall be erected on double support tied together by horizontal pieces, over which the scaffolding planks shall be fixed. No part of it shall rest on or touch the surface which is being washed/painted. Where ladders are used, pieces of old gunny bags shall be tied on their tops to avoid damage or scratches to walls. For white washing the ceiling, proper stage scaffolding shall be erected. The surface on which wash is to be applied shall be thoroughly brushed free from mortar droppings and foreign matter.

11.3.2 White Wash

The wash shall be prepared from fresh stone white lime of approved quality and shall be thoroughly slaked on the spot mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for 24 hours and then shall be screened through a clean coarse cloth. 4 Kg of gum dissolved in hot water shall be added to each cubic metre of the cream.

The approximate quantity of water to be added in making the cream will be 5 litres of water to 1 Kg of lime. Indigo/ultramarine blue upto 3 gm per kg of lime dissolved in water shall then be added and wash stirred well. Water shall then be added at the rate of about 6 litres per kg of lime to produce a milky solution. The white wash shall be applied with approved brushes to the specified number of coats. The operation for each coat shall consist of stroke of brush given from the top downwards, another from the bottom upwards over the first stroke and similarly one stroke horizontally from the right and another from the left before it dries. The white washing on ceiling shall be done prior to that on walls.



Each coat shall be allowed to dry before the next one is applied and shall be subjected to inspection and approval by the Engineer. No portion of the surface shall be left out initially to be patched up later on.

The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed. Doors, windows, floors and such other parts of the building not to be white washed shall be protected from being splashed upon.

11.3.3 Colour Wash

A priming coat of white wash with lime shall be applied before applying two or more coats of the colour wash (as specified). Entire surface should represent a smooth and uniform finish. Sample of colour wash shall be duly approved by the Engineer before application. Same specification as that of white wash shall be followed for colour wash also using necessary amount of colouring ingredient of approved tint.

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11.3.4 White Washing with Whiting

Whiting (ground white chalk) shall be dissolved in sufficient quantity of warm water and thoroughly stirred to form a thin slurry which shall then be screened through a clean coarse cloth. 2 Kg of gum and 0.4 Kg of copper sulphate dissolved separately in hot water shall be added for every cum. of slurry which shall then be diluted with water to the consistency of milk so as to make wash ready for use. Other specification remains same as per white washing with lime.

11.4 Cement Primer Coat

The surface shall be thoroughly cleaned of dust, mortar, droppings etc., and shall be allowed to dry for at least 48 hours. It shall then be rubbed thoroughly by sand paper to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulation and then sand papering the same after it is dry. The cement primer shall preferably be applied by brushing and not by spraying. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as smooth as possible, leaving no brush marks.



11.5 Water-proof cement paint

The prepared surface shall be thoroughly wetted with clean water before water proof cement paint is applied. The paint shall be prepared strictly as per manufacturer's specifications, in the absence of which it shall be mixed in two stages. The first stage shall comprise of 2 parts of water proof cement paint and one part of water stirred thoroughly and allowed to stand for 5 minutes. Care shall be taken to add the paint gradually to the water and not vice versa. The second stage shall comprise of adding further one part of water to the mix and stirring thoroughly to obtain a liquid of workable and uniform consistency. The paint shall be mixed in such quantities as can be used up within an hour of its mixing.

Paint shall be applied with brushes or spraying machine. The solution shall be kept well stirred during the period of application. It shall be applied as far as possible on the surface which is on the shady side of the building so that direct heat of the sun on the surface is avoided. Painted surfaces shall be sprinkled with water 2 or 3 times a day. This shall be done between coats and for at least 2 days following the final coat. The curing shall be started as soon as paint has hardened so as not to damage by sprinkling of water say about 12 hours after the application. A uniform shade should be obtained after application of paint. Cement paint shall not be applied on surfaces already treated with white wash, colour wash, distemper, varnish paint etc., and on gypsum, wood and metal surfaces.

11.6 Synthetic washable distemper

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The surface shall be prepared as for Cement Primer Coat. A primer coat of cement or distemper primer shall be applied as specified in the description of the item. Unevenness in the plaster shall be made good by applying plaster of Paris putty mixed with distemper of the colour to be used on the entire surface including filling up the undulations. The surface shall then be rubbed down with a fine grade sand paper and made smooth. After the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth, taking care not to rub the priming coat out. All loose particles shall be dusted off. One coat of distemper properly diluted with thinner, shall be applied with brushes/rollers in horizontal strokes followed immediately by vertical ones which together constitute one coat. The subsequent coats shall be applied in the same way. Two or more coats of distemper as are found necessary shall be applied to obtain an even shade. A time interval of at least 24 hours shall be allowed between consecutive coats. The brushes shall be of 15 cm. double bristled type. They shall be maintained in proper condition and those that are dirty or caked will not be allowed to be used. The finished surface shall be even and uniform without patches, brush marks, distemper drops etc. Sufficient quantity of distemper shall be mixed to finish one room for applying one coat in one operation.

11.7 Dry Distemper

The surface shall be prepared in the same manner as for synthetic washable distemper. A primer coat using approved whiting shall be applied over the prepared surface. Distemper prepared as per manufacturer's direction shall be applied and each coat shall be allowed to dry before subsequent coat is applied. The finished surface shall be free from chalking when rubbed, even, uniform and shall show no brush marks.

11.8 Plastic emulsion paint



The surface on which plastic paint has to be laid must be thoroughly cleaned and prepared and all defects rectified and finally prepared in the same manner as for synthetic washable distemper. The surface shall be dry and rubbed smooth by means of sand paper to the satisfaction of the Engineer. One coat primer and two coats of plastic emulsion paint are to be applied. The work is to be carried out under direct guidance and instructions from the manufacturers whose expert advice and supervision are to be made available in order to achieve the high grade finish. The painters employed for this work must be capable of producing the highest standard of workmanship required. If the finish is of doubtful nature, the bidder shall have to rectify at his own cost to the entire satisfaction of the Engineer.

11.9 Bitumen painting

Bitumen painting to concrete surface shall be done as follows :

(i) Hot application

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The surface shall be cleaned of all mud etc., before painting. The honey-combs and other defects of concrete surfaces to be painted shall be rectified properly. Any projection of binding wire shall be cut to keep it 10 mm inside the concrete surface and then filled with mortar. Before application the surface shall be absolute dry.

Bitumen of standard quality as specified shall be heated to the temperature specified by the maker and then applied hot with brushes on the prepared surface. The surface shall be allowed to cool before applying the second coat.

(ii) Cold application

The surface shall be prepared in the same way as for hot application. The bitumen emulsion of approved quality shall be applied with special brushes. Where acid resistant treatment is specified such surface shall be covered with approved acid resisting coating to the satisfaction of the Engineer. Before the coating is applied, the surface shall be properly cleaned and prepared in the manner described above.

11.10 Tarring

- (i) Timber surfaces in contact with earth/concrete/ plaster shall be treated with one coat of hot tar or as specified in schedule before fixing.
- (ii) If required steel work in holdfasts and the like shall be treated as above and sanded in addition before being fixed in position.



11.11 Painting to Timber & Steel Surface

11.11.1 General

The priming coat for steel/wood work shall be applied after the surface has been prepared. After the priming coat has dried, all nails, screw holes and cracks shall be filled with putty and surface smoothened with sand paper.

All surfaces must be thoroughly dry before painting work is started and painting in exterior/exposed parts shall not be taken up in wet/humid or otherwise unfavourable weather.

All stains of paint to glasses, walls, fittings and fixtures etc. shall be cleaned thoroughly by applying required turpentine or thinner. The bidder's rate shall include all these.

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11.11.2 Painting to timber

- (i) Unless otherwise specified, all timber surfaces shall be treated with one priming coat, one under coat and one finishing coat. Under coat and finishing coat shall be synthetic enamel or as specified. Priming coat shall be of approved primer. In case the surface is to be polished or varnished, a priming coat as approved or specified shall be given. No primer shall be applied to wood work until it has been inspected and passed by the Engineer.

(ii) Polishing

The surface to be polished shall be prepared in the same manner as specified under painting.

(iii) French Spirit Polish

After preparation of the surface it will be well dusted and then the pores of the wood shall be filled up with a filler made of a paste of whiting in water or methylated spirit with a pigment if so required. The spirit polish shall be prepared by dissolving pure shellac in methylated spirit, @ 0.75 Kg of shellac to 5 litres of spirit, with the addition of pigment if so required.

The polish shall be applied with a pad consisting of cotton wool inside a clean white cloth. Several coats shall be applied with light sand papering from time to time and cleaning the dust before applying next coat except the final coat. The final coat of the polish shall be rubbed thoroughly until the wood feels perfectly dry when touched and gives a satisfactory smooth shining.

(iv) Wax Polishing

After preparation of surface wax polish will be applied. The polish shall be prepared by heating together 2 parts of pure bees wax and boiled linseed oil each over a slow fire. When the wax is completely dissolved the mixture shall be cooled till it is just warm and one part of genuine turpentine is to be added and entire mixture shall be well stirred.



Polish shall be applied in the same manner as specified for spirit polish.

11.11.3 Painting to Steel Surface

11.11.3.1 General

All surfaces shall be thoroughly cleaned of all dirt, grease, rust and mill scale. Areas which become inaccessible after assembly shall be painted before assembly after cleaning the surfaces as described above. The surfaces shall be perfectly dry before painting.

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Wherever shop primer painting is damaged, the surfaces shall be thoroughly cleaned and touched up with corresponding primer.

Site painting shall not be done in frosty or foggy weather or when humidity is such as to cause condensation on the surface to be painted.

11.11.3.2 Steel Structures

Unless otherwise specified all structures shall be painted with two coats of primer. One coat shall be applied at shop and the second coat at site. All structures after erection shall be given two coats of finishing paint and shall be of synthetic enamel of approved colour. The under coat shall have different tint to distinguish from the finishing coat.

11.11.3.3 Galvanized Iron Sheets

All plain and CGI sheets requires surface pre-treatment or use of other patented primer to ensure adhesion of paint to zinc coated surfaces. Such pre-treatment shall be as per manufacturer's specifications. Where pre-treatment is adopted one coat of primer paint of suitable quality shall be applied. Unless otherwise specified the finishing coats shall consist of an under-coat of an aluminium paint having blue tint and a second coat of aluminium paint having aluminium colour.

11.11.3.4 Structures embedded

Exposed surfaces of embedded parts shall be given two coats of red lead graphite primer at shop and finished with two coats of anti-corrosive paint at site after embedment. Type of paint and procedure of painting shall be as per manufacturer's specification. Surfaces to be field welded shall have no paint applied within 100 mm of the welding zone.

12.0 INTERNAL WATER SUPPLY PLUMBING, DRAINAGE & SANITATION



12.1 Scope of Work

The work comprises supply, laying testing, commissioning etc. of water supply, plumbing, drainage & sanitation.

The work includes the following activities connected with the job :

- i) Supply and delivery of all required pipes and other materials.
- ii) Earthwork in excavation for trenches, pits/chambers/manholes etc.
- iii) Civil works connected with the laying/erection of pipe lines such as making holes in the wall etc. and repairing them after pipe erection, construction of pipe supports, valve chambers, manholes, bedding and covering of pipe laying wherever required.

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- iv) Laying and jointing of pipe lines as specified in this chapter
- v) Testing of pipe lines after laying as per standard tests specified in this chapter.
- vi) Back filling of trenches after successful and satisfactory testing.
- vii) Disinfection of the complete piping system in the case of water supply.
- viii) Commissioning of entire network.
- ix) Safe custody of the pipes/materials/equipment/work and other obligation stated elsewhere in the specification.
- x) Any other activities which are not mentioned above but essential and required.

12.1.1 Materials

The materials shall conform to Part-I of this series.

12.2 Water Supply & Plumbing

12.2.1 General

12.2.1.1 General Requirements

The Bidder shall lay all the pipes and fittings in the best workman like manner by skilled workmen and licensed plumbers in conformity with the regulations and requirements of the local appropriate authorities and to the satisfaction of the Engineer. Unless otherwise specified water supply works in buildings shall be carried out in accordance with IS:2065 "Code of Practice for Water Supply in Buildings" & IS:2064 "Code of practice for selection, installation and maintenance of sanitary appliances".



12.2.2 Installation

All works like earth work, masonry, concrete, steel work, cutting holes, chases in brick, concrete & RCC works, cutting of roads, repairs and rectifications associated directly with the installation of water supply system shall come under the scope of the bidder and shall be governed by the specification of the relevant chapter.

12.2.3 Laying

Before lowering down for laying in the trenches, the pipes shall be checked against crack by means of light hammering and for any other damage. All fixing shall be carefully aligned and spaced at a distance from the main structure to give reasonable all round access for maintenance and inspection and laid true to line plumb and level. Any deviation shall need approval of the

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Engineer. Meticulous care shall be taken to avoid chances of airlock and water hammer.

Pipes shall be laid on continuous unyielding surface holder or on reliable supports at least one near each joint and spacings as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every direction and easy maintenance. If situation requires, pipes shall be encased or concealed in masonry or concrete if shown on drawing or directed by the Engineer. Pipes embedded in floors and wall shall be securely bound so as not to allow any movement due to expansion and contraction. adequate width shall be provided to lay the pipes as per standard practice.

Excavation below the required level is not permitted. The bidder shall make good any excess excavation as directed by the Engineer.

Soft spots in the bottom of beds for pipe lines in rock shall be leveled with sand or soft soil or concrete as approved by the Engineer and the thickness of the layer shall not be less than 100mm.

12.2.4 Excavation for pipe lines in trenches

Excavation shall comply with chapter 2. The sides of pits and trenches shall be adequately supported at all times, except where otherwise directed by the Engineer.

12.2.5 Underground piping in and around building



Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic and other loads and frost, where applicable, and as shown in the drawing and instructed by the Engineer. The thrust blocks shall be provided wherever required.

The size and depth of the trench shall be as approved by the Engineer. Backfilling in trenches shall be done with selected fine earth, unless otherwise permitted, in 150mm layers and carefully consolidated and well treated so that it does not set as a drainage channel. Special care shall be taken while filling in the vicinity of the pipe to avoid damages. Before backfilling the laid pipe shall be fully tested and approved.

12.2.6 Concealed piping

Where desired by the Engineer or shown on the drawings the pipes shall be concealed in masonry or concrete of the adjoining structure by making chases in walls/floors and these shall be secured by hooks and the chases filled with concrete 1:2:4 (1 cement, 2 sand and 4 aggregate). The bidder will rectify, if required the chases, openings and pipes, supplement and make good after laying and testing of the concealed pipelines.

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12.2.7 GI.Piping

- 12.2.7.1 The pipes shall be fixed in longest lengths possible with all necessary bends, tees, couplings, reducing sockets, short piece, jamnut and tees etc. in perfect straight lines both vertically and horizontally.
- 12.2.7.2 All exposed GI pipes shall be fixed at least 15mm clear of wall face with holder bat clamps at suitable places not exceeding (2.5 metres) centre to centre. Where the pipes are laid in chases in walls as shown in the drawing, these shall be secured to walls by hooks. Chases in walls and floors shall be filled in with cement concrete 1:2:4. Where the pipes are to be run underground these may be laid at least 60 cm below ground level.
- 12.2.7.3 The joints of pipes and fittings shall be sealed with red lead paint and fine spun yarn. Joints must be perfectly water tight when put under maximum test pressure.
- 12.2.7.4 Unless otherwise specified the exposed portion of pipes and fittings shall be given two coats of approved synthetic enamel paint over a coat of approved priming. Pipes laid underground or concealed in walls/floors shall be treated with two coats of bituminous paint.

12.2.8 Jointing of pipes

The interior of all pipes and joints shall be cleaned before jointing commences. Jointing of pipes shall be done in such a manner as to render them completely leakproof and durable. Instruction of the manufacturer shall be followed unless desired otherwise by the Engineer. However, the general norms and recommended practices for different types of pipes are given below for guidance :

(a) Cast Iron

i) Spigot and socket joints :

Interior surface of bells and exterior surface of smooth ends of pipes shall be cleared of redundant insulating cover and other foreign materials particularly of oil, burning off materials from bells and smooth pipe ends. Sharp rises on interior bell surface shall be smoothed out.



Bells should be lined up, in compliance with direction of pipe. Laying work shall be started from lower points.

ii) Lead and Flanged Joint :

Lead joints shall be made as per Sl. 15.4.6.1 and flanged joints as per Sl. 15.4.6.2 of chapter 15.

b) Steel Pipes

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Plain ended steel pipes may be jointed by welding. Screwed and socketed joints shall be carefully tightened. Care shall be taken to remove burring from the ends of the pipes. Jointing compound, if used, shall be lead free and approved by the Engineer.

c) G.I Pipes

Threads shall be cut with, sharp tools, and before jointing all scale shall be removed from pipes by suitable means. The screw threads of the pipe shall be cleaned out and the joint made by screwing the fitting after treating the threads with approved pipe jointing compound. Once a joint has been screwed up it shall not be backed off unless threads are recleaned and new compound applied.

d) Asbestos cement pipes

Socket and spigot ended pipes shall be jointed by caulking with tarred gaskets and grouted with 1:3 cement sand mortar.



12.2.9 Precautions

- a) All water supply pipes shall be so laid and so fixed and maintained as to be and remain completely water tight.
- b) During installation open ends of each pipe shall be protected by suitable covers or plugs so that the ends, thread, sockets or spigot are not damaged and no foreign materials can make its way into the pipe line.
- c) Due care should be taken to ensure that there shall be no cross connection whatsoever between a pipe or fitting for conveying or containing wholesome water and a pipe or fitting containing impure water or water liable to contamination or of an uncertain quality of water which has been used for any other purposes.
- d) Fittings and fixtures liable to be stolen shall be fitted and fixed just before testing and handing over.

12.2.10 Painting

When mentioned in the schedule of item underground steel and cast iron pipes shall be treated with 2 coats of anticorrosive bituminous paint on the outside surface after cleaning the surface from soil, dust, moisture, rust, scales soot etc. When painting is to be done for pipes above ground, G.I. pipes shall be given a coat of zinc chromate primer, C.I. & M.S. pipes shall be given one coat of red lead or zinc chromate primer over which at least 2 coats of paint of best quality and manufacture as approved by the Engineer shall be provided or as specified in the schedule of item.

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12.2.11 Ferrule and stop cock box with chamber

Square cast iron surface box 15 cm square and 22.5 cm deep weighing not less than 4.54 Kg with hinged lid shall be provided in masonry chamber. Top of box shall be made flush with the finished level of the chamber. The chamber 25cm x 25cm inside shall be with half brick wall in cement mortar 1:4 over a cement bed concrete of 75mm thick in proportion 1:4:8 with stone chips. The inside wall faces shall be plastered with 12mm thick cement mortar 1:4 finished smooth with a floating coat of neat cement.

The exposed surfaces of cast iron box and cover shall be treated with two coats of bituminous paint.

12.2.12 Inspection, Testing and Acceptance

12.2.12.1 Pipes, fittings and fixtures before laying

All pipes, fittings and appliances shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes and fittings shall be

inspected on site before laying and shall be sounded to disclose cracks. Any defective items shall be clearly marked as rejected and forthwith removed from the site.



12.2.12.2 Testing of pipes after laying

General

- a) The bidder shall ensure the safety of the pipe work under test and provide all necessary stoppers, testing apparatus etc. that are required for testing.
- b) The bidder shall be responsible for any damage done to pipe work and ancillary work while testing and shall replace any pipe or fitting which does not satisfactorily withstand the test.
- c) The bidder shall give written notice of the times at which tests are to take place. On completion of each test two copies of the complete records shall be given to the Engineer.
- d) The work will not be considered complete until the tests are found satisfactory and a certificate issued by the Engineer.

After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25mm inlet with a stop-cock, allowed to stand full of water for a few days if time permits and then tested under pressure. The test pressure shall be 6Kg/cm² or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long

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mains or a large diameter, by a power driven test pump, provided that pump is not left unattended. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been re-calibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable loss for at least five minutes. The end of the main shall be closed by fitting a water-tight expanding plug and the plug shall be secured by struts to resist the end thrust of the water pressure in the mains.

12.2.12.3 Testing of service pipes and fittings

The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely watertight. All pipings, fittings and appliance shall be checked for satisfactory support and protection from damage, corrosion and frost.

12.2.13 Storage Tank

12.2.13.1 Pressed steel tank



Pressed steel water storage tanks shall be of nominal size and capacity as mentioned in the Schedule of Item and fabricated with all flanges external / internal or bottom flange internal and side flanges external, as shown on drawings or schedule of items. Inlet, overflow, vent pipes and manholes shall be arranged and provided as shown in drawing or mentioned in the schedule. Unless otherwise specified, the outlet pipe shall be 50mm above the bottom of the tank and there shall be 150mm free board at the top of the tank. The fabricator shall supply 5 prints of fabrication drawing to the Engineer for prior approval showing thickness of plates, method of jointing the plates. All supports, stays, gussets etc. Pads, cleats etc., required for supporting the tanks shall also be supplied by the manufacturer.

All tanks shall be supplied with mosquito-proof top with manhole not less than 450mm diameter. Tanks deeper than 1.00 Metre shall be provided with M.S. internal access ladder adjacent to the manhole. Meter level indicator shall be provided if asked for. Two coats of anticorrosive paint over a suitable primer shall be applied to both internal a external surface of tanks. The paint shall be so selected as not to impart any taste or odour of water and be of lead free composition.

12.2.13.2 G.I. Water Tank

G.I. water tanks shall be procured from a reputed manufacturer. The design shall be good enough to withstand the loads safely. Galvanized iron water storage tank shall be made of minimum 16 gauge galvanized iron sheet. Unless otherwise specified plain sheets shall be fixed at the corner to angle

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iron frames by means of 6 mm rivets at 40 mm pitch for tanks upto 1000 litres capacity and 8 mm rivets at 35 mm pitch for tanks above 1000 litres capacity. Tanks above 1000 litres shall have 20 mm dia. galvanised iron stays, one fixed to angle framing at top and two in the body of the tank for extra strength. Holes for rivetting shall be drilled and not punched. Lead shall be applied to the joints before rivetting.

Tanks shall have 400 mm dia. holes at the top with hinged covers. The covers shall be made of galvanised iron sheet with angle iron frame. The cover shall be just loose but close fitting to keep out dust and mosquito and will not be airtight. It shall be complete with lockable arrangement.

Tanks unless otherwise specified shall be provided with rising main inlets of 40 mm dia. galvanised iron pipe or as shown on drawing and 40 mm dia. G.I. overflow pipe and 25 mm washout with plug. If specified the rising main shall be connected to the tank with a ball valve near the top which disconnects the supply when tank is full up to the point of overflowing.

The ball valve shall permit the entry of water when the tank is empty and disconnect the supply when the tank is full. It consists of a hollow floating ball made of copper, plastic or hard rubber, 110 mm in diameter attached to an arm which is so pivoted that the end near the pivot close the orifice of the main when the ball is raised to the required height of water in the tank and opens the main as soon as the ball drops with the fall of water level as it is drawn off through the distribution. The ball valve shall be fixed to the tank in such a position that the body of the ball valve submerge when the tank is full upto the water line. The ball valve shall be so adjusted as to limit the level of the water in the tank below the lip of the over-flow pipe, and above the maximum water filled level shall be as per the standard norms for GI water tank.



- 12.2.13.3 Water reservoirs made of concrete or masonry shall be governed by the specification in the relevant chapter. It shall have, inlet, outlet, overflow and wash out with plug and a top MS/CI cover as per schedule of items and drawings.

12.3 Drainage and Sanitation (Internal)

12.3.1 Scope

This section covers the layout and construction of drains for waste water, surface water and sewage together with all fittings and fixtures inclusive of ancillary works, such as connectins, manholes and inspection chambers used within and around the building and the connection to a public sewer upto treatment work, septic tank and soak pit. All sewerage and drainage works shall be executed in accordance with specifications given for different works. All sewerage and drainage works shall be executed by a licensed plumbing supervisor or a licensed plumber and in accordance with IS : 1742 "Code of Practice for Building Drainage" unless otherwise specified.

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12.3.1.1 Installation

All pipe lines, locations of fittings and fixtures, etc. shall be as per drawings or as directed by the Engineer. Correctness of lines, plumbs, orientation, symmetry and levels shall be strictly ensured. All items shall be fully secured against movement in any direction and shall be located so as to allow easy maintenance.

All pipelines, fittings and fixtures shall be installed leakproof; when the works under scope of this specification are 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 gasses.

12.3.2 Rainwater Downcomers

Rainwater downcomers shall be standard cast iron cement pipes. In case where specifically desired, M.S. pipes may also be used. M.S. pipes shall be painted outside with two coats of anticorrosive paint over a coat of primer. Rain water 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 clamp 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. 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.



12.3.3 Gutter

The gutters shall be made of G.I. or A.C. Gutters shall be supplied by reputed specialised firms. Each section shall be sufficiently rigid, edges and corners straight and the slopes perfectly uniform. GI gutters shall have the edges strengthened by suitable means. The joints may be made by rivetting, bolting or soldering.

Unless specified 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 deflection even when the gutter is full. Each joint must have a support. Unless otherwise specified the supports shall be fabricated of MS 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 downcomers shall be made fully watertight and secured.

12.3.4 Soil and Drainage Pipes

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12.3.4.1 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

12.3.4.2 Relation with water supply pipe lines

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

12.3.4.3 Laying

Each separate pipe shall be individually set for lines and levels. 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 16 m apart. The excavation shall be boned in at least one in every 2 m. 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.



12.3.4.4 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 jointings.

Where pipes are not bedded on concrete, the bed 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 sand or gravel 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 :

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- a) When cover is less than 1 metre and where pipes are unavoidably exposed above ground surface, the pipes shall be completely encased surrounded with concrete as per IS:4127.
- b) Where pipes are laid on soft soil with the maximum water table laying at the invert of the pipes, the sewer shall be bedded on concrete 1:4:8 mm with 20mm down aggregates as per IS:4127.
- 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 with concrete 1:4:8 mm with 20mm down aggregates as per IS:4127.
- d) Where maximum water table is likely to rise above the top of the barrel the pipe sewers shall be completely encased/surrounded with 1:4:8 concrete with 20mm down aggregate as per IS:4127.



Vitrified clay pipes shall be laid on a bed of 150mm thick cement concrete (1:3:6) nominal mix by volume.

Cast iron pipes and concrete pipes may be supported on suitable concrete or brick support, where specified. The support 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.

12.3.4.5 Entry into structures

For entry of the pipes lines into any building or 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. Where 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.

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12.3.4.6 Traps and Ventilating pipes

- a) Pipes carrying the sewage from water closets and waste water and overflow water from baths, wash basins, sinks shall be trapped immediately beneath such fixtures. Traps shall have minimum water seal of 50mm 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 600mm above the outer covering of the roof top of the building or as shown on drawings. All vertical ventilating, anti-siphonage 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.

Connecting to existing sewer lines shall be through a manhole.

b) Sand Cast Iron Spigot and Socket pipe and fittings

All soil waste and vent pipes and fittings used in the work shall be cast iron and shall conform to IS:1729. The pipes shall have spigot and socket ends, with bead on spigot end and shall be with or without ears. The pipes shall be free from cracks and other flaws. The interior of the pipes and fittings shall be clean and smooth and painted inside and outside with Dr. Angus Smith's solution or other approved anticorrosive paint. Fittings shall include bends, offsets, branches of various types, junctions etc. as required for the work which shall be provided according to drawings and directions of the engineer.

The fittings shall be provided with access doors where so specified or directed by the engineer. The access door fittings shall be of proper design so as not to form cavities in which the filth may accumulate. Doors shall be provided with 3mm thick rubber insertion packing, and when closed and bolted they shall be watertight. The access doors shall have MS studs and bolts or screws or bolts and nuts.



Fixing

The pipes and fittings shall be fixed to wall by means of MS holder bats clamp of approved type and steel bolts or by pipe nails, bobbins etc. as the case may be, keeping the pipe clear from the finished surface of the wall. The holder bat nails shall be fixed to the wall in wooden block. The soil pipe shall be supported at the foot upon a bed of cement concrete of proportion 1:3:6 and firmly attached to the wall.

The pipes shall be laid truly vertically or along the line as shown in the drawing. Connection between main pipe and branch pipe shall be made by using branches and bends with access door for cleaning.

All vertical soil waste, ventilating and anti-siphonage pipes shall be carried up above the roof and provided with suitable C.I. cowl on top.

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Pipes outside the building shall be laid underground for which trenches shall be excavated as required for the work. The trenches shall be back-filled with excavated material after the drainage system has been tested and passed.

Jointing (Lead Caulked Joint)

Unless otherwise specified, the pipes and fittings shall be jointed with lead joints as described below :

The annular space between the socket and spigot will be first well packed in with tarred gasket or hemp yarn leaving 25mm from the lip of the socket for the lead. The joint may be leaded by using proper leading rings or if they are not available by wrapping a ring of hemp rope covered with clay round the pipe at the end of the socket, leaving a hole through which lead shall be poured in (for pipes with sockets facing a upwards 15mm high small clay band on socket edge may be used).

The lead shall be rendered thoroughly fluid and each joint filled in one pouring. Before caulking, the projecting lead shall be removed by flat chisels and then the joint caulked round with proper caulking tools and a hammer of 2 to 3 pounds in weight in such manner as to make the joint quite sound. After being well set up the joint is to be left flush neat and even with the socket.

Lead for caulking shall conform to IS:782.

Painting

All the exposed CI pipes and fittings shall be painted to match the colour of the surroundings. The surface of the pipes and fittings to be painted shall be cleaned thoroughly and painted 2 coats with approved paint over and including 1 coat of approved primer. Pipes laid underground shall be painted with 2 coats of anti-corrosive paint.

12.3.4.7 Cutting of pipes



Manufacturer's instructions shall be followed for cutting of pipes where necessary. Suitable and approved tools shall be used for the cutting so as to leave surface clean and square to the axis of the pipe.

12.3.4.8 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 man- holes shall be gas tight when above ground and watertight when underground. Method of jointing shall be as per instructions of the 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.

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(a) Sand Cast Iron Pipes

Jointing of cast iron pipe shall be done as described in Sl. No. 12.3.4.7(b).

(b) Concrete pipes

i) Spigot & Socket Joint

The opening of the joint shall be filled with stiff mixture of cement mortar 1:2 (1 cement : 2 fine sand) which shall be rammed with caulking tool.

ii) Collar Joint

Joint shall be done by slipping the collar over and clear of the end of the pipe. The recess at the end of the pipe shall be filled with jute braiding dipped in hot bitumen. Care shall be taken that no off-set of the jute braiding shall be visible either outside or inside the pipe. The collar shall be then set up over the joint covering equally both the pipes and leaving an even caulking space all round. cement and sand mortar (1:1.5) shall then be well punched or pressed home with a caulking tool.

(c) Glazed stoneware pipes

Tarred gasket or hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly so as not to fill more than 1/4 of the socket. The remainder of the socket shall be filled with a stiff mixture of cement mortar of 1:1 proportion. When the socket is filled, a fillet shall be formed round the joint with a trowel, forming an angle of 45 degree with the barrel of the pipe. The newly made joints shall be protected, until set, from sun and rain and shall be covered with damp sacking or other suitable materials.



12.3.5 Trenches and other excavations

Excavation shall be carried out according to chapter-2, Earthwork.

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. 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

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carefully rolled and stacked for use in reinstatement. All excavations shall be properly timbered, where necessary. Efficient arrangements for dewatering during excavation and keeping it dry till back filling 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 bidder 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 for packing with selected material in areas 300 mm around the pipe. 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 settlements shall be made good regularly to minimise inconvenience or traffic where applicable.

12.3.6 Installation of fittings & fixtures

12.3.6.1 General

All fittings & fixtures shall be laid out as per drawings and in proper line, level and shall be firmly secured to floors with screws and ditto fix and to walls with wall plugs and screws. Unless otherwise specified only C.P. Brass screws shall be used for fixing sanitary fittings to wall plugs and floors.



12.3.6.2 European pattern WC

Water closet shall be fixed with floor by means of 75 mm long, 6.5 mm diameter counter sunk bolts & nuts embedded in floor using rubber or fibre washers so as not to allow any lateral displacement.

12.3.6.3 Indian Patttern W.C.

The water closet pan shall be sunk into the floor and embedded in a cushion of average 150 mm cement concrete 1:4:8 (1 cement, 4 sand and 8 broken brick ballast of 40 mm size). The concrete shall be left about 125 mm below the top level of the pan so as to allow for flooring and its bed concrete. The joint between the pan and trap shall be made with C.M. 1:1 and joint between trap and CI soil and waste pipe to be made with lead. All the joints shall be leak proof. The WC floor shall slope towards the pan. The foot rest shall be set in cement mortar 1:3 (1 cement : 3 sand).

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The cast iron cistern, brackets and flush pipe etc. shall be painted with two coats of approved paint, over and including a coat of approved priming.

12.3.6.4 Wash basin

Wash basin shall be fixed to C.I./R.S. brackets fixed in cement mortar 1:3 (1 cement :3 sand). The brackets shall be fixed to approved wooden wall plugs with screws. C.P. brass trap and union shall be connected to waste pipe if specified.

12.3.6.5 Urinals

The urinal shall be fixed to the walls with C.P. Brass screws fixed to wooden wall plugs. Urinal partitions shall be fixed to walls by making chases in walls and grouting the same in 1:2:4 cement concrete.

12.3.6.6 Mirror

Fixed type mirror shall be screwed to wall plugs with CP brass screws and shall have a backing of asbestos or similar material as specification in the item.

Swivel type mirror shall be fixed with C.P. brackets which shall be fixed to wall plugs with CP brass screws

12.3.6.7 Soap tray / toilet paper holder

This shall be of flush mounting design and shall be housed in walls by making chases and grouting the same in cement mortar 1:3 unless otherwise specified. All other fittings shall be fixed with screw or as per manufacturer's specification

12.3.6.8 Towel rail & Toilet glass-shelf unit

This shall be fixed with CP Brass screws which shall be fixed to wall plugs.



12.3.6.9 Gully trap

This shall be fixed on 100 mm thick bed and encasement of size 600mm x 600mm x full height of trap shall be provided with cement concrete of proportion 1:4:8 with 40mm stone aggregate. The gully outlet shall be jointed to the branch drain as specified or directed by the Engineer.

12.3.6.10 Masonry chamber for Gully Trap

After fixing and testing gully and branch drain, a brick masonry chamber 300mm x 300mm x 450mm deep or as specified (internal dimensions) in cement mortar 1:4 (1 cement and 4 sand) shall be built with half brick thick wall round the gully trap from the top of the concrete. The internal faces of the chamber shall be finished smooth with 15 mm thick cement plaster (1:4)

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and neat cement finish. Brick wall exposed to outside shall be finished with 12 mm thick cement plaster 1:4. P.C.C. (1:2:4) band 100 mm thick shall be provided over the brick work with suitable grooves for accommodating R.C.C. cover to be supplied as per drawing and made water tight by providing suitable beading in the band.

12.3.6.11 High level flushing cistern - (fixing flush pipe & cistern)

The W.C. pan shall be connected to the cistern by G.I. 32mm dia or 40mm (O.D) high density polythene flush pipe with holder clamp and brass coupling.

12.3.6.12 Low level flushing cistern

Unless otherwise specified, it shall be connected to the closet by means of 40mm dia white porcelain enameled flush bend using rubber adaptor joints.

12.3.7 Septic tank and effluent disposal

12.3.7.1 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 drawing. This item shall also include ventilating pipe of at least 100mm dia whose top shall be provided with a suitable mosquito proof wire mesh and cowl. Generally ventilating pipe shall extend to a height of about 2 metres when the septic tank is at least 15 metres away from the nearest building and to a height of 2 metres above the top of building when it is located closer than 15 metres. Ventilating pipes can be connected to the normal soil ventilating system of the building where allowed.

12.3.7.2 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 S.W pipes laid in a trench filled with broken bricks.

12.3.7.3 Soak Pit

Shall be complete as shown on drawing. In absence of a detailed drawing it shall consist of a 900mm dia pit 1000mm in depth below the invert level of the inlet pipe. The pit shall be lined with stone, brick or concrete blocks with dry open joints backed with at least 75 mm of clean coarse aggregate. The lining above the inlet level shall be set in cement mortar (1:6). The pit shall be filled with brick bats. Inlet pipe shall be taken down to a depth of 900mm from the top as an anti-mosquito measure.

12.3.7.4 Open jointed S.W pipes

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Minimum dia of the S.W pipes shall be 200mm nominal. The trench for laying the pipes shall be minimum 600x600mm. The joints of the pipes shall be left unsealed.

12.3.7.5 Commissioning septic tank

After the septic tank has been proved water-tight 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.

12.3.8 Manhole/Inspection chambers

Necessary excavation as required for the manhole shall be done true to dimensions and levels as shown in the drawing. The manhole chamber shall be built with brick work in C.M. 1:4 with minimum one brick thick on a base of 100mm thick cement concrete 1:4:8 with 40mm down aggregate or as specified. The concrete bed shall extend beyond the external face of brick work on all sides by at least 75mm. The thickness of wall shall be as indicated. The work shall be carefully built in English bond, the jointing faces of each brick being wall buttered with cement mortar before laying so as to ensure a full joint.

The inside of the walls shall be plastered with 15mm thick cement mortar 1:4 and finished with a floating coat of neat cement and outside shall be plastered with 12mm thick C.M. 1:4.



The channels and benching shall be done in cement concrete 1:2:4 with 20mm down stone aggregate and finished with 12mm thick cement plaster in C.M. 1:3. The channels shall be semicircular in the bottom half and of diameter equal to the sewer. Above the horizontal diameter the top edge shall be suitably rounded off. The Branch channels shall also be similarly constructed with respect to benching but at their junction with the main channel an appropriate fall suitably rounded off in the direction of flow of the main channel shall be given. The benching at the sides shall be carried up in a slope of 1 in 3.

All angles shall be rounded to 75mm radius with cement mortar 1:4 and shall be rendered smooth. The internal surfaces shall have a hard impervious finish obtained by using a steel trowel.

The manhole chamber shall be covered on top with RCC (1:2:4) slab with necessary reinforcement as per drawings. Unless otherwise specified circular type light duty M.H. cover with single seal weighting 25 kg. will be provided in each RCC cover.

12.3.9 Testing and acceptance

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12.3.9.1 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.

12.3.9.2 Testing of pipelines

Comprehensive tests of all pipe lines shall be made by simulating conditions of use. The method of actual test shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review and instruction. The Engineer's discretion regarding tolerance shall be final.

General guidance for the tests are given below :

12.3.9.3 Smoke Test



Soil, waste, vent and all other pipes, when above ground, shall be tested for gas tightness by a smoke test conducted under a pressure of 25mm water gauge 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.

12.3.9.4 Water Test

For pipes other than cast iron Glazed ware and concrete pipes shall be subjected to a test pressure of at least 1.5m head of water at the highest point of the section under tests. The tolerance figure of two litres per centimetre of diameter per kilometre may be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the end 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 funnel which could be raised or lowered till required head is obtained and fixed suitably for observation.

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

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

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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 and made good.

12.3.9.5 For cast iron pipes

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.

12.3.9.5.1 For straightness

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

12.3.9.6 Testing septic tank

The septic tank shall be tested for water tightness. It shall be filled up with water and allowed to soak for 24 hours. Then, it shall be topped up and allowed to stand again for 24 hours and loss of level recorded. The fall shall not be more than 15mm.

12.3.9.7 Fixtures etc.

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

13.0 EXTERNAL SEWERAGE & DRAINAGE



13.1 Scope of Work

The work comprises supply, laying, testing, commissioning etc., of sewerage & drainage network as specified.

The work includes the following activities connected with the job.

- i) Supply and delivery of all required pipes and other materials including erection.
- ii) Earth work in excavation for trenches and pits/ manholes.



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- iii) Civil works connected with the laying/erection of pipe lines such as making holes in the walls etc., and repairing them after pipe erection, construction of pipe supports, brick / concrete manholes, preparation of concrete bedding and covering for pipe laying wherever required etc.
- iv) Laying and jointing of the pipelines as specified in this chapter
- v) Testing of the pipelines after laying as per standard tests as specified in this chapter.
- vi) Back filling of the trenches after successful and satisfactory completion of tests for the pipeline laid.
- vii) Cleaning, painting/coating and wrapping etc of pipes and fittings etc.
- viii) Commissioning of entire network laid.
- ix) Safe custody of pipes/material/equipment/work and other obligations stated elsewhere in the specification.
- x) Any other activities which are not mentioned above but essential and required.
- xi) If specified, at road crossing the pipe shall be laid in encasing pipes, wrapped & coated M.S pipes shall be used as encasing pipes. The encasing pipe shall project beyond the berm or both sides of the road. The encasing pipe shall be supported on P.C.C saddles if the site condition warrants so.

13.2 Materials

The materials shall conform to part-I of this series. Sewerage net work in Township shall generally be of R.C.C/S.W.G pipes, R.C.C pipes being used normally for pipe sizes of 400mm dia and above. In plant area, at road crossings etc Cast Iron Pipes may be used.

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13.3. Excavation of trenches & pits

Excavation shall be carried out according to Chapter of Earthwork.

Before starting earth work in excavation, temporary drainage arrangement shall be provided to prevent surface water entering the trenches and pits at the cost of Bidder.

Excavation of trenches and pits for pipelines shall be carried out in shortest possible time so as to avoid sinking of ground and consequent damage to the pipelines.

Excavation of trenches for pipelines and surface drains, shall be in exact accordance with the plans and section, alignment, levels and gradients as indicated on the drawings or as directed at site by the Engineer. The final bed must be dressed, levelled or trimmed to proper gradient and rammed with sprinkling of sand and got passed by the Engineer. No excavation shall be made below the specified levels without written permission of the Engineer. Should any excavation be taken below the specified level due to carelessness of the Bidder, he will fill in such excavation at his own expense as specified in clause 2.12.

13.4 Cast Iron Pipes

I.S 3114 has to be followed in general for Laying and jointing of pipes unless otherwise specified.

13.4.1 Back filling

For the purpose of back filling, the depth of the trench shall be considered as divided into the following three zones from the bottom of the trench to its top.

ZONE-"A" From the bottom of the trenches to the level of the center line of the pipe.



ZONE-"B" From the level of the center line of the pipe to a level 300 mm above the top of the pipe.

ZONE-"C" From a level 300 mm above the top to the top of the trench.

Trenches shall not be back filled until the pipe joints have been tested, alignment and gradient passed by the Engineer but back filling shall be done, at least from the bottom of the trench to the level of the center line of the pipe (ZONE "A") leaving 450 mm on either side of the joints uncovered, with earth till testing is completed. These joints should however be kept covered with mats, gunny, straws etc., to avoid damage to joints by temperature effects.

While back filling care should be taken to ensure that no damage should be done to the pipeline. All back fill materials shall be free from cinders, ashes, slag, refuse, rubbish, vegetables or organic material, lumpy or foreign

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material, boulders, rocks or stones or other materials which in the opinion of the Engineer is unsuitable or deleterious. However, materials containing stones up to 20 cm as the greatest dimension may be used in Zone-"C" unless specified otherwise herein.

Backfilling in Zone-"A" shall be done by hand with sand, fine gravel or other approved material placed in layers of 80 mm and compacted by tamping. The back filling material shall be deposited in the trench for its full width of each side of the pipe, fitting and appurtenances simultaneously.

Backfilling in Zone-"B" shall be done by hand or approved mechanical methods. Special care being taken to avoid injuring or moving the pipes. The type of back fill materials to be used and the method of placing and consolidating shall be prescribed by the Engineer to suit individual locations.

Back filling in Zone-"C" shall be done by hand or approved mechanical methods. The type of back fill materials and method of filling shall be as prescribed by the Engineer.

Paving and metaling shall be reinstated in as good order as before removal and the Bidder shall do adequate ramming and watering of under layers to guard against subsequent settlement all at his cost.



13.4.2 Custody of pipes

The Bidder shall remain responsible for the safe custody of pipes, specials and other materials supplied by him/issued to him either free or on cost recoverable basis till these are laid installed, tested, back filled etc., and handed over to the Engineer.

The Bidder shall verify the conditions of the pipes, specials etc., at the time of receipt from sources and shall be responsible for all damages during handling, transporting, laying, installing, testing etc., and the cost of such damages shall be borne by the Bidder.

13.4.3 Erection/laying of pipelines

- i) Erection of all equipment shall be carried out with highly skilled workers.
- ii) The pipelines shall be laid and supported properly and it shall be deemed as a contractual obligation that the lines are not thrown out of alignment or lifted off during commissioning and subsequent operation.

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13.4.4 Pipeline erection

All the underground pipelines shall be laid in accordance with IS : 3114.

13.4.5. Handling of pipes & fittings

Unloading of pipes & fittings

While unloading, pipes shall not be dropped down from trucks on hard surface. This should be done with the help of a steadying rope and timber skids. Pipes should not be dragged, specially to the spigot end along hard surface.

Lowering of pipes & fittings

Proper implements, tools etc. shall be provided and used by the bidder while lowering pipes & fittings in the trenches and in no case these should be dropped. Pipes over 300mm dia shall be handled with the help of chain pulley blocks with tripod supports.

Detection of cracks in pipes and fittings

The pipes and fittings shall be inspected for defects and cracks by ringing with a light hammer preferably while suspended. Smearing the outside with chalk dust helps location of the crack. If doubt persists, pouring a little Kerosene on the inside of the pipe at the suspected spot will confirm it as it will seep through.

Cleaning of pipes and fittings

All foreign materials shall be cleaned from the socket and spigot ends both from inside and outside. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being laid. When pipe laying is not in progress, the open ends of the pipe shall be closed suitably.

Cutting of pipe



The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat manner without damage to the pipe. Pipe cutting machine may be used for this purpose and in case it is not available, for large diameter pipes electric arc cutting method using a carbon or steel rod may be adopted. The pipes can be cut by using chisels also depending on the circumstances.

Permissible deflection at socket and spigot joints

Direction

On level ground the socket ends should face the upstream. When the line runs uphill the socket ends should face the upgrade.

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Permissible deflection

In case it becomes necessary to deflect pipe from a straight either in the vertical or horizontal plane, due to obstructions or where long radius curve is permitted, the following norms shall be adhered to:- Lead joint 2.5 degrees Rubber joints

for nominal bore	80 to 300mm	5 degrees
for nominal bore	350 to 400mm	4 degrees
for nominal bore	450 to 750mm	3 degrees

Anchor and thrust blocks

Suitable concrete thrust blocks shall be installed, wherever the thrust is appreciable, specially at dead ends and bends. In case of unbalanced also this may be required. In case of steep gradients and under influence of temperature change also thrust blocks may be required for rigidly joined pipes.

It is advisable to avoid sharp bends above 45 degrees. In soft ground as far as possible two bends should not be put together and be separated by at least one length of straight pipe.

Anchor or thrust blocks shall be generally as per IS : 5330 and thrust resistant design pressure shall be equal to the test pressure.

13.4.6 Pipe jointing

The type of jointing will be defined in the detailed working drawing and Schedule of items i.e. whether they should be (i) socket and spigot with molten lead or lead wool joint or (ii) flanged joint.



13.4.6.1 Socket & spigot joints

a) Molten lead joints

Unless otherwise specified, socket and spigot joints shall be done with molten lead.

The spigot shall be cleaned of the coating, carefully entered in the socket of the adjacent pipe by one or more laps of white hamper spun yarn, sufficient yarn only being driven into the socket to leave the depth of the lead specified. The proper depth of each joint shall be tested before running the lead by passing completely round it a wooden gauge, notched out to the correct depth of lead, the notch being held close up against the face of the socket. The pipes shall be carefully packed underneath so that they shall bear properly throughout their whole length.

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The lead shall be carefully skinned of all scale when melted in a cast iron pot or patent melting machine. The joints must be perfectly dug before being run with lead. The pipes shall again be examined for line and level and the space left in the socket shall be filled in generally by pouring in melted lead. This may be done best by using proper loading rings or if these are not available, by wrapping a ring or hemp rope, covered with clay round the pipe at the end of the sockets leaving a hole into which lead shall be poured. For large pipes, it is also necessary to leave one or more air vents around lower half of the joints. The lead shall be rendered thoroughly fluid and each joint shall be filled at one pouring. If the pipe is too large for the joint to be filled from one ladle, two or more ladles shall be used. It is to be noted that the lead should be heated to such a temperature as will ensure that it flows completely around the joint. Overheating of lead shall be avoided.

After a section of convenient length has been laid, lead caulking shall be commenced. The lead shall be freed from the loading pipe outside the socket of the other pipe with a flat chisel, and then caulked around 3 separate times, with proper caulking tools of increasing thickness and a hammer 2 to 3 kg in weight in such a manner as to make the joints sound and water tight. After being well and evenly set, the joint is to be left flush neat and even with the socket. The approximate weight of lead and spun yarn for different size of cast iron pipe socket and spigot joints, as per IS : 3114 are given in the Table-I.

TABLE – I

QUANTITY OF LEAD AND SPUN YARN FOR DIFFERENT SIZES OF PIPES	
Nominal size of pipe mm	Lead / Joint kg
80	1.8
100	2.2
125	2.6
150	3.4
200	5.0
250	6.1
300	7.2
350	8.4
400	9.5

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450	14.0
500	15.0
600	19.0
700	22.0
750	25.0
800	31.5
900	35.0
1000	41.0
1100	46.0
1200	50.0
1500	66.5

Note : The quantities of lead given are provisional and a variation of 20% is permissible either way.



b) Lead wool joint

In the event of the Engineer specifying or permitting the use of lead wool the joint shall be made as follows :

Hempen spun yarn shall be driven into the socket and thoroughly caulked with suitable caulking tools. Lead wool shall then be introduced and this caulking shall be repeated with each turn of lead wool under which the socket is full within 3 mm and the wool of the lead wool is compressed into dense mass. The joint shall then be finally pressed with finishing tool. The table giving the quantity of lead wool and yarn to be used in different sizes of pipes is given in the Table-2

TABLE – 2

Nominal Internal dia in	Lead wool weight in	Spun yarn weight in
mm	kg	kg
80	1.30	0.17
100	1.70	0.23
150	2.41	0.34
175	2.89	0.37
200	3.37	0.57
225	3.63	0.64

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250	4.11	0.74
300	4.82	0.82
350	6.04	1.17
375	6.52	1.25
400	7.00	1.33
450	9.64	1.84
500	10.86	1.99
600	12.79	2.83
750	15.68	3.52
825	17.12	3.88
900	18.80	4.25
1200	28.44	6.01

Note : Higher tolerance may be permitted under special circumstances depending upon site condition for quality of lead wool and spun yarn.

13.4.6.2 Flanged joints



Flanged joints should be made by painting the facing of the flanged with graphite or red lead freely. Packing should be of rubber insertion sheet or compressed fibre board and of approved thickness. The packing should be of full diameter of the flange with proper pipe hole and bolt holes cut out and even at both the inner and outer edges. All the bolts shall be tightened up evenly on all sides keeping the longitudinal axes of adjoining pipe in exactly the same straight line.

The interior of the pipe must be checked carefully so as to be free from all dust and other foreign matters as the work proceeds. For this purpose a disc plate or brush sufficiently long to pass two or more joints from the end of the pipe last laid shall be continuously drawn forward as the pipes are laid. The ends of the pipes must be securely protected preferably with wooden plugs during the process of the work. The pipes laid must not be made receptacles either for tools, cloth or any other material during progress of the work.

13.4.7 Inspection & testing

- a) If required all materials shall be inspected by the Engineer before dispatch to site. All the tests shall be carried out in the manufacturer's works and necessary test certificates shall be furnished as proof of such testing. The Bidder shall intimate the Engineer at least two weeks in advance for any such inspection / testing. All facilities for inspection / testing including necessary test certificates shall be provided by the Bidder at his own cost.

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- b) After completion of erection all pipelines shall be inspected by the representative of the Bidder and the Engineer. Any discrepancy, defect pointed out during this inspection shall be made good by the Bidder to the entire satisfaction of the Engineer without additional cost.
- c) All pipes with valve and fittings shall be tested to 1.5 times maximum working pressure. The pressure should remain constant for a period of 8 hours. All arrangements for testing shall be done by the Bidder. Any defect found during testing shall be made good by the Bidder to the entire satisfaction of Engineer and the test shall be repeated till acceptable results are achieved. Any special tools, instrument or equipment required for these tests shall be provided by the Bidder for tests only.
- d) All oils, lubricants and other consumables required during tests and trials of different equipment shall be supplied and arranged by the Bidder at his own cost.



13.4.8 Painting

- i) All equipment, valves and other exposed steel parts shall be given a coat of red oxide, zinc chromate or red lead and two coats of final approved quality paint according to the colour scheme of the Purchaser.
- ii) **All the exposed pipes and fittings shall be painted with two coats of paints of approved quality.**

13.4.9 Commissioning

After pressure testing the main, it should be flushed with water of sufficient velocity to remove all dirt and foreign materials.

The system shall be commissioned after all necessary tests have been conducted successfully. All lubricants, oils, and other consumables required for commissioning of the system shall be supplied by the Bidder at no extra cost. Commissioning of the equipment to be supplied, if any, by the Owner, shall be carried out by the Bidder under guidance of the representatives of the supplier of these equipment and Engineer. Any adjustment and/or changes/rectifications that may be found necessary during commissioning of these equipment shall be carried out by the Bidder at his cost.

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13.5. Stoneware Glazed Pipelines (S.W.G)

13.5.1 Back filling

Trenches shall not be back filled until the pipe joints have been tested, alignment and gradient passed by the Engineer, but back filling shall be done at least for a depth equal to the diameter of the pipe or 300 mm whichever is greater over the pipes leaving 450 mm on either side of the joints uncovered with earth till the testing is completed. These joints should however be kept covered with mats, gunny bags, straws etc., to avoid damage to joints by temperature effects.

While back filling care should be taken to ensure that no damage is done to the pipelines. The first 300 mm of filling material immediately over and around the pipe should be of soft material free from clods and stones etc. The remainder of the filling materials shall be watered and rammed in layers not exceeding 250 mm at a time.

Paving and metalling shall be reinstated in as good order as before laying of the pipelines.

Unless otherwise required by the Engineer, there shall be a minimum cover of 700 mm over the pipes and at road crossing etc., it shall not be less than 900 mm.

13.5.2 Laying of pipes



The laying of the pipelines shall commence only after the levels of the bottom of the trench at various points have been checked by the Engineer. Cracked pipes whether at the socket or in the body shall be rejected. All SW pipes shall be fitted together on the surface of the ground to ensure a proper fit before they are lowered. The spigots and sockets shall be properly cleaned and brushed, if necessary & then lowered by hand to the bottom of the trench.

The pipes shall be carefully laid to the alignment, levels and gradients shown on the plans and sections, and great care shall be taken to prevent, sand, earth or other matter from entering the pipes during laying. As it is not permitted to rectify errors of grade by packing up underneath with earth, care should be taken in excavating and slight scraping, if necessary, done to bring to grade. The pipes between manholes shall be laid truly in straight lines without vertical or horizontal undulations.

Bedding, haunching or encasing of the pipes during laying shall be in accordance with IS : 4127 and shall be done with cement concrete in proportion (1:4:8) to prevent ground water from entering the pipelines.

All inverts shall be laid from site rail fixed at the true levels, with proper boning rod. The sight rails and boning rods shall be provided, fixed and maintained by the Bidder at his own expense.

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The pipes shall be laid, sockets facing up the gradient, beginning at the lower end, and with the sockets, resting in the socket rest holes cut in the trench bottom. Each pipe shall be laid singly and no pipe shall be laid until the trench has been excavated to its required depth to a distance of twenty yards in front of the pipes to be laid.

No pipes of any description shall be covered until they have been passed by the Engineer.

13.5.3 Jointing of pipes

(a) Cement joint

The stoneware pipes shall be cement jointed normally. In case, if specified so, bituminous joints shall be used. In each joint, spun yarn soaked in neat cement slurry or gasket of tarred yarn shall be passed round the joint and inserted in it by means of suitable jointing tools. More skeins of spun yarn or gasket shall then be added and well rammed home. The yarn shall be moistened to avoid absorbing moisture from cement mortar.

The yarn should be so placed as to centre the spigot of one pipe within the socket of the other and shall prevent the jointing mortar penetrating inside the pipe where it might set and interfere with the flow of sewage.

Yarn or gasket (cemented or tarred) so rammed shall not occupy more than one-fourth of the depth of socket.



The cement shall be thoroughly mixed with medium sand in the proportion of 1:1 (1 cement : 1 sand) and then just enough water shall be added to make the mix plastic. On no account, the mortar shall be made soft or sloppy. The mix shall then be carefully inserted by hand into the joint.

Special care shall be taken for inserting the mortar into the portion of the joint underneath the pipe. When the cement mortar has been inserted, it shall be punched or caulked into the joint with wooden caulking tools, and more cement mortar shall be added until the space of the joint has been filled completely with tightly caulked cement. No fillet of cement shall be added.

No mortar which is older than 30 minutes shall be permitted for jointing. The cement mortar joints shall be cured at least for seven days before testing.

The inside of each pipe shall be carefully wiped out with a mop or scrapper sufficiently long to pass two joints from the end of the pipe and any projecting cement shall be removed.

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All pipes entering the manholes should be set in cement mortar 1:3 and a completely watertight junction effected.

(b) Bituminous joints

If specified so this joint will be used. Asphalt and sand in the ratio of 1:7 shall be boiled together and filled into the socket in a molten state with the aid of special moulds.

13.5.4 Testing of pipes

Testing of pipes shall be done wholly at bidder's expense inclusive of apparatus, provision of water etc., and/or as per IS : 4127.

After cement has had time to set, the pipes shall be tested in lengths between manholes in the following 'manner'. In the lowest manhole a plug shall be inserted in the pipe. The disc in the pipe and at the upper manhole shall be fitted with a filling pipe with a right angle bend and an air cock. The length of pipe shall then be filled with water by means of the pipe connection on the upper disc. The air cock in the upper disc shall be kept open, while the pipeline is being filled to permit the escape of air.

When the pipes have been filled with water and air excluded, the air cock shall be shut and water shall be poured into a conical "Filler" attached to the testing and filling pipe of the disc in the upper manhole until water remains in the filler. The testing or filling pipe shall then be raised and fastened so that the height of the pipe is six feet, which will be the usual test pressure for stone ware pipe joints.

The test will be for an hour or such longer period as may be set by the Engineer. If the water level does not fall more than 25 mm in the length of 90 metre, the test may be considered satisfactory.

If it is found that certain pipe joints are leaking, the water shall be run off and joints recaulked with cement mortar and the test repeated till it is proved by the Bidder that the joints are leak-proof.



13.5.5 Concrete bedding, haunching & encasing

Unless otherwise specified in the Schedule of Quantities, all SW pipes shall be laid in accordance with IS: 4127 As per site condition haunching or/and encasing of pipes with cement concrete may be required as per clause 4.2 & 4.3 of IS 4127. The concreting shall be done with 1:4:8 cement sand concrete.

Where sewers have less than 1.2 m cover at places of heavy traffic, these shall be surrounded with mass concrete if directed by the Engineer.

13.5.6 Handling of pipes

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While unloading, pipes shall not be dropped from the trucks/carts on the ground. Timber skids and steadying rope should be used while unloading or lowering in trenches. To avoid damage specially to spigot end, pipes should not be dragged on the hard surface.

13.6 Manholes

All manholes shall be of the size and type as given in the Schedule and shall be provided as per drawing or as directed by the Engineer. All the manholes shall be circular or other shape as shown in drawing. The bed shall be in cement concrete of Mark-10B (or 1:3:6 mix) (Size of coarse aggregate 40 mm and down) of 100 mm thickness or as shown in the drawing and shall be projected out 75 mm from the outside face of the wall all round. or as shown in the drawing. The working part including channeling, benching etc., made of P.C.C. shall be of grade-15C (or 1:2:4 mix). All manholes shall be plastered inside with 1:3 cement plaster 20 mm thick and finished with a floating coat of neat cement unless otherwise specified.

Concrete used for precast RCC cover slabs shall be of grade 20C (or 1:1.5:3 mix) and shall be constructed as per drawing.

The top level of manholes shall be generally 100 mm above the surrounding ground levels or as directed by the Engineer. Channeling inside the manhole shall be done in smooth bends.

The end of pipe shall be neatly built in and finished in cement mortar 1:3.

Circular medium duty Cast iron water sealed manhole cover and frames, 560 mm dia (clear opening) and nominal weight 128 kg shall be provided for each manhole and shall be in accordance with IS:1726. Manhole covers with double seals (Light duty) with wt. as specified in schedule of item shall be provided within compound near the buildings if specified so. If specified heavy duty cover and frames, either circular or double triangular type, shall be provided. Step irons shall be provided with two coats of bituminous paint and shall be as per drawing.



In cases where branch pipe sewers enter the manhole or main pipe sewer at a level more than 1m, from the main sewer, a drop connection shall be provided. The extra pipe length required for this connection will be paid under item for pipelines. No other extra payment will be allowed.

All exposed surfaces of cast iron frame and cover shall be painted with two coats of bituminous painting

13.7 Marker plates

Marker plate indicating the particular service installed shall be provided along the routes of pipes laid below ground. These shall be of mild steel, with the type of service and direction of flow, painted on it. The markers shall be set

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firmly in a concrete base and installed at all corners and turning points. Over straight runs markers shall be spaced at 100 m intervals generally.

14.0 ROAD WORK

14.1 General

Road works in general shall be constructed according to the requirements to the various specifications and codes of practices of the Indian Roads Congress.

Works such as earthwork, masonry, concreting and the like, wherever they occur in association with construction of roads, shall be governed by the respective specifications of these series.

14.2 Trenching and Preparation of Subgrade

The surface of the formation of width equal to that of soling coat shall first be cut to a depth below the proposed finished level equal to the combined depth of soling and wearing coat, (due allowance being made for consolidation), and dressed parallel to the finished profile. Any roots of bushes, trees etc., shall be taken out to the full depth and the cavities thus formed shall be filled up and rammed by the bidder at his cost.

In slushy soil or in areas where water logging is frequent, adequate arrangement shall be made for drainage of the area so that the sub-soil water level is kept as low as possible.

The sub-grade shall then be consolidated with a power road roller of 8-10 tonne capacity by rolling with minimum of 5 numbers of passes till it is densely consolidated to the satisfaction of the Engineer.

Surplus earth shall be disposed of as directed by the Engineer and the areas where it is disposed of shall be neatly dressed.

All undulations of the sub-grade surface that might develop due to rolling shall be made good with earth and sub-grade re-rolled.



14.3 Ash / Moorum Carpet

Wherever the ground is soft and slushy, ash carpet consisting of common boiler ash shall be laid to 5 cm thickness over the subgrade and then rolled. In firm ground no ash carpet is necessary and boulder soiling shall be laid directly over the sub-grade. If decided by the Engineer, a bed of moorum of specified thickness shall be provided for to form a sub-grade.

14.4.1 Boulder Soling

The width of the soling coat shall be 30cm (15cm on either side) more than that of the wearing coat. Its depth shall be 15cm in cutting and 23cm in filling

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and made up soil, unless otherwise specified in the schedule of quantities or shown in the drawing.

The edges of the soling shall be marked out by strings and stakes. Soling stone shall be hand packed and set on edge with greatest length across the road. This shall be laid closely in position on the sub-grade, firmly set with their broadest side downwards. The joints shall be staggered. All interstices between the stones shall be wedged in with locking smaller stones well driven into gaps to ensure tight packing and complete filling of interstices. Such filling shall be carried out simultaneously with the placing in position of soling stones and shall not lag behind.

After packing, surface shall be checked with template of approved shape and high and low spots corrected by removing soling and re-packing. The top surface of the soling coat shall be perfectly true to camber and grade.

The soling shall then be thoroughly consolidated with power roller of 8-12 tonne weight depending upon the type of soling stones, starting at "edges" and working towards the centre. In case of super-elevated curve the rolling shall commence from the inside edge of the curve to the outside edge. The roller shall run over the same surface of soling at least 10 times or more till the soling coat is well consolidated to the satisfaction of the Engineer. The surface shall be checked by templates and any disturbance in grade or camber corrected after every rolling and finally consolidated. After that, at least 50mm thick moorum shall be laid on top of soling coat and rolled with water to proper compaction so that the top surface seems smooth. The rate for soling coat shall be inclusive of the cost of the moorum as blinding materials for which no separate payment shall be made.

14.4.2 Laterite soling



In case of laterite soling the thickness of soling shall be as follows :

- (i) For road width of 7m and above the sub-base shall consist of two layers of laterite stones 150mm maximum size. The sub-base shall be rolled to a thickness of 230mm after compaction.
- (ii) For road width of 4m to 7m, the sub-base shall consist of one layer of laterite stone of 150mm maximum size consolidated to 115mm thick.
- (iii) A layer of moorum, 33.3 % in volume of laterite, shall be spread over the laterite to a uniform thickness and rolled with 8 tonne roller with constant watering until the mixture penetrates into the voids of laterite layer. Care shall be taken to maintain the camber and slopes.

Other steps for laying, compacting etc. of the laterite soling shall be same as given under clause 14.4.1 "Boulder soling".

14.5 Kerbs

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Concrete or stone kerbs, where shown in drawings, shall be fixed in position after laying and consolidation of soling. They shall be fixed true to line and level and secured in position by approved means.

14.6 Water Bound Macadam Surfacing

The construction of water bound macadam shall be carried out according to IRC : 19 "Standard Specification and Code of Practice for Water Bound Macadam".

14.7 Preparation of Base and Shoulders

The subgrade shall be reshaped to the required grade and camber. Where water bound macadam is to be laid over existing black top surface, 50 mm x 50 mm furrows shall be cut in the existing surface at 1 m intervals inclined 45 degree to the centre line of the carriageway, before laying of coarse aggregates. Necessary arrangements shall be made for the lateral confinement of aggregates by constructing shoulders in the form of two parallel mud walls 20 x 15cm which shall be made along the outer edges of the wearing course.

14.8 Spreading Coarse Aggregate

The coarse aggregates shall be spread uniformly and evenly upon the prepared base in required quantities from stock piles along the roadside or directly from vehicles. In no case shall these be dumped in heaps directly on the base. The aggregates shall be spread to proper profile by using templates placed across the road about 6m apart. Where possible, mechanical devices shall be used to spread the aggregates uniformly.



The water bound macadam course shall be constructed in layers of not more than 75 mm thickness. However, the Engineer may permit courses of 100 mm compacted thickness to be constructed in a single layer. Each layer shall be tested by depth blocks. No segregation of large or fine particles shall be allowed.

14.9 Rolling

The coarse aggregates spread as described above shall be compacted to full width by rolling with either three wheel power roller of 6 to 10 tonnes capacity or an equivalent vibratory roller. The weight of roller shall depend on the type of coarse aggregate.

The rolling shall begin from edges and after the edges have been compacted, progress gradually towards the centre, parallel to the centre line of the road, uniformly lapping each preceding rear wheel track by one half width. On super elevated portions, rolling shall commence from the lower edge. Where screenings are to be applied, rolling shall be discontinued when the aggregates are partially compacted with sufficient voids to permit application of screenings. Where screenings are not to be applied, as in the case of

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crushable aggregates compaction shall be continued until the aggregates are thoroughly keyed, with no creeping of stones ahead of the roller. Slight sprinkling of water may be done during rolling, if necessary.

Rolling shall not be done when the subgrade is soft or yielding nor when it causes a wave like motion in the base course. If irregularities develop during rolling, and exceed 12 mm when tested with a 3m straight edge, the surface shall be loosened and aggregates added or removed before rolling again. The surface shall be checked by template for camber. In no case shall screenings be used to make up depressions.

14.10 Application of Screenings

After coarse aggregates have been rolled, screenings to fill the interstices shall be applied gradually over the surface in thin layers. Dry rolling shall be done when the screenings are being spread, so that the jarring effect of roller causes them to settle into the voids of the coarse aggregates. Damp and wet screenings shall not be used and the spreading, rolling and brooming of screenings shall be taken up on sections which can be completed within one day's operation.

14.11 Sprinkling and Grouting

After application of screenings, the surface shall be copiously sprinkled with water, swept and rolled. The sprinkling, sweeping and rolling operations shall be continued and additional screenings applied where necessary until the coarse aggregates are well blended and firmly set and a grout of screenings and water forms ahead of the wheels of the roller.

14.12 Application of Binding Material



After the application of screenings, approved binding material, where it is required to be used, shall be applied at a uniform and slow rate in two or more successive thin layers to a thickness of 2.5 cm. After each application of binding material, the surface shall be copiously sprinkled with water and the resulting slurry swept in with brooms, so as to fill the voids properly. This shall be followed by rolling with a 6-10 tonne roller, during which, water shall be applied to the wheels to wash down the binding material that may get stuck to them. The spreading of binding material, sprinkling of water, sweeping with brooms and rolling shall continue until the slurry of binding material and water forms a wave ahead of the wheels of moving roller.

14.13 Setting and Drying

After final compaction the road shall be allowed to cure overnight. Next morning, hungry spots shall be filled with screenings or binding material, lightly sprinkled with water and rolled. No traffic shall be allowed till the macadam sets.

14.14 Surface Evenness

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The surface evenness of completed water bound macadam course in longitudinal direction shall be within 12 mm when tested with a 3 m straight edge and in cross profile within 8 mm when checked with a template.

14.15 Bituminous Pavements

14.15.1 Bitumen premix carpet with seal coat

The consolidated thickness of this type of treatment shall be 2cm/2.5cm/4cm or as specified.

14.15.1.1 Surface preparation

Water bound macadam surface on which black topping is to be provided shall be thoroughly cleaned of dust, loose materials, caked mud and other foreign material with the help of wire brush, chisel, picks etc. Cleaning shall be such as to expose the stone metal to a depth of about 6mm without dislodging the interlock of the metal. All dust and other materials thus removed shall be thrown away at a suitable place as directed by the Engineer.

Any potholes, depressions and undulations found after cleaning shall be made good with premixed chippings, and well rammed.

14.15.1.2 Tack coat

Just before the application of tack coat, the surface shall be thoroughly cleaned by brooms and then by fanning with gunny bags.



Bitumen of specified grade heated to a temperature of 177 to 188 degree 'C' shall be spread on the prepared surface uniformly at the rate of 0.75 kg/sq.m. by means of sprayers. It shall be applied just ahead of and keeping pace with, laying of premix carpet.

14.15.1.3 Preparation of mix, laying & consolidation

The stone grit (aggregate) shall be surface dry and contain not more than 2% moisture before use. It shall be first screened of dust and measured in boxes and then loaded into the drum mixer according to the capacity of the mixing drum in the proportion given in the table below. The aggregate shall be heated to facilitate mixing with the binder in cold weather, where so directed by the Engineer.

The binder heated in boilers, to a temperature of 149 to 177 degrees C or as specified for the grade used and maintained to that temperature, shall be drawn off from the boiler into a suitable container or in bucket gauged to show the weight of bitumen in it. This shall then be poured over the aggregate in the mixer at the correct rate of 64 Kg/cum of aggregate or as specified and mixing started and continued till aggregate is uniformly coated with bitumen.

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Immediately after applying the tack coat, the hot mix shall be discharged from the mixer, carried to the road surface and spread to a thickness sufficient to achieve after consolidation the specified thickness. Rakes or drag spreaders shall be used for spreading the mixture.



When the premix has been laid for a length of 15-20 metres it shall be rolled. Rolling shall commence from edges and proceed towards the centre. The roller wheels shall be moistened continuously so as to prevent metal chips sticking to it. Any high spot or depression which become apparent shall be corrected by addition or removal of premix materials.

Further the prepared finished surface shall be protected from the traffic for 24 hrs or such period as may be specified by the Engineer.

14.15.1.4 Materials

Quantity of materials required per 100 sqm of road surface shall be as given in the table below, unless otherwise specified.

Sl. No.	Consolidated thickness of premix carpet	Stone chips (cum)	Sand (cum)	Binder		
				Tack coat (kg)	Carpet (kg/cum)	Seal coat (kg/cum)
Using Paving bitumen80/100 or 30/40 grade						
1.	Priming tack coat					
a)	on a water bound macadam surface			75		
b)	on an existing black top surface			65		
2.	Carpet					
	2 cm	2.4 (10 mm nominal size)			64	
	2.5 cm	3.0 (10 mm nominal size)			64	
	4.0 cm	4.8 (12 mm nominal size)			64	
3.	Seal Coat					
a)	Dry area (Premixed sand seal coat)		0.6			68
b)	Wet area (Liquid seal coat with chips		0.9			98

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14.15.2 Seal coat

In dry areas where rainfall is under 150cm per year a premix sand seal coat shall be applied immediately after laying the carpet. The binder shall be heated in boilers of suitable design, to the temperature appropriate to the grade of bitumen. The aggregates shall be dry and suitably heated to a temperature directed by Engineer before the same are placed in the mixer of suitable design. Mixing of binder with aggregates to the specified proportions shall be continued till the latter are thoroughly coated with binder. The mix shall be immediately transported from the mixing plant to the point of use and spread uniformly on the bituminous surface to be sealed. As soon as sufficient length has been covered with premix materials, the surface shall be rolled with 6 to 8 tonne power roller. Rolling shall be continued till the premix material completely seals the voids in the bituminous course and a smooth uniform surface is obtained.

In wet areas where rainfall is above 150cm per year a liquid seal coat with chippings (not sand) shall be applied after laying the carpet. The binder shall be heated in boilers of suitable design, to the temperature appropriate to the grade of bitumen and spread on the surface preferably using mechanical sprayers. Immediately following the application of the binder, stone chippings in a perfectly dry condition shall be uniformly spread on the surface. Immediately after the application of the cover material, the entire surface shall be rolled with 8-10 tonne road roller.

14.15.3 Surface dressing

The surface shall be prepared in the same way as that for premix carpet work as per 14.15.1.1. Depression or pot holes, if any, shall be repaired as indicated.



After the surface has been prepared and is in perfectly dry condition, bitumen heated in the same manner as for premix carpet, shall be sprayed over the surface preferably using mechanical sprayers. It shall be ensured that there is even and uniform distribution of bitumen on the surface. Spraying shall be carried out parallel to the centre line of the road.

Immediately following the application of bitumen, stone chippings in a perfectly dry condition, shall be uniformly and evenly spread as specified in the item, over the entire sprayed surface. Spreading may be done preferably by means of mechanical gritter. Finally the entire surface shall be broomed to ensure perfect uniform spreading.

The final surface shall be checked by means of camber board etc. The spread surface shall be rolled with 6 to 8 tonne roller till there is sufficient boundage of chippings with bitumen. The finished surface shall be thrown open to traffic on the following day.

14.15.4 Premixed Bitumen Concrete

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14.15.4.1 General

In this type of road carpet a mixture of sand and stone aggregate is used as aggregate producing a dense mixture. Seal coat is not necessary as the sand used in the mix works up to the surface and forms a seal by itself. The consolidated thickness of this type of treatment shall vary from 4cm to 7.5cm as specified.

14.15.4.2 Surface Preparation

Same as in para 14.15.1.1 above.

14.15.4.3 Tack Coat

Same as in para 14.15.1.2 above.

14.15.4.4 Preparation of Mix, Laying & Consolidation

Para 14.15.1.3 shall generally apply except that the mixing shall be done in two stages. The stone aggregate of the the correct specified size and in the proportion shown in the table above shall be fed into the mixer to which 2/3rd of the total specified quantity of bitumen heated to the appropriate temperature shall be added. When the stone metal is well coated, the sand in the specified proportion and the balance 1/3rd quantity of total bitumen shall be fed into the mixer. Mixing shall be continued until a homogeneous mix is produced and all particles are uniformly coated with bitumen.

The premix shall be emptied on to wheel barrows or stretchers and carried to the site of work. It shall then be spread uniformly on the road surface with rakes or drag spreaders immediately after applying the tack coat to a thickness sufficient to achieve after consolidation the specified thickness. When the premix has been laid for a length of 15-20m it shall be rolled. Rolling shall commence from edges and proceed towards the centre.



The roller wheels shall be moistened continuously so as to prevent metal chips sticking to it. After preliminary rolling, all honeycombs, any high spot or depression which become apparent shall be corrected by addition or removal of premix materials. Camber and grade shall be checked at every stage to ensure correctness and any defect found shall be rectified.

14.15.4.5 Materials

Quantity of materials required per 100 sqm of road surface shall be as given in the table below unless otherwise specified.

BINDER

Sl. No.	Thickness of consolidated bitumen concrete	Tack coat (kg)	Hot Bitumen (cut back)/ Paving Bitumen 80 / 100 grade	
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	surfacing		Bitumen concrete	
			Stone aggregate (kg / cum)	Sand (kg / cum)
1.	4 cm, 5 cm, 6 cm & 7.5 cm	75	560	128

Aggregate

Sl.	Thickness of compacted bitumen concrete surfacing		Stone aggregate (cum / 100 sqm)	Coarse sand (cum / 100 Sq.m)
1.	4 cm	3.8	(12mm nominal size)	1.90
2.	5cm	4.8	(20mm nominal size)	2.40
3.	6cm	5.8	(60% 40mm nominal size) (40% 25mm nominal size)	2.90
4.	7.5 cm	7.3	(60% 50mm nominal size) (40% 40mm nominal size)	3.65



The nominal size of Coarse Aggregate herein shall mean as defined below:

Sl. No.	Nominal size of coarse aggregate	Designation of IS sieve through which the aggregate shall wholly pass	Designation of IS sieve through which the aggregate shall be retained
i)	40 mm	50 mm	25 mm
ii)	25 mm	40 mm	20 mm
iii)	20 mm	25 mm	12.5 mm
iv)	12 mm	20 mm	10 mm
v)	10 mm	12.5 mm	6.3 mm
vi)	6 mm	10 mm	2.36 mm

14.15.5 Surface evenness

The finished surface of premix carpet and bituminous concrete shall be tested with a straight edge 4.5 m long and any irregularity greater than 6mm shall be corrected.

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14.16 Berms

Shoulders and berms shall be prepared as shown on the drawings. Work on making berms shall not lag more than 100 metres behind the water bound macadam consolidation. Suitable drains shall be cut on the berms so that the water bound macadam surface is kept drained till bituminous macadam is laid.

14.17 Kerbs

Kerbs shall be laid and set in place before completing the bituminous or concrete wearing surface as well as the wearing surface of footpath. Setting shall be done in mortar where so specified with Schedule of Items. They shall be laid and set in such a way as to obtain straight lines in the finished work, the top surface matching with the finished surface of footpath.

Where the road edge forms a curve, the kerbs shall follow such curve. Gaps shall be left as shown in drawings or as may be required to provide for drainage.

14.18 Bridges and Culverts

Bridges and culverts shall be constructed according to the specifications of Indian Roads Congress. Relevant chapters of earthwork, concrete, masonry etc., of these series shall apply.

14.19 Boulder Pitching



Wherever specified, boulder pitching shall be provided at the inlet and outlet of pipe culverts, or for embankments of bridges. The subgrade shall first be dressed to level or slight slope as indicated. The transverse slope of the pitching shall be made strictly in accordance with the drawings or as directed by the Engineer.

14.20 Scarifying & Dismantling

Where a new carriage-way abuts or includes an existing carriage-way and the Engineer so directs, the surface of the latter shall be scarified, adjusted and reshaped to conform with the existing and new camber or crossfall. Materials from the existing road shall be used or disposed off as directed by the Engineer.

Where dismantling of the existing road has been specified, the various layers of the road viz., bituminous macadam, water-bound macadam and soling shall be scarified separately. Scarifying can be done either by hand picks, or by means of scarifiers fixed to the roller. When a roller is used for scarifying, crushing of the metal shall be avoided by moving the metal clear of roller wheels after the scarifier has passed over it. The loosened material shall then be combed by means of rakes to bring out most of the larger stone. If

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necessary, the larger stones thus collected shall be screened to separate fine particles if any.

The remaining metal shall then be removed and screened to recover reusable metal. Different grades of metal shall be stacked separately and measured.

14.21 Diversions

Where the construction of the road or culvert or bridge is in progress, the road shall be closed to traffic and a suitable diversion shall be provided for traffic by the Bidder, as directed by the Engineer.

The road shall be closed by the erection of barriers and suitable sign boards at both ends which shall be provided with lights at night. Both during night and during day, one man shall be posted at each barrier to suitably divert the traffic and to keep the light burning during the night.



15.0 WATERPROOFING TO ROOFS & WATERPROOFING PAINTS

15.1 Scope

This chapter deals with different types of waterproofing on roof.

15.2 Material

The materials shall conform to relevant codes of BIS.

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15.3 General Workmanship

The waterproofing to roofs being specialised works the Bidder shall get these done by specialised firms/agencies.

15.4 Painting with Hot Bitumen

The surface to be painted shall be thoroughly dried and then cleaned, with wire brushes and cotton or gunny cloth, of all loose materials and scales. The surface shall further be cleaned with a piece of cloth lightly soaked in kerosene oil. Bitumen shall be brought to the site in its original container and this shall not be removed from site till the painting job is completed. Before applying the main coatings of hot bitumen paints, one coat of bituminous primer shall be applied. The number of coats of hot bitumen shall either two coats or as specified in the Schedule of Items. The bitumen of approved quality (either of grade 80/100 or 30/40) or as specified shall be applied to the surface after heating it to the manufacturer's specifications. Care shall be taken to see that no blank patches are left and the quality of bitumen to be spread shall be as specified and shall be to the satisfaction of the Engineer.

15.5 Painting with Bitumen Emulsion

Before applying, the surface shall be cleaned thoroughly. Generally two coats of Bitumen Emulsion are provided over a coat of emulsion primer. Since the painting is with emulsion, the surface need not be made dry.



15.6 Waterproofing of Roof

15.6.1 With bitumen felt

Prior to laying the insulation, roof gradient shall be checked. If necessary, the roof shall be re-graded by screed to ensure everywhere a run off gradient of not less than 1 in 120. The screed shall consist of one part cement and four parts medium to coarse sand by volume. The screed shall be cured for 7 days. The surface shall then be cleaned of all foreign matter by wire brushing and dusting.

Waterproofing unless specified otherwise in drawings shall be the "heavy treatment type" with primer coat as described in IS : 1346. The method of laying roofing treatment, surface finishing with pea gravels, special mode of treatment for drain outlets, projecting pipes, parapet walls, expansion joints, gutters, timber roofs etc., shall conform to IS : 1346. The number of layers of felts shall be as specified in the drawing or Schedule of Items. The bonding bituminous material shall be of grade 30/40 or as specified and the minimum quantity of hot bitumen to be applied, shall be 1.2 kg/m². Unless specified otherwise, the bituminous felts shall be hessian bases of Type-3 Grade-2. Pea gravel finish may be substituted by a coat of bituminous aluminium paint, where so specified in the Schedule of Items.

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The cement mortar used for filling the chases shall be of mix 1:4 and the cement concrete for fillets shall be of the same grade as the roof slab.

Where special surface finish with precast concrete or clay tiles is specified, it shall be in accordance with the relevant chapter of this series.

15.6.2 With bitumen mastic

The work shall be carried out generally in accordance with IS : 4365 "Code of Practice for Application of Bitumen Mastic for Waterproofing of Roofs" or according to the manufacturer's specifications. The work shall be carried out by a firm of specialists in the trade.

The type of underlay or primer, thickness of application, surface finish etc., shall be as shown on drawing or described in the Schedule of Items. Bitumen melting shall be done in a mechanical mixer by gradually heating to about 200 degree 'C'. Coarse aggregate where required shall be added to the hot bitumen and stirred.

Each coat shall be spread evenly and uniformly by means of a float to the required thickness. Timber gauges shall be used to regulate the thickness. Particular care shall be taken to tuck the mastic into grooves on vertical surfaces, at joints, around pipes or other projections and at junction of adjoining bays.

15.6.3 Waterproofing of RCC roof with Lime concrete and Pressed clay tiles.

Lime concrete shall consist of broken brick aggregates and lime. Proportion of brickbat coba shall be 2.5 parts of brick jelly to one part of lime. The brick jelly shall be hard, well burnt and of size varying from 12mm to 25mm.

The lime concrete is then laid over roof to slope to give specified thickness and in slope of 1 in 80 or as shown on the drawing for proper roof drainage as per roof drainage plan. The lime concrete is then to be beaten in the manner approved by the Engineer for 48 hours or as directed with hand beaters.



If the surface during the process of compaction becomes so uneven that water lodges in pools, the surface shall be pricked up, and fresh concrete

spread and consolidated as necessary to obtain an even surface.

The concrete shall then be cured by sprinkling water and allowed to harden for a period of not less than six days before laying the roof finish.

Roof shall be finally finished with one coarse of machine pressed clay tiles 20 mm thick laid over a 12mm thick of 1:3 mix cement mortar mixed with 5% crude oil by weight of cement mixed in mortar. The pressed clay tiles shall be immersed in water for two hours before being used. The side joints of the tiles shall be more than 60 mm thick set full in mortar. Before the work dries up completely, the tile joints shall be raked out and pointed with cement mortar

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1:3 mixed with crude oil which shall be 5% by mass of cement. The joints shall be well rubbed over with thin bar trowel and excess of mortar scrapped off until the surface of the pointing attains a black polish and becomes hard. As the work proceeds, it shall be kept thoroughly wetted until the mortar has set firm and hard. Watering shall be continued for three weeks after construction.

Lime concrete and tiles shall be taken up the parapet walls to a height of 150 mm or as shown in the drawing.

The specification of pressed clay tiles shall be as given in IS:2690 (Part-I). The specification of crude oil shall be as per IS:2119.

The areas around drain pipes shall be properly finished with provision of adequate slope.

The bidder shall give guarantee for any/all types of waterproofing for a period of 7 years against bad of faulty material and construction and shall rectify the same at his own cost during the guaranteed period.

15.7 Waterproofing for Basement

15.7.1 The specification covers the requirements of waterproofing of basements, tunnels, ducts, pits, bunkers, etc.

The material used shall be bitumen felt type-3 of grade-2 conforming to IS : 1322, together with the specified bonding material and primer.

Waterproofing shall be provided on the outside of walls and top of the floors and shall be carried 150 mm above ground level.



The number of layers of bitumen felt to be used for walls and floor unless otherwise shown in the drawing shall be :

- i) For depths upto five metres below ground : 2 layers.
- ii) For depths beyond five metres : 3 layers.

The method of laying the bitumen felts and workmanship shall in general conform to IS : 1609.

Waterproofing work shall be taken in hand only when the sub-soil water level is at its lowest, the site shall be kept dry by adequate arrangements for pumping out water till the work has been completed. For this purpose drains shall be formed along the edges of the excavation but beyond the building line, with suitable collecting sumps. In case of large excavation areas where it is necessary to dewater under the floor, additional land drains shall be formed across the excavation, to adequately drain the area. Adequate arrangements shall be made to prevent the sides of excavation from slipping while the work is in progress.

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The base concrete of mud-mat shall be rendered smooth by a 20 mm thick sand-cement plaster (6:1). Any sharp corner over which the waterproofing course is to be laid shall be eased out by means of cement mortar fillets 7.5 cm in radius.



The surface must be dry before the next operation is carried out. Blown bitumen conforming to IS : 702 shall be applied hot over the prepared surface at the rate of 1.5 kg/m² for the first layer and for every other subsequent layer(s). The laying of felt over the bitumen so applied shall always commence on the floor, and shall be carried to the walls only after treatment of the floor is complete. The minimum overlapping of joints at sides and ends of felts shall be 10 cm. Joints for subsequent layers of felt shall be staggered. All joints shall be completely sealed by blow lamp.

A protective flooring of either flat bricks in cement mortar 1:3 or 6 cm thick cement concrete type M15B or a coat of cement sand plaster (1:3) 4 cm thick shall be constructed over the waterproofing treatment to prevent damage to the latter during subsequent construction of the structural floor.

The walls shall be treated in a similar way, the bitumen felts joining at the base with the projecting felt laid over the mud-mat. The wall surface shall be made smooth, where necessary with a coat of cement plaster 1:5, the felts shall be laid as for the floor ensuring that the surface to be treated is dry and then a protective brick wall, half-brick nominal thickness shall be built in cement mortar 1:6 over the projecting mud-mat, the space between the wall and felt being grouted with cement slurry. Sufficient care shall be taken to ensure a perfect bond between the waterproofing on the floor and that on the walls.

The treatment on the wall shall be carried 150 mm above the surface of ground and tucked into a groove 6.5 cm. wide and 7.5 cm deep, the chase being filled with cement mortar (1:4).

Where waterproofing is done to the roof of an underground structure, such as a tunnel, it shall be done in a similar way. The structural concrete shall be rendered smooth, hot bitumen and bitumen felts applied in the same way as for the floor and walls, and over this shall be laid a protective layer of cement concrete grade M10C, 7.5 cm thick.

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15.7.2 With epoxy based emulsion

Over the mud-mat a 20 mm plaster is to be provided to make the surface even.

On the plastered surface of the mud-mat, three coats of epoxy based leakproof emulsion shall be applied with reasonable gap between each coat in order to permit sufficient drying time.

Precaution should be taken that during the process of rod binding if any damages happens it should be immediately rectified by making patch painting on the affected portion only and as such a complete vigilance is to be kept to rectify the defect.

After the rod binding is over the concreting should be done with high polymer based, chloride and sulphide free cement waterproofing additive/admixtures @ 2% by weight of cement all through the floor area and all through the vertically raised walls of four sides which shall remain underground upto a depth of 8 metre and above from ground level.

After the concreting and immediately after de-shuttering cleaning of the concrete surface on the external faces of the walls are to be done and then three coats of epoxy based leakproof emulsion shall be applied with a reasonable gap between the each coat before back filling. If the back filling is with hard material again a protective layer of plaster shall also be applied on the external faces of walls in order to avoid damages on the painted surface.

If the back filling is with soft sandy or alluvial soil there is no necessity for protective layer of plastering as mentioned above.

Epoxy based paint can be applied on the wet surface hence there shall be no stoppage of the normal progress of the project works.



15.8 Surface Application

Waterproofing done by surface application of bitumen based or epoxy based material shall conform strictly to the recommendations of the manufacturer. The work shall be carried out by a firm of specialists in the trade.

15.9 Guarantee

For the waterproofing on the roof as well as for underground basements the Bidder shall give guarantee in writing for the period of 5 years as specified . For such guarantee the Bidder shall get guarantee from the manufacturer/specialised firms and forward the same to the Engineer. However, the Bidder shall be fully responsible for the serviceability of the waterproofing treatment throughout the guarantee period and any leakage during that guarantee period shall be stopped by the Bidder at no cost to the Owner and without disturbing working facility of the Owner.

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15.10 Water proofing course with Fibre glass R.P. tissue

15.10.1 Scope

This section covers the furnishing of all labour, equipment and performing all operations necessary to complete to provide water proofing course of Fibre glass R.P. tissue all in accordance with the drawing and these specifications.

15.10.2 Terminology

For the purpose of these specifications the following definitions detailed hereinafter shall apply.

15.10.3 Preparation of surfaces

Surface to receive waterproofing shall be dry, free from dirt, loose particles and foreign materials. Projections which might puncture the membrane shall be removed and voids and crevices shall be filled in prior to the start of work.



Adequate covering shall be provided during this work to avoid splashing or staining of the adjacent work and surfaces. Any work or surface splashed or stained shall be thoroughly cleaned to the satisfaction of the Engineer. Joints in the tissue felt in the different layers shall be staggered.

15.10.4 In built-up roofing

Application

- i) Suitable slope shall be provided in the roof as per manufacturers specifications. Heat insulation may also be provided if necessary.
- ii) Prime the plastered surface primer at the rate of 0.4 Kg/sqm. This should properly impregnate the surface and should be left till the time it is touch-dry.
- iii) Apply first coat of hot bitumen @ 1.8 Kg/sqm.
- iv) Embed first layer of fibre glass RP tissue. Overlaps shall be 100mm between the layers in either direction.
- v) Apply second coat of hot bitumen @ 1.8 Kg/sqm.
- vi) Embed second layer of fibre glass RP tissue after the surface of the first layer has become dry.
- vii) Apply third coat of hot bitumen @ 1.8 Kg/sqm.
- viii) Embed third layer of fibre glass RP tissue.
- ix) Apply fourth coat of hot bitumen @ 1.8 Kg/sqm.

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- x) Finish with gravel grit @ 0.006 cum per sqm.

Guarantee

A written guarantee for the water tightness shall be taken for a minimum period of 10 years.

15.10.5 Specification

Water proofing medium

- i) By impregnation into the fibre glass reinforcement membrane forms a monolithic mass.
- ii) Prevents the penetration of water/moisture.
- iii) Acts as a top dressing.

Layer

A single thickness of fibre glass tissue impregnated with bituminous compound.

Multiple layer

2 or more layers of fibre glass tissue laid consecutively with overlapping joints and impregnation with bitumen.

Bitumen/primer

A liquid bitumen of low viscosity which penetrates into a prepared surface upon application.

Half-brick masonry shall be of approved quality 50 class brick work in cement mortar 1:4 (1cement : 4 sand). Plaster should be in cement mortar 1:4 (1cement : 4 sand). Sand should be fine sand conforming to IS 383



Application

Suitable slope may be provided in lean concrete, if necessary. Over this, 12mm thick plaster with cement mortar 1:4 (1cement : 4 coarse sand) is to be laid.

Prime the plastered surface with primer at the rate of 0.4 Kg/sqm. This should properly impregnate the surface & then should be left till the time it is touch dry.

Water proofing shall be as follows :-

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- i) Apply first coat of hot bitumen @ 2.4 Kg/sqm.
- ii) Embed first layer of fibre glass RP tissue. Overlaps shall be 100mm between the layers in either direction.
- iii) Apply second coat of hot bitumen @ 2.4 Kg/sqm.
- iv) Embed second layer of fibre glass RP tissue after the surface of the first layer has become dry .
- v) Apply third coat of hot bitumen @ 2.4 Kg/sqm.
- vi) Embed third layer of fibre glass RP tissue after the surface of the second layer has become touch-dry.
- vii) Apply fourth coat of hot bitumen @ 2.4 Kg/sqm.
- viii) Embed fourth layer of fibre glass RP tissue after the surface of the third layer has become touch-dry.
- ix) Apply fifth coat of hot bitumen @ 2.4 Kg/sqm.
- x) A layer of 12mm thick fine sand is to be laid after completing the above operations. The layer of sand will not be applied on vertical walls.



The surface should be finished with half-brick masonry in cement mortar 1:4 (1cement : 4 coarse sand).

Guarantee

A written guarantee for the water tightness shall be taken for a minimum period of 10 years.

General

The work will be carried out by specialists in the trade. Workers shall be provided with gum boots and hand gloves. There shall be no air pockets. Corners shall be treated flush without any air pockets or voids.

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Measurement

The unit will include supply of materials, transport, preparation of surface, application of water proofing treatment, plastering, masonry work etc., as specified herein. The measurement of the item will be in square metres nearest to the second decimal of the concrete surface which is to be damp-proofed.

15.11 Water proofing course with P.V.C sheets/ membranes

15.11.1 Jointing

The adjacent lengths of the P.V.C sheets shall be jointed by giving an overlap of 50mm, one over another by sealing with the approved adhesive. A minimum width of the sheet, as specified in the item, shall be used without any joint. Jointing of the sheets, to the extent possible and practicable, shall be done at the site workshop.

15.11.2 Laying

- i) Horizontal areas: The base concrete shall be rendered smooth by cement sand plaster 1:6 mix of 20mm thick unless otherwise specified. It shall be ensured that there are no sharp crivices, projections etc which may puncture and damage the sheet. P.V.C sheets shall then be evenly laid over the smooth rendered surface while it is green.



After laying of sheets a protective cover shall be laid over it. This cover may be of 1:6 cement sand mortar bed of thickness 20mm and above, flat brick/tile soling over cement sand mortar bed, any other suitable layer or thermal insulation cover as specified in the item. However care is to be taken that sheets do not get damaged while laying the protective cover. The horizontal layer of P.V.C sheets shall be carried over to a minimum of 150mm height and tucked in to the connecting vertical walls as in the case of roof parapets, if there is no provision of continuous laying of the sheets in the adjacent vertical surface.

ii) Vertical surfaces

On vertical concrete surfaces the P.V.C sheets shall be fixed along with the form work with the knobs projecting toward concrete. The sheets shall be clamped on the top of the form work to keep it in position. Concrete is then poured and knobs are locked in it. After the forms have been stripped off, all the tie bolt holes, cuts and other damages are sealed with additional patches of sheets as per manufacturer's specification.

In case good quality of soil, completely free from foreign materials like stone piece, hard lumps and rubbish etc, is available, it can be used

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directly as a back fill. Otherwise a half brick wall or any other measure as specified shall be provided as a protection barrier over the projecting base of the concrete/mud mat. The top edge of the sheet shall be tucked into a chase to be subsequently sealed with cement sand mortar of 1:4 mix.

In case of sheets being laid both on horizontal and adjacent vertical surfaces, the horizontal sheets shall be carried on the vertical portion as one monolithic layer.

15.11.3 Agency

The execution work including jointing, laying and testing etc. shall be done by a specialised agency duly approved by the Engineer.

15.11.4 Testing

After laying is complete, the sheets shall be tested by an Electronic Pin hole detector for pin holes, cuts and other damages etc. All such portions shall be patched suitably with additional sheets as directed and again test checked.

15.11.5 Expansion joints

All Expansion Joints etc of dimensions as specified, shall be filled up by Polymer Sealant of pourable grade as per manufacturer's specification on the P.V.C sheets locked in the joint.



15.11.6 Guarantee

The bidder shall guarantee the water tightness and leak proofing of the structure for a period of ten years after certified completion and handing over of the jobs by furnishing a free maintenance guarantee as per prescribed format and as specified.

15.12 Waterproofing with Non-Shrink Polymeric Waterproof Grouting Compound

15.12.1 Work Included

The Bidder shall furnish materials, labour, plant, equipment and tools to complete the work as specified and/or as shown in drawings.

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15.12.2 Materials

Cement

Ordinary portland cement shall conform to IS : 269 and portland blast furnace cement shall conform to IS : 455.

Aggregates

All aggregates shall conform to IS : 383 Fine aggregates shall be approved river or pit sand.

Cement waterproofing compound

All cement waterproofing compound shall conform to IS : 2645 and shall be of approved quality.

Solvent less resin

High build polymeric surfacing which forms a thick resilient and flexible membrane on concrete with high resistance to oil and water.

Nozzle

15 mm dia threaded G.I. pipes of suitable length plugged at both ends.

Super plasticiser

High range water reducing admixture and integral cement waterproofer for concrete. Super plasticiser shall conform to ASTM C-194 Type F, IS: 9103 & IS:2645.

15.12.3 Waterproofing of underground structures



Waterproofing shall be carried out as per the approved manufacturer's specification .

15.12.3.1 Raft

The sub-base (PCC) of the underground structure shall be cleaned of all dirt and kept dry by continuous pumping of water. 20 mm thick plaster with cement-sand mortar (1:3) mixed with approved cement waterproofing compound as per manufacturer's specification shall be laid on top of the sub-base. The plaster shall be finished smooth with a steel trowel.

The plastered surface shall then be painted with two (2) coats of approved solvent less resin to form a thick resilient and flexible resinous membrane over the plastered surface.

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Threaded nozzles of 15 mm dia and of suitable length shall be placed and fixed in a grid pattern of maximum 1.5 m centre to centre over the whole raft, prior to casting of RCC raft. similar nozzles will also be placed along the construction joint, if any, at regular intervals not exceeding 1.5 m c/c. Adequate precaution shall be taken to keep the nozzles plugged at both ends to prevent them from getting clogged by concrete. Similar nozzles shall also be post fixed at critical points, if required. Approved super plasticiser-cum-cement waterproofer shall be added to the concrete which shall be at least M20 grade as defined by IS : 456 and the water cement ratio of the concrete shall not exceed 0.45. Adequate precaution shall be taken to keep the nozzles vertical while concreting.

Approved non-shrink polymeric waterproof grouting compound mixed with cement slurry shall be injected through the nozzles under pressure by pump as per the instructions of the manufacturer. When the injection operation is over the nozzles shall be sealed with a sealing compound as per manufacturer's specification and instruction.

15.12.3.2 Vertical wall

15 mm dia threaded nozzle of suitable lengths shall be placed and fixed in a grid pattern of maximum 1.5 m centre to centre over the entire surface prior to concreting of the vertical wall. Similar nozzle are to be also fixed at construction joints, if any, y, at regular intervals not exceeding 1.5 m c/c. Adequate precaution shall be taken to keep the nozzles plugged at both the ends to avoid clogging of the nozzles by concrete. Similar nozzles shall also be post fixed at critical points, if required.

The concrete for the vertical wall shall be at least M20 grade as defined by IS:456 having a maximum water cement ratio of 0.45. Approved super plasticiser-cum-cement waterproofer shall be added to the concrete as per the manufacturer's specification. Adequate precaution shall be taken to keep the nozzles horizontal during concreting. The exterior surface of the concrete shall be plastered with 12 mm thick cement sand mortar (1:3) mixed with approved cement waterproofing compound conforming to manufacturer's specification. The plastered surface shall then be finished smooth with a neat coat of cement slurry and painted with two coats of approved solventless resin to form a thick resilient and flexible resinous membrane over the plastered surface. Approved non-shrink polymeric waterproof grouting compound mixed with cement slurry shall be injected through the nozzles under pressure by pump as per the manufacturer's specification and shall be sealed with a sealing compound as per manufacturer's specification and instruction.

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16.0 MISCELLANEOUS

16.1 False ceiling

16.1.1 Scope

This chapter deals with the specification for various types of false ceiling as listed below :

- a) Wooden ceiling (solid wood) and decorative ply.
- b) Ceiling with insulating Building Board/Particle Boards etc.,
- c) A.C. Sheet and ply wood ceiling.
- d) Plaster of Paris (Gypsum Anhydrous) ceiling over wooden frame.
- e) Plaster of paris (Gypsum Anhydrous) Tiles ceiling.
- f) Wooden cover, fillets, beading for ceiling.

16.1.2 General

16.1.2.1 Materials

All materials shall be in accordance with the general specifications of materials, Part-I, Schedule of items and as shown in drawings.

Special finishing materials as specified in schedule of item shall be procured from the specified source and got fixed by employing skilled worker in the trade under direct supervision of the manufacturer.

16.1.3 Openings for installation of light fittings

Openings in the ceiling for installation of A/C grills, light fittings shall be provided as per drawings.



16.1.4 Recess for pelmet

Recess for the installation of pelmets shall be provided where shown in drawings along the windows/ doors.

16.1.5 Grills

Grills made of wooden, M.S., Aluminium, PVC or any other material as necessary shall be provided as indicated in the drawing.

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16.1.6 Frame work

The type of frame to receive the ceiling material may be of wood, aluminium or M.S. as specified in the schedule of item and as mentioned in the drawing.

16.1.7 Wooden framing for false ceiling

Unless otherwise specified in schedule of items the wooden frame work shall be of following description :

The frame work for false ceiling shall be of approved quality teak wood scantlings, the runners shall be 75 x 50 mm size and shall be spaced at 1200 mm c/c and the battens shall be 50 x 50 mm size spaced at 600 mm c/c (approx) forming a grid of 600 x 600 mm or any other grid suitable for fixing the false ceiling material and its size. The runner and battens shall be joined by halving joint using counter sunk 6 mm bolt with washer of required length with soffit of runner and batten in perfect level. The heading joints between runners shall be made with lap joints using 2 nos. 6 mm dia counter sunk bolts with washer. Heading lap joints between battens shall be made with suitable size screws. The wall ends of the runner shall be embedded in the wall (50 mm deep) and shall be grouted with 1:2:4 cement concrete. The soffit of framework shall be made perfectly horizontal. The teak wood frames shall be treated with 2 coats of wood preservations treatment before fixing the tiles/boards as the case may be.

The main runners of frames shall be suspended by M.S. flat 40 x 3 mm /12mm dia M.S. round/T.S. hangers placed at 1200 mm c/c (approx), the top end of the hangers shall be hocked to R.C.C. reinforcement of slab or fixed to M.S. flat cleats installed in slab for the purpose or hooked to purlins of the trusses. The hangers may be twisted or ends of M.S. round/T.S. hanger flattened to allow for fixing the same with T.W. frame or M.S. cleats with bolts of suitable size.



For teak wood framings of shaped ceilings the spacings of frames and hangers levels of false ceiling etc., shall be required to obtain the shapes/drops and profile of the ceiling and to the requirement of ceiling material. The frames shall be locally adjusted to create openings of required sizes for installation of light fittings, grills of air conditioning system.

16.1.8 Metal framing

16.1.8.1 Galvanised pressed steel framing system

Galvanised pressed steel framing system for false ceiling shall be procured from reputed manufacturer and installed by specialist agencies under technical guidance of the manufacturer and strictly as per their specifications. Unless specified otherwise these shall consist of G.I. rectangular pipes at 900 mm c/c suspended by M.S. hanger fixed to R.C.C. slab with M.S. cleats and cross channels fixed to rectangular pipes at 450 mm c/c as per "Galvolock"

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system of M/s Eastern Interior Pvt Limited or equivalent. Ceiling materials shall be fixed to cross channels as per specifications of the manufacturer.

Framing shall be adjusted to provide openings for the light fittings and air-conditioning grills but these shall be supported independently and not on the framing.

16.1.8.2 Aluminium grid ceiling framing system

Framing for Aluminium grid false ceiling system shall be of reputed manufacturer Bestlok, Eezilock or equivalent. It shall consist of aluminium main tee and cross tee's suspended by adjustable hangers fixed to R.C.C. floor with cleats. The grid may be 600 x 600 mm, 1200 x 600 mm or as per drawings. Ceiling materials, shall be fixed to frames strictly as per manufacturers specification.

16.1.9 Fixing of Ceiling

16.1.9.1 Wooden ceiling with planks

These shall be of class of wood and thickness as specified in Schedule of items. Unless specified otherwise the width of the ceiling board shall be 100 mm to 150 mm and shall be planed true on the exposed surface. The maximum length of the finished board shall be 1800 mm. The boards/strips shall be joined with tongue and groove joints and heading joints in adjacent board of the same strip shall be square butt type neatly finished. These joints shall be staggered in alternate strip or line. The boards shall be fixed to T.W. battens by headless brass pins. Moulding beads at junctions with walls and other locations as per drawings shall be provided. Necessary opening for installation of light fittings and A/C grill shall be provided and junctions if required shall be finished with moulded beads.



The false ceiling shall finally be checked for line and level, sand papered and polished with colourless polish to achieve matt satin natural finish.

16.1.9.2 Decorative ply ceiling

These shall be with decorative selected group matched ply of Teak Ply, white cedar ply or any other approved class of veneer ply in strips, square or rectangular panel matching the ply of wall panelling, if any, in the same room and of thickness as per schedule of item and drawings. The strip ply, square/rectangular panels shall be fixed to T.W. framework with panel pins. Moulded beads of same wood as that of ply of matching shade shall be provided at junctions with walls and as specified in drawings.

Where specific pattern of grains and shade is required the ply cut into shapes as per design may be pasted on a backing ply with adhesive and such made panels shall be fixed to framing.

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The ceiling shall be checked for line, and levels and exposed surfaces shall be sand papered and finally polished with colourless polish to achieve matt satin natural finish.

16.1.9.3 Ceiling with insulation board/particle boards

Insulation boards shall be of approved manufacturer, shade, design and thickness as specified in schedule of items and drawings. These may be plain, textured, perforated with natural finish or with white finished surface.

The boards shall be cut to suit the panel sizes of ceiling with special tools and by skilled workmen strictly as per manufacturers specifications. The board shall be fixed to T.W. frames with brass screws or as per manufacturers recommendation and in case of metal frames as per recommendations of the manufacturer of the ceiling system. The joints where exposed shall be of uniform thickness (3 mm to 6 mm) and pattern as shown in drawings.

The ceiling shall be checked for line and level and exposed surfaces prepared appropriately to receive the paint as specified in schedule of item and drawing.



16.2. Wooden partitions

16.2.1 Scope

All materials for the wooden partitions shall be of respective class as specified in the part (I) and as mentioned in schedule of items.

16.2.1.2 Frame work

Unless otherwise specified in the schedule of items, framing for partitions shall be made of approved quality teak wood scantlings of sizes as mentioned in schedule of items and drawing. The spacing of frames shall not exceed 1200 mm c/c in both direction. The joints of the frame shall be made as per standard joinery practice using standard adhesive as described in wood work chapter. The faces of the frames to receive ply/wooden board shall be true to line, level and plumb. The frames shall be firmly secured to walls, ceilings, floors by making chases and grouting the frames in 1:2:4 cement concrete or fixing the frames with metal clamps/flats screwed to above elements. The frame shall be treated with 2 coats of wood preservative. Where the panelling material is of decorative ply of 3.5 mm to 4 mm thickness, commercial ply of 6 mm thickness shall be fixed to the frame work for backing purpose. Where sunk (coffered) panels are to be made, combination of single and double layers ply shall be used for backing to achieve level difference for sunk panels.

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16.2.3 Boarding/facing for partition

a) Wooden plank/board

These shall be of class of wood and thickness as specified in the schedule of item and drawings. These shall be fixed to backing wooden frame work with counter sunk brass screws in pattern and designs, with groves, joints, beads, fillets, cover moulds as shown in drawings. The exposed surfaces shall be sand papered and polished as specified.

b) Decorative ply wood facing

These shall be with decorative teak wood/rose ply/white cedar 3.5 to 4 mm thickness of selected pieces with matching colour, texture and grains and shall be fixed to the backing ply with panel pins in pattern, design, with uniform width of joints, beads, fillets, cover mould as shown in drawings. The exposed surfaces shall be lightly sand papered finished with colourless polish to achieve matt satin finish.

c) Jolly pan (laminated) board

Where specified Jolly pan boards shall be fixed to teak wood frame work strictly as per manufacturer's specification. The boards after fixing shall be cleaned of all adhesives etc.

d) Formica facing

Formica facing shall be fixed to the backing ply with standard adhesive as described for panelling works.



16.3 Expansion and Isolation Joints

16.3.1 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 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 Bidder to supply the material, the Engineer may demand test certificates for the materials and/or instruct the Bidder 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, for the method of forming the joints, should be obtained from the Engineer before starting the work.

16.3.2 Bitumen impregnated board

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Bitumen impregnated fibre board of approved manufacturer as per IS: 1838 (Part 1) 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. 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.

16.3.3 Joint sealing strips

16.3.3.1 General

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. The sealing strips will be either metallic like G.I., Aluminium 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 jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Engineer. If desired by the Engineer, joints in rubber seals may have to be vulcanised.



16.3.3.2 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 and schedule of items and/or as instructed by the Engineer.

The transverse joints will be gas welded using brass rods and approved flux. In case it is found that the joints cannot be made leak proof, longer lap lengths and different method of brazing which will render it leak proof, will be adopted by the Bidder without any additional cost to the Owner. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

a) G.I. Strips

G.I. strips shall be minimum 1.5 mm thick and 150 mm in width unless specified otherwise. The Strips shall be strong, durable, without any rust or crease. At the joints, the overlapping should be for a minimum length of 50mm

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b) Aluminium strips

Aluminium strips shall be minimum 18 SWG thick and 300 mm wide unless specified otherwise and shall conform to IS : 737. A minimum lap of 50 mm length is required at the joints.

c) Copper strips

The copper strips shall be minimum 18 SWG in thickness and 300 mm width.

It should be cleaned thoroughly before use so as to expose fresh surface, without any reduction in gauge. A minimum lap of 50 mm in length is required at the joints.

16.3.3.3 Non-metallic sealing strips

These will be normally in Rubber or PVC Rubber or PVC joint seals can be of shape having any combination of the following features :

- a) Plain
- b) Central bulb
- c) Dumb-bell or flattened ends
- d) Ribbed and corrugated wings
- e) V-shaped

Transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer. The actual size and shape shall be as shown in drawings/Schedule of Items and or as directed by 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 and the edges accurately.



a) Rubber sealing strips

The minimum thickness of rubber sealing strips shall be 3 mm and the minimum width 100 mm. The material will be natural rubber and be resistant to corrosion, abrasion and attacks from the acids, alkalis and chemicals normally encountered in service. The physical properties will be generally as follows :

Specific Gravity : 1.1 to 1.15

Shore Hardness : 65A to 75A

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Tensile Strength : 25 - 30 N/mm²

Maximum Safe Continuous
Temperature : 75 Degree '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 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 :

Specific Gravity : 1.3 to 1.35

Shore Hardness : 60A to 80A

Tensile Strength : 10 - 15 N/mm²

Maximum Safe Continuous Temperature : 70 Degree 'C'

Ultimate Elongation : Not less than 275%

16.3.4 Bitumen compound

When 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.

16.4 Barbed Wire Fencing

16.4.1 Materials



16.4.1.1 Galvanised barbed wire

Barbed wire shall be properly galvanised and shall be obtained from the approved manufacturer as specified in detail in Part-1.

16.4.1.2 Other materials

The specifications of materials, for angle iron posts, concrete works, plasters, if any, and for other works, shall conform to the requirements as specified in Part-I.

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16.4.2 Workmanship

The work shall comprise of the following :

- a) Excavation in ground of required dimensions with all sides vertical in any type of soil including soft rock and removing the soil and dressing it neatly.
- b) Filling the holes in full with cement concrete 1:3:6 mix, well packed, after erecting the posts in correct line, level and plumb. In case of any post coming at local depression, the hole may not be of full depth but the depth of concrete will always be made 60 cm raising it above ground level with necessary shuttering.
- c) Where the angle iron posts are specified in the item these shall be 50 mm x 75 mm x 6 mm unless mentioned otherwise. 10 mm dia holes with saw cuts for inserting the wires shall be made as per the spacings of barbed wire shown in drawing or as directed by the Engineer. The foot of the post shall be provided with base plate for anchorage. The spacing shall be 2.5 m or as per drawing. After inserting the wire into holes the socket is to be pressed back.
- d) Straining bolts are to be provided 15 m apart from each row of wire for maintaining proper tension in the wire and without any sag or looseness.
- e) Posts are to be painted as directed by the Engineer.



16.5 Chain link fencing

16.5.1 Scope

The work under this specification covers the supply and fixing of galvanised steel chain link fencing with galvanised steel posts chain link fabric.



16.5.2 Material

Galvanised steel chain link fabric and galvanised steel pipe posts shall be obtained from the approved manufacturer as specified in detail in Part - I .

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16.5.3 Workmanship

The GI pipe posts shall be embedded in plain cement concrete not leaner than 1:4:8 foundations. The height of posts above top of foundations and spacing of post shall not be more than 3 m. The chain link fabric shall be fixed to the fencing posts with the help of stretcher galvanised bars (25 x 6 flats) which will be bolted to the lugs welded to the posts. The stretcher bars shall be provided in the lapping of fabric also.

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PART III (NORMS OF CEMENT CONSUMPTION)
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1. MASONRY WORK
2. PLAIN/REINFORCED CONCRETE WORK
3. FINISHING WORK
4. FLOORING WORK
5. MISCELLANEOUS ITEMS
6. WATER SUPPLY/DRAINAGE & SANITARY WORKS

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PART- III (NORMS OF CEMENT CONSUMPTION)

GENERAL



For calculating the requirements of cement in various items of work the following standards will be adopted.

For items not covered in this standard, CPWD standards shall be followed or calculated as per uses/requirement in absence of standard norms. If the actual consumption of cement exceed the quantities given in the subsequent pages, no additional payment will be made for the extra quantities of cement consumed. The wastage as per standard practice shall also be considered by the bidder which quoting cost for civil work.

MASONRY WORK

1 Quintal=100kg

Sl.No.	Description of Item		Cement Requirement
1.	Random rubble masonry with	CM 1:4	1.255 quintals per cum
2.	Random rubble masonry with	CM 1:6	0.825 quintal per cum
3.	Coursed rubble masonry in	CM 1:6	0.75 quintal per cum
4.	Brick work in	CM 1:4	0.950 quintal per cum of BW
5.	Brick work in	CM 1:6	0.625 quintal per cum of BW
6.	Half brick work in	CM 1:3	1.43 quintals per 10 sqm of area
7.	Half brick work in	CM 1:4	1.06 quintals per 10 sqm of area
8.	75mm thick brick in	CM 1:4	0.65 quintal per 10 sqm of area
9.	75mm thick brick in	CM 1:3	0.81 quintal per 10 sqm of area
10.	Projected brick bands, Drip course etc. in CM 1:6 finished with 12mm thick cement plaster		0.165 quintal per 10 RM
11.	Half brick thick, Honey combed brick work in	CM 1:4	0.064 quintals per sqm



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PLAIN/REINFORCED CONCRETE

- | | | |
|----|--|-----------------------------------|
| 1. | PCC of nominal mix 1:5:10 complete
(excluding finishing with CP) | 1.30 quintals per cum of concrete |
| 2. | PCC of nominal mix 1:4:8 complete
(excluding finishing with CP) | 1.70 quintals per cum of concrete |
| 3. | PCC of nominal mix 1:3:6 complete
(excluding finishing with CP) | 2.23 quintals per cum of concrete |
| 4. | RCC/PCC of nominal mix 1:2:4 complete
(excluding finishing with CP) | 3.18 quintals per cum of concrete |
| 5. | RCC/PCC of nominal mix 1:1.5:3 complete
(excluding finishing with CP) | 4.00 quintals per cum of concrete |

Controlled Concrete - Plain and Reinforced

- | | | | |
|------|----------------|--|--|
| 7. | Concrete grade | (i) M -5A
(ii) M -5B
(iii) M -7.5A
(iv) M -7.5B | Volumetric |
| 8. | Concrete grade | (i) M -10A
(ii) M -10B
(iii) M -10C | Volumetric |
| 9. | Concrete grade | (i) M -15B
(ii) M -15C
(iii) M -15D | To be mutually agreed
based on |
| 10. | Concrete grade | (i) M -20B
(ii) M -20C
(iii) M -20D | mix design to be prepared
by bidder & approved by the
Engineer |
| 11.. | Concrete grade | (i) M -25B
(ii) M -25C
(iii) M -25D | plus
wastage and all incidentals
as decided. However the
minimum cement content
shall be followed. |
| 12. | Concrete grade | (i) M -30C
(ii) M -30D | |

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13. Applying cement slurry on RCC slab for receiving cement concrete flooring.



2.75 kg/sqm

FINISHING



1.	6mm thick C.P. 1:4	0.280 quintal per	10 sqm area
2.	10mm thick C.P. 1:5	0.370 quintal per	10 sqm area
3.	10mm thick C.P. 1:4	0.430 quintal per	10 sqm area
4.	10mm thick C.P. 1:6	0.300 quintal per	10 sqm area
5.	12mm thick C.P. 1:3	0.734 quintal per	10 sqm area
6.	12mm thick C.P. 1:4	0.547 quintal per	10 sqm area
7.	12mm thick C.P. 1:6	0.360 quintal per	10 sqm area
8.	15mm thick C.P. 1:4	0.655 quintal per	10 sqm area
9.	15mm thick C.P. 1:6	0.440 quintal per	10 sqm area
10.	20mm thick C.P. 1:4	0.850 quintal per	10 sqm area
11.	20mm thick C.P. 1:6	0.560 quintal per	10 sqm area
12.	12mm thick bearing plaster in CM 1:4 with neat cement finish	0.767 quintal per	10 sqm area
13.	Neat cement punning	0.220 quintal per	10 sqm area
14.	Flush or ruled or cut or weather pointing on brick work with CM 1:3	0.155 quintal per	10 sqm area
15.	Flush or ruled or cut out or weather pointing on brick work with CM 1:2	0.200 quintal per	10 sqm area
16.	Raised and cut pointing on brick work with cement mortar 1:3	0.204 quintal per	10 sqm area
17.	Flush or ruled pointing on brick flooring with cement mortar 1:4	0.075 quintal per	10 sqm area
18.	Flush or ruled pointing on brick flooring with cement mortar 1:6	0.050 quintal per	10 sqm area

FLOORING

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- | | | | |
|----|--|-------------------|-------------|
| 1. | Brick on edge flooring in cement mortar 1:4 | 1.100 quintal per | 10 sqm area |
| 2. | Brick on edge flooring in cement mortar 1:6 | 0.800 quintal per | 10 sqm area |
| 3. | 25mm thick (IPS) cement concrete flooring 1:2:4 (1 cement : 2 sand : 4 graded stone chips 12mm nominal size) finished with a floating coat of neat cement. | 1.020 quintal per | 10 sqm area |
| 4. | 40mm thick (IPS) cement concrete flooring 1:2:4 with 20mm and down stone chips finished with a floating coat of neat cement. | 1.700 quintal per | 10 sqm area |
| 5. | 25mm thick (IPS) flooring with base coat 19mm thick 1:2:4 using stone chips 10mm nominal size and 6mm topping coat 1:1 (1 cement : 1 stone chips 3mm size) with a floating coat of neat cement. | 1.370 quintal per | 10 sqm area |
| 6. | 40mm thick (IPS) flooring with base coat 30mm thick 1:2:4 using stone chips 10mm nominal size and 10mm topping coat 1:1 (1 cement : 1 stone chips 3 to 6mm size) with a floating coat of neat cement. | 2.320 quintal per | 10 sqm area |
| 7. | 25mm thick cast-in-situ grey terrazzo flooring, under layer 19mm thick cement concrete 1:2:4 with 10mm nominal size chips and 6mm thick topping laid in cement marble powder mix 3:1 (3 cement : 1 marble powder) by weight in proportion of 4:7 (4 cement marble powder mix : 7 marble chips) by volume. | 1.370 quintal per | 10 sqm area |
| 8. | 40mm thick cast-in-situ grey terrazzo flooring, under layer 30mm thick cement concrete 1:2:4 with 10mm nominal size chips and 10mm thick topping laid in cement marble powder mix 3:1 (3 cement : 1 marble powder) by weight in proportion of 4:7 (4 cement marble powder mix : 7 marble chips) by volume. | | |



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9.	40mm thick cast-in-situ terrazzo flooring, under layer 31mm thick cement concrete 1:2:4 with 10mm nominal size chips and top layer 9mm thick with marble chips of size 4 to 7mm nominal size laid in cement marble powder mix 3:1 (3 cement : 1 marble powder) by weight in proportion of 4:7 (4 cement marble powder mix : 7 marble chips) by volume.	1.575 quintal per 10 sqm area
a)	Dark or light shade pigment with grey cement	1.583 quintal per 10 sqm area
b)	Light shade pigment or without any (grey cement) pigment with white cement	1.010 quintal per (grey cement) 10 sqm area
		0.580 quintal per (white cement) 10 sqm area
c)	Medium shade pigment with 50% grey cement and 50% white cement	1.295 quintal per (grey cement) 10 sqm area
		0.290 quintal per (white cement) 10 sqm area
10.	40mm thick cast-in-situ terrazzo flooring, under layer 28mm thick cement concrete 1:2:4 with 10mm nominal size chips and top layer 12mm thick with marble chips of size 7 to 12mm nominal size laid in cement marble powder mix 3:1 (3 cement : 1 marble powder) by weight in proportion of 2:3 (2 cement marble powder mix : 3 marble chips) by volume.	
a)	Dark or light shade pigment with grey cement	1.705 quintal per 10 sqm area
b)	Light shade pigment or without any (grey cement) pigment with white cement	0.895 quintal per (grey cement) 10 sqm area
		0.810 quintal per (white cement) 10 sqm area
c)	Medium shade pigment with 50% grey cement and 50% white cement	1.300 quintal per (grey cement) 10 sqm area
		0.405 quintal per (white cement) 10 sqm area

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- d) White cement without any pigment 0.895 quintal per (grey cement) 10 sqm area
0.810 quintal per (white cement) 10 sqm area
11. Terrazzo cast-in-situ skirting and dado, top layer 6mm thick marble chips laid in cement marble powder mix 3:1 (3 cement : 1 marble powder) by weight in proportion of 4:7 (4 cement marble : 7 marble chips) by volume.
- (A) 18mm thick with under layer 12mm thick cement plaster 1:3
- a) Dark or light shade pigment with grey cement 1.490 quintal per 10 sqm area
- b) Light shade pigment or without any pigment with white cement. 1.090 quintal per (grey cement) 10 sqm area
0.400 quintal per (white cement) 10 sqm area
- c) Medium shade pigment with 50% grey cement and 50% white cement 1.290 quintal per (grey cement) 10 sqm area
0.200 quintal per (white cement) 10 sqm area
- (B) 21mm thick, with under layer 15mm thick cement plaster 1:3
- a) Dark or light shade pigment with grey cement 1.640 quintal per 10 sqm area
- b) Light shade pigment or without any pigment with white cement. 1.230 quintal per (grey cement) 10 sqm area
0.400 quintal per (white cement) 10 sqm area
- c) Medium shade pigment with 50% grey cement and 50% white cement 1.430 quintal per (grey cement) 10 sqm area
0.200 quintal per (white cement) 10 sqm area
12. Precast terrazzo tiles 20mm thick with marble chips of sizes upto 6mm laid in

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25mm thick bed of lime mortar, jointed with neat cement slurry mixed with pigment

- | | | | |
|----|---|------------------------------------|-------------|
| a) | Dark shades using grey cement | 0.88 quintal per | 10 sqm area |
| b) | Light shade using white cement. | 0.44 quintal per
(grey cement) | 10 sqm area |
| | | 0.44 quintal per
(white cement) | 10 sqm area |
| c) | Medium shade using 50% grey cement and 50% white cement | 0.66 quintal per
(grey cement) | 10 sqm area |
| | | 0.22 quintal per
(white cement) | 10 sqm area |
13. Precast terrazzo tiles 20mm thick with marble chips of sizes upto 6mm in skirting or on walls, laid on 12mm thick cement plaster 1:3 jointed with neat cement slurry
- | | | | |
|----|---|------------------------------------|-------------|
| a) | Dark shades using grey cement | 1.395 quintal per | 10 sqm area |
| b) | Light shade using white cement. | 1.175 quintal per
(grey cement) | 10 sqm area |
| | | 0.22 quintal per
(white cement) | 10 sqm area |
| c) | Medium shade using 50% grey cement and 50% white cement | 1.285 quintal per
(grey cement) | 10 sqm area |
| | | 0.11 quintal per
(white cement) | 10 sqm area |
14. White glazed tiles 5, 6 or 7 mm thick in flooring, skirting and dado on 12 mm thick cement plaster 1 : 3 in base and joined with white cement, slurry etc.
- | | | | |
|--|--|------------------------------------|-------------|
| | | 0.942 quintal per
(grey cement) | 10 sqm area |
| | | 0.25 quintal per
(white cement) | 10 sqm area |
15. Marble stone slab flooring over 20mm thick base of lime mortar 1:1:1 (1 lime : 1 surkhi : 1 sand) and jointed with white cement slurry etc.
- | | | | |
|----|---|-------------------------------------|-------------|
| a) | 20 mm thick / 30 mm thick / 40 mm thick | 0.075 quintal per
(white cement) | 10 sqm area |
|----|---|-------------------------------------|-------------|
16. Marble stone slab flooring over 20mm thick base of cement mortar 1:4 & jointed

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with white cement slurry etc.



a) 20 mm thick	1.275 quintal per (grey cement) 0.075 quintal per (white cement)	10 sqm area 10 sqm area
b) 30 mm thick	1.290 quintal per (grey cement) 0.075 quintal per (white cement)	10 sqm area 10 sqm area
c) 40 mm thick	1.310 quintal per (grey cement) 0.075 quintal per (white cement)	10 sqm area 10 sqm area
17. Marble tiles 18 to 24 mm thick in risers of steps, skirting, dado, walls and pillars laid on 12mm thick cement mortar 1:3 (1 cement : 3 sand) and jointed with white cement slurry	1.16 quintal per (grey cement) 0.075 quintal per (white cement)	10 sqm area 10 sqm area
18. Extra for each additional thickness of 5 mm granolithic layer of 1:2:4 for flooring	0.016 quintal per	10 sqm of area
19 12mm thick cement plaster skirting, dado risers of steps and edges of ground sink with CM 1:3 finished with a floating coat of neat cement.	0.800 quintal per	10 sqm of area
20 15mm thick cement plaster skirting, dado risers of steps and edges of ground sink with CM 1:3 finished with a floating coat of neat cement.	0.995 quintal per	10 sqm of area
21. 19mm thick cement plaster skirting and dado with 12mm thick backing with CM 1:3 and 7mm topping 1:1 (1 cement : 1 stone chips 3mm size) finished with a floating coat of neat cement.	1.35 quintal per	10 sqm of area
22. 25mm thick cement plaster skirting and dado with 18mm thick backing with CM 1:3 and 7mm topping 1:1 (1 cement : 1 stone chips 3mm size) finished with a floating		

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coat of neat cement.	1.85 quintal per	10 sqm of area
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MISCELLANEOUS

- | | | |
|--|---|----------------------------------|
| 1. Marble work for wall lining (Veneer work) 1.8 to 2.4 cm thick in CM 1:3 including pointing with white cement mortar 1:2 (1 white cement : 2 marble dust) | 0.715 quintal per (grey cement)
0.170 quintal per (white cement) | 10 sqm of area
10 sqm of area |
| 2. Marble work for wall lining (Veneer work) 4 cm thick in CM 1:3 including pointing with white cement mortar 1:2 (1 white cement : 2 marble dust) | 1.020 quintal per (grey cement)
0.170 quintal per (white cement) | 10 sqm of area
10 sqm of area |
| 3. Grading roof for water proofing treatment with :- | | |
| a) CC 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 20mm nominal size) | 3.2 quintal per | cum of Concrete |
| b) CM 1:3 | 5.1 quintal per | cum of mortar |
| c) CM 1:4 | 3.8 quintal per | cum of mortar |
| 4. Providing and fixing MS fan clamps of standard shape and size in existing RCC slab including cutting chase and making good. | 0.016 quintal | each |
| 5. Making plinth protection 50mm thick of CC 1:3:6 (1 cement : 3 sand : 6 graded stone aggregate 20mm nominal size) over 75mm bed of dry brick ballast 40mm nominal size well rammed and consolidated and grouted with fine sand including finishing the top smooth. | 1.1 quintal per | 10 sqm of area |
| 6. Grouting with | | |
| a) CM 1:2 | 7.18 quintal per | cum |
| b) CM 1:3 | 5.40 quintal per | cum |



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7.	DPC 25mm thick (1:2:4)	0.81 quintal per	10 sqm of area
8.	Making plinth protection with bricks on edge in CM 1:6 over 7.5cm bed of dry brick aggregate 40mm nominal size rammed, consolidated and grouted with fine sand and top of bricks pointed with CM 1:2.	0.86 quintal per	10 sqm of area
9.	Providing and fixing 25mm dia GI pipe outlet in CM 1:3 including cutting and making good the walls.	0.05 quintal per	10 RM
10.	Providing and fixing 40mm dia GI pipe outlet in CM 1:3 including cutting and making good the walls.	0.075 quintal per	10 RM
11.	Providing chases 75mm wide 50mm deep in walls for conduit pipe and filling the same with CC 1:3:6	0.075 quintal per	10 RM
12.	Fixing steel windows with 1:2:4 concrete blocks	0.40 quintal per	10 sqm of area
13.	Cement-sand mortar :		
	a) 1:1(1cement :1sand)	10.2 quintals per	cum
	b) 1:2(1cement : 2sand)	6.8 quintals per	cum
	c) 1:3(1cement : 3sand)	5.1 quintals per	cum
	d) 1:4(1cement : 4sand)	3.8 quintals per	cum
	e) 1:5(1cement : 5sand)	3.1 quintals per	cum
	f) 1:6(1cement : 6sand)	2.5 quintals per	cum



DRAINAGE/SANITARY & WATER SUPPLY INSTALLATIONS

1.	100mm dia AC rain water pipe l/c fittings with CM 1:2	0.725 quintal per	100 RM of pipe
2.	150mm dia AC rain water pipe l/c fittings with CM 1:2	0.82 quintal per	100 RM of pipe
3.	Fixing IWC pan with traps, pair of		



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	footrests, and flushing cistern complete	0.125 quintal	each
4.	Fixing EWC pan with trap and flushing cistern complete	0.01 quintal	each
5.	Fixing wash basin and kitchen sink	0.025 quintal	1 each
6.	Fixing urinal cistern including pipes	0.025 quintal	each
7.	Fixing & finishing floor trap	0.015 quintal	each
8.	Fixing HCl pipes and specials, 100mm dia and 75mm dia including making good the walls	0.135 quintal per	10 RM of pipe
9.	Fixing GI pipes of all dia with clamps (for inside work only)	0.015 quintal per	10 RM of pipe
10.	Jointing glazed stoneware pipe with CM 1:1		
	a) 100 mm dia	2.17 quintals per	10 RM of pipe
	b) 150 mm dia	3.23 quintals per	10 RM of pipe
11.	Laying cement concrete 1:5:10 all round SW pipe including bed concrete as per standard design		
	a) 100mm dia SW pipe	19.24 quintals per	100 RM of pipe
	b) 150mm dia SW pipe	23.53 quintals per	100 RM of pipe
12.	Gully chamber as per specification.	0.385 quintal	each
13.	Stopcock chamber as per specification	0.185 quintal	each
14.	Inspection chambers as per specification		
	a) 600x600x600mm deep	1.43 quintals	each
	b) 750x600x600mm deep	1.435 quintals	each
	c) 900x900x600mm deep	1.885 quintals	each



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15. Extra depth of inspection chambers as per specification
- | | | | |
|----|------------|-------------------|-------------|
| a) | 600x600mm | 0.805 quintal per | RM of depth |
| b) | 750x600mm | 1.295 quintal per | RM of depth |
| c) | 900x900mm | 1.460 quintal per | RM of depth |
| d) | 1200x900mm | 1.835 quintal per | RM of depth |

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- 3.0 Stones
- 4.0 Pipes & Fittings
- 5.0 Tiles
- 6.0 Doors, Windows Shutters & Ventilators
- 7.0 Mild steel tubes, tubulars and other wrought steel fittings
- 8.0 Earth Work
- 9.0 Concrete & Reinforced concrete
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- 12.0 Reinforcement
- 13.0 Anchor Bolts
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PART IV (DIMENSIONAL TOLERANCE)



GENERAL

The materials used in construction shall, besides conforming to the specifications and standards mentioned, be the best of the existing kinds obtainable. Where a particular 'Brand' or 'Make' of material is specified such 'Brand' or 'Make' of material alone shall be used.



A high standard of workmanship and accuracy shall be achieved in all sections and parts of the work. The workmanship shall be in accordance with the latest and the best civil engineering practice.

The Bidder shall ensure that all sections of the work are carried out with utmost care to achieve the dimensions shown in drawings or specifications. Where special and close tolerances are required in any particular section of work, these will be shown in the drawing and such tolerances shall be met. In the absence of such specific mention in drawings the following dimensional deviations may be tolerated, provided they do not impair the appearance or render the particular section of work unacceptable to the purpose for which it is intended. Tolerance for materials and workmanship not covered in this part as mentioned hereinafter will be in accordance with the relevant IS code.

Description	Permissible tolerance
Building bricks , in length width and height	: As per IS 1077
Laterite stone , in length, width & height	: Plus or minus 5 mm
<u>Natural building stone</u>	
a) For stones required in ashlar masonry :	
Length & Breadth	: Plus or minus 5mm
Height	: Plus or minus 3mm
b) For stones required other than in ashlar masonry :	
Length & Breadth	: Plus 5mm, minus 10mm
Height	: Plus 5mm, minus 5mm
Concrete and reinforced concrete pipes : Length	: Plus or minus 1% of standard length
Internal diameter, upto 300 mm	: Plus 3 mm Minus 1.5 mm
<u>Cast iron spigot & socket pipes and fittings :</u>	
Length of fittings	: Plus or minus 10mm

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Description	Permissible tolerance
Length of pipe	: Plus or minus 20mm
Thickness	: minus 1 mm
Internal dia of socket	: Plus or minus 3 mm
Depth of socket	: Plus or minus 10mm
External dia, upto 75 mm	: Plus or minus 3mm
100 mm	: Plus or minus 3.5mm
150 mm	: Plus or minus 4mm
<u>Stoneware pipes, in length</u>	
upto 75 cm	: Plus or minus 10mm
Upto 90 cm	: Plus or minus 15mm
In thickness of barrel and socket not exceeding 450mm	: Plus or minus 2mm
In thickness of barrel and socket between 500 to 600mm	: Plus or minus 3mm
Glazed tiles , length of all 4 sides	: Plus or minus 0.8mm
Individual dimensions and thickness	: Plus or minus 0.5 mm
Metal doors, windows and ventilators - In overall dimension	: Plus or minus 1.5 mm
Wooden doors, windows, ventilators Overall dimension of door, window, ventilators	: Plus or minus 3 mm
All components of shutter except glazing bar	
Width	: Plus or minus 3 mm
Thickness	: Plus or minus 1 mm
Glazing bar, width & thickness	: Plus or minus 1 mm



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Mild steel tubes, tubulars and other wrought steel fittings

- | | | | |
|----|-----------|--|--------------------------------|
| a) | Thickness | | |
| | i) | butt welded light tubes | : Plus not limited minus 8% |
| | | medium and heavy tubes | : plus not limited minus 10% |
| | ii) | seamless tubes | : plus not limited minus 12.5% |
| b) | Weight | | |
| | i) | single tube (irrespective of the quantity) | : + 10% , - 8% |
| | ii) | for quantity of less than 150m of one size | : + 10% , - 8% |
| | iii) | for quantity of 150m and over of one size | : + 4% , - 4% |

Earth work

- | | |
|---|------------------------|
| Finished level of site levelling in hard rock | : Plus or minus 50mm |
| Finished level of site levelling except for hard rock | : Plus or minus 100 mm |
| Level of pits, trenches foundations | : Plus or minus 50mm |

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Concrete & Reinforced concrete

Footings, plan dimension	:	Plus 50 mm Minus 12 mm
Eccentricity	:	0.02 times the dimension of footing in the direction limited to 50 mm
Thickness	:	Plus or minus 0.05 times the specified thickness
Foundations		
Deviation of planes and lines of their intersection from vertical or inclination along full height	:	Plus or minus 20 mm
Deviation of horizontal plane from horizontal line		
for 1 m of the plane in any direction	:	Plus or minus 5mm
for the whole plane	:	Plus or minus 20mm
Sizes of cross section	:	Plus or minus 8mm
Surfaces of inserts to support loads	:	Plus or minus 5mm
Length of elements	:	Plus or minus 20 mm

Equipment foundations :

Top level of bolt	:	Plus 20mm
Top level of foundation before grouting	:	Minus 20mm
Axes of anchor bolts in plan	:	Plus or minus 5mm
Axis of foundation in either direction	:	Plus or minus 10mm
Deviation in vertical line along height	:	Plus or minus 10mm
Sizes of pits in plan	:	Plus or minus 20 mm
Sizes of steps in plan	:	minus 20mm
Levels of steps, benches and pits	:	minus 20mm

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Axes of inserts in plan	:	Plus or minus 10 mm
Basic dimensions in plan	:	Plus or minus 10mm
Deviation of horizontal plan from horizontal line for 1 m of plane in any direction	:	Plus or minus 5mm
for the whole plane	:	Plus or minus 20mm
Local deviations of top surface when checked with a 2 m long straight edge	:	Plus or minus 8mm

Buildings :

Surfaces when checked with a 2 m long straight edge	:	Plus or minus 8mm
Sizes of cross section	:	Plus 8mm Minus 0 mm
Length of elements	:	Plus or minus 20mm
Deviation from horizontal plane, for whole building	:	Plus or minus 10mm
Plumb in verticality	:	1 in 1000 of height
for columns supporting floor beams	:	Plus or minus 10mm
for framed columns linked with crane girders and beams	:	Plus or minus 10mm
Reinforced concrete walls	:	Length : Plus or minus 20mm
Flatness of surface when checked with a 2 m long straight edge	:	Plus or minus 8mm
Level of top surface to support assembled elements	:	Plus or minus 5mm
Deviation in planes and lines of intersection from vertical	:	Plus or minus 15mm
Size of cross section	:	Plus or minus 8mm

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Placing of reinforcement :

Length of bar upto 75 cm long (Other than straight bars)	:	Plus 3 mm Minus 5 mm
75 - 150 cm long	:	Plus 5 mm Minus 10 mm
150 - 250 cm long	:	Plus 6 mm Minus 15 mm
250 cm long and above	:	Plus 7 mm Minus 25 mm
Straight bars, all lengths	:	Plus or minus 25 mm
Spacing of bars	:	Plus or minus 5 mm

Anchor bolts :



Shift in location in plan	:	Plus or minus 5 mm
Same, when bolts are located outside of structural columns	:	Plus or minus 10mm
Top level	:	Plus 20 mm
Threaded length	:	Plus 30 mm

For Walls

For Pillars

Masonry

Width	:	Plus or minus 10 mm	Plus or minus 10 mm
Shift in axes	:	Plus or minus 10 mm	---
Deviation in row from horizontal line for every 10m length	:	Plus or minus 15 mm	---

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Flatness of surface when checked
with a 2 m long straight edge

: Plus or minus 10 Plus or minus 5 mm
mm

Deviation in lines separating
storeys Deviation of surface from
vertical and and at angles and
corners

: Plus or minus 15 Plus or minus 15 mm
mm

for 1 storey

: Plus or minus 10 Plus or minus 10 mm
mm

for whole building

: Plus or minus 30 Plus or minus 30 mm
mm

Dimensions of openings for doors,
windows etc

: Plus 15 mm
Minus 0 mm

Flooring, skirting, dado and
plastering :

Insitu concrete floor : 4 mm

Concrete tile and mosaic, in any 3
m length : 3 mm

in large open area : 15 mm

wall tiling - surface should not vary
from general plane by more than 1
in 200. Marble and such superior
work, in any 2 m length

: 1.5 mm

in any row : 3 mm



Plastered surfaces, flatness when
checked with a 2 m long straight
edge

: 3 mm

Vertical surfaces, upto 1 storey : 5 mm

Over full heights : 10 mm

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Metallic Inserts on assembled components length and width : Plus or minus 3 mm

Road work



The levels of the sub-grade and different pavement courses should not vary from those calculated with reference to the longitudinal and cross-sections of the road as shown on the drawing beyond the tolerance given below :-

Sub-grade	:	plus or minus 25mm
Sub-base	:	plus or minus 20mm
Base	:	plus or minus 15mm
Wearing course	:	plus or minus 6mm

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PART V (METHOD OF MEASUREMENT)
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5.0	MASONRY
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PART VI (SAFETY REQUIREMENTS FOR CONSTRUCTION WORKS)

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1.0	GENERAL
2.0	BLASTING
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4.0	DEMOLITION
5.0	VEHICLE
6.0	SCAFFOLDING, GANGWAYS, LADDERS & SHUTTERING
7.0	MOBILE LIFTING APPLIANCES
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9.0	SAFETY APPLIANCES
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PART VI (SAFETY REQUIREMENTS FOR CONSTRUCTION WORKS)

1.0 GENERAL

This specification deals with the subject matter of safety and protection to be observed in the Civil Construction. This shall be followed along with all related statutory requirements/obligation including Governmental byelaws, codes, ordinance of local or central authorities related to the construction work.



In case of complicated work like deep excavation, intricate shuttering and formwork, excavation in loose soil and below water table, stacking of excavated earth etc., work plan with necessary drawings and documents have to be prepared by the Bidder and got approved by the Engineer.

Necessary reference shall be made to the following Indian Standard Codes on safety requirements for various type of work :

Indian Standard

4081	Blasting & Drilling.
5916	Construction with Hot Bituminous Materials.
4130	Demolition of Buildings.
3764	Excavation Work
5121	Piling & Other Deep Foundations.
4014 - (P-II)	Scaffolding, Steel Tubular.
3696 - (P-I & P-II)	Scaffolds and Ladders.
6922	Structures Subject to Underground Blasts.
4756	Tunneling Work.
5499	Underground Air-raid Shelters in Natural Soil.
4138	Working in Compressed Air.
7293	Working with Construction Machinery
8989	Erection of Concrete Framed Structures.

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2.0 BLASTING

- 2.1 Detonators and other explosive for blasting shall be taken to the blasting area in the original container or any separate non-metal container. This shall not be carried loose or mixed with other materials. Detonators and explosives must be kept separately.
- 2.2 No shot for blasting shall be fired except by persons licensed to do so.
- 2.3 Drilling shall not be resumed after a blast has been fired unless a thorough examination has been made to make sure that there is no unexploded charge.
- 2.4 Before firing a shot, sufficient warnings by means of whistling and/or otherwise shall be given to get men off the danger area. Blasting areas shall be cordoned off & red flags during day time and red lights during night time displayed prominently marking off the cordoned area.
- 2.5 All people except those who have actually to light the fuses must be removed to a safe distance of not less than 200 metres as a rule.
- 2.6 Wherever possible, blasting mats should be used.
- 2.7 Bidders doing blasting work must have licence and an approved magazine to store explosives.
- 2.8 Blasting operations shall be carried out during fixed hours of the day which shall be notified in writing.
- 2.9 Provisions in explosives Rules 1940 as amended from time to time, Indian Explosives Act 1844 (IV of 1884), and others shall be strictly followed.

3.0 EXCAVATIONS

- 3.1 Sides of all excavations must be sloped to a safe angle, not steeper than the angle of repose of the particular soil. If it is not possible to give a proper slope, the sides of the excavation where there is a danger of fall or dislodgement of earth or any material, shall be securely supported by timber or other type of shoring.
- 3.2 No excavation or earth work below the foundation level of an adjoining building shall be taken up unless adequate steps are taken to prevent damage to the existing structure or fall of any part.
- 3.3 Every accessible part of an excavation, pit or opening in the ground into which there is a danger of persons falling shall be suitably fenced with a barrier upto a

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height of one metre suitably placed from the edge of the excavation as far as practicable.

- 3.4 No material or load shall be placed or stacked near the edge of the excavation or opening in the ground. The excavated material shall not be placed within 1.5 m of the trench or half of the depth of the trench whichever is more.
- 3.5 Cutting shall be done from top to bottom. No undercutting of sides of excavation shall be allowed.
- 3.6 All narrow trenches 1.2 m or more depth, shall at all times be supplied with atleast one ladder for each 30m in length or fraction thereof. Ladder shall be extended from bottom of the trench to atleast one metre above the surface of the ground. The side of the trenches which are 1.5 m or more in depth shall be stepped back to give suitable slope, or securely held by planking, strutting and bracing so as to avoid the danger of side collapse.
- 3.7 Materials shall not be dumped against existing walls or partition to a height that may endanger the stability of the walls.
- 3.8 While withdrawing piled materials like loose earth, crushed stone, sand, etc., from the stock piles, no over hanging shall be allowed to be formed in the existing dump.
- 3.9 No material on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or public or any other agency at work.



4.0 DEMOLITION

- 4.1 On every demolition job, danger signs shall be conspicuously posted all round the structure and all doors, openings giving access to the structure shall be kept barricaded or marked except during the actual passage of workmen or equipment. However, provision shall be made for at least two independent exits for escape of workmen during any emergency.
- 4.2 During night, red lights shall be placed on or about all the barricades.
- 4.3 Where in any work of demolition it is imperative, because of danger existing to ensure that no unauthorised person shall enter the site of demolition outside working hours, a watchman should be employed. In addition to watching the site he shall also be responsible for maintaining all notices, lights and barricades.
- 4.4 All the necessary safety appliances as per IS :4130 shall be issued to the workers and their use explained. It shall be ensured that the workers are using all the safety appliances while at work.

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- 4.5 The removal of a member may weaken the side wall of an adjoining structure and to prevent possible damage, these walls shall be supported until such time as permanent protection is provided. In case any danger is anticipated to the adjoining structure the same shall be got vacated to avoid any danger to human life.
- 4.6 The power on all electrical service lines shall be shut off and all such lines cut or disconnected at or outside the property line, before the demolition work is started. Prior to cutting of such lines the necessary approval shall be obtained from the electrical authorities concerned. The only exception will be any power line required for demolition work itself.
- 4.7 All gas, water, steam and other service lines shall be shut off and capped or otherwise controlled at or outside the building line, before demolition work is started.
- 4.8 All the mains and meters of the building shall be removed or protected from damage.
- 4.9 If a structure to be demolished has been partially wrecked by fire, explosion or other catastrophe, the walls and damaged roofs shall be shored or braced suitably.
- 4.10 Walkways and passage ways shall be provided for the use of the workman who shall be instructed to use them and all such walkways and passageways shall be kept adequately lighted, free from debris and other materials.
- 4.11 All nails in any kind of lumber shall be withdrawn, hammered or bent over as soon as such lumber is removed from the structure being demolished, and placed in piles for future cleaning or burning.
- 4.12 All the roads and open area adjacent to the work site shall either be closed or suitably protected.
- 4.13 No electric cable or apparatus which is liable to be a source of danger or a cable or apparatus used by the operator shall remain electricity charged.
- 4.14 All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.

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5.0 VEHICLE

- 5.1 No person shall board any vehicle or equipment when it is in motion.
- 5.2 Suitable blocks shall be placed against the wheels of a vehicle when it is used for tipping materials into excavation or a pit or over the edge of any embankment or earthwork to avoid the danger of its running over the edge.
- 5.3 All workers shall stand clear of the vehicle while it is dumping. If the material being dumped is very heavy or sticky, dump hooks shall be used or dumper shall be clamped to prevent any danger of its tripping.
- 5.4 Materials shall not be allowed to be loaded in a vehicle so as to project horizontally beyond the sides of the body of the vehicle. All materials projecting beyond the front or rear shall be indicated by a red flag in the day and with red light in the night.
- 5.5 Driver of the truck or any heavy vehicle shall not reverse it unless assisted by a signal man who shall have a clear view of the driver and the area beyond the truck during reversing operation.
- 5.6 Maximum speed of a heavy vehicle must not exceed 15 km. per hour.



6.0 SCAFFOLDING, GANGWAYS, LADDERS & SHUTTERING

- 6.1 For all work that cannot be done from the ground level or from part of any permanent structure or from other available means of support, soundly constructed scaffoldings of adequate strength shall be used as a safe means of access to places of work.
- 6.2 All scaffolding shall be securely supported or suspended and wherever necessary be properly braced to ensure stability.
- 6.3 Chains, ropes or other lifting materials used for the suspension of scaffoldings must be of adequate strength and shall be of tested quality.
- 6.4 All such chains and ropes used for the suspension of scaffoldings shall be properly fastened to safe anchorage points.
- 6.5 The platform of a suspended scaffolding shall be sufficiently wide. Suspended scaffolding shall have hand rail on 3 sides of about 1.0 m height.
- 6.6 All working platform and stages from which workers are liable to fall shall be of adequate width depending on the type of work done and closely boarded and planked.



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- 6.7 Scaffolding or staging more than 3.5 m above the ground or floor, suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise secured atleast 1 m high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside ends thereof with only such opening as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure. The platform shall also be provided with toe boards of atleast 150 mm high so placed as to prevent the fall of materials and tools from there.
- 6.8 All platforms or gangways, runways and the stairs shall be kept free from unnecessary obstructions, materials or junk.
- 6.9 Working platforms, gangways & stairways shall be so constructed that they shall not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more than 3.5 m above ground level or floor level they shall be closely boarded, shall be of adequate width and shall be suitably fenced.
- 6.10 Every opening in the floor of a building or in a working platform shall be provided with suitable fencing or railing whose minimum height shall be 1 m to prevent the fall of persons or materials.
- 6.11 Every ladder shall be securely fixed at top and bottom. A ladder more than 5 m long shall have a prop.
- 6.12 All ladders used shall be of good construction, sound materials and adequate strength. Ladders with defective or missing rungs shall not be brought into use. The spacing of rungs shall not exceed 30 cms and these shall be recessed atleast 12 mm into rails.
- 6.13 All ladders or rungs used for vertical height of more than 10 m shall have an intermediate landing. All such intermediate landings shall be provided with guard rails to a height of atleast 1 m.
- 6.14 Every ladder shall be securely placed so that it cannot move either at the top or at the bottom and it shall rise to a height of atleast 1.2 m above the place of landing.
- 6.15 No portable single ladder shall be over 8 m in length.
- 6.16 Spacing between the side rails of the ladder shall not be less than 300 mm for ladders upto 3 m in length. For longer lengths, this shall be increased at 6 mm for each additional 0.3 m of length.

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- 6.17 Metal ladders must not be used for electrical work or near electric circuit of equipments.
- 6.18 All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use.
- 6.19 Unfinished scaffolding which is under construction shall be prominently marked as unsafe and any access points shall be closed.
- 6.20 All Planking and Decking on walkways and scaffolds should be adequately supported at each end of the plank and intermediately if necessary. Planks should not be allowed to cantilever beyond the last support but should be overlapped if necessary on to the next plant.
- 6.21 Shuttering**
- The above remarks shall be applicable for this also. Shuttering, particularly for slabs, should be treated as a scaffold. Unfinished shuttering should be marked as dangerous similarly the finished formwork should be adequately supported, care being taken to avoid trap door effects.
- 7.0 MOBILE LIFTING APPLIANCES**
- 7.1 No mobile lifting appliances shall used on a sloping surface unless adequate precautions are taken to ensure stability.
- 7.2 Adequate precautions shall be taken to see that jib of the mobile crane does not come in contact with overhead electric transmission line.
- 7.3 Only one person shall give signals to the operator of mobile lifting appliances.
- 7.4 Maximum load to be lifted by lifting appliances shall be marked in a position where it can be clearly seen by the crane driver and the operator.
- 7.5 No load shall be raised, lowered or suspended from a chain or rope having a knot in any of the part.
- 7.6 No chain which is joined to another chain by means of bolt and nut shall be used for raising, lowering or suspending any load.
- 7.7 All chains, ropes and lifting gears shall be carefully examined and tested by a competent Maintenance Engineer atleast once in every quarter.

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- 7.8 When the work is stopped or when the mobile lifting equipment is not in operation, the boom must be lowered to the horizontal position and tied securely in place to prevent accidental drop.
- 7.9 No person shall walk under a load which is swinging by a lifting equipment.
- Guide rope must be attached to the load to prevent its swinging.
- 7.10 The foot blocks of the crane before starting work shall be securely supported and firmly anchored to prevent its movement in any direction.
- 7.11 Use of Hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following standards of condition.
- 7.11.1 These shall be of good mechanical construction, sound material and adequate strength and free from defect and shall be kept in good working order.
- 7.11.2 Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength and free from patent defects.
- 7.11.3 Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years shall be in charge of any hoisting machine or give signals to the operator.
- 7.11.4 In case of every hoisting machine and every chain ring hook shackle swivel and pulley block used in hoisting or lowering or as means of suspension the safe working load shall be ascertained by adequate means, every hoisting machine and all gears referred to above shall be plainly marked with the safe working load. In case of hoisting machine having a variable safe working loading, each safe working load of the conditions under which it is applicable shall be clearly indicated. No part of any machine or of any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing. Mobile cranes shall have the working load and the radius of jib for the load marked on it.
- 7.11.5 The top pulley for hoisting a load shall be opened monthly and the spindle inspected to see if any undue wear has taken place and for greasing.
- 7.11.6 In case of departmental machine, the safe working load shall be notified by the Engineer concerned. As regards bidder's machines the Bidder shall notify the safe working load of the machine to the Engineer whenever he brings any machinery to site of work and get it verified by the Engineer concerned.
- 7.12 Motors, gearing, transmission, electric wiring and other dangerous part of hoisting appliances shall be provided with efficient safeguards. Hoisting appli-

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ances shall be provided with such means as will reduce to the minimum, the risk of accidental descent of the load. Adequate precautions shall be taken to reduce to the minimum, risk of any part of a suspended load becoming accidentally displaced.



8.0 RIVETTING, WELDING & GAS CUTTING & STEEL ERECTION

8.1 Rivetting



- 8.1.1 Bolts covered with wet or slippery compounds shall not be used in fabricating structural work.
- 8.1.2 The rivet heater must keep the rivet heating equipment as near as possible to the place of work.
- 8.1.3 A pail of water shall always be kept ready for quenching fire when stopping rivetting work.
- 8.1.4 Hot rivet shall not be thrown across aisles and shaftways.
- 8.1.5 Metal buckets for catching hot rivets must have false wooden bottoms to prevent rivets from rebounding.
- 8.1.6 All rivets, bolts, nuts, and other tools must be kept in boxes and not left loose, (For any further safety measures relevant Indian Standards and safety specifications of structural section shall be referred to).

8.2 Welding & Gas Cutting



- 8.2.1 All cylinders must be used and stored in upright position only.
- 8.2.2 Cylinders must be stored away from open flames and other source of heat.
- 8.2.3 Oxygen cylinders must not be stored near other cylinders containing gas or oil, grease or other combustible materials.
- 8.2.4 While the cylinder is in use, the cylinder valve key or wrench must be placed on the valve spindle.
- 8.2.5 Before a cylinder is moved, the cylinder valve must be closed.
- 8.2.6 Gas cutting torches must be lighted by means of friction flames or similar other methods and not with matches.

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- 8.2.7 When torches are being changed or welding stopped for some time valves for all cylinders must be closed.
- 8.2.8 The coloured lenses used for welding or gas cutting must be of proper shade for the work being done.
- 8.2.9 Suitable eye protection equipment such as goggles, hand shields etc., must be used by persons engaged in welding or gas cutting operations.
- 8.2.10 Before any heavy structural member is gas cut, make sure that it is cleared and supported by ropes, cables, chains or any other means to prevent its dropping or swinging.
- 8.2.11 Cylinder valves and connections are not to be lubricated. All oily or greasy substances must be kept away from cylinders.
- 8.2.12 Substantial and incombustible screen must be used below or near the welding operations, if there is a possibility of a spark falling on other workmen engaged in work closely.
- 8.2.13 All air pipe lines and air hoses must be frequently inspected. Air hoses shall not be used for dusting or for cooling purposes.
- 8.3 Steel Erection
- 8.3.1 All persons shall stand clear when a crane is sorting or shifting steel girders or other structural materials.
- 8.3.2 No person shall stand, walk or work beneath any suspended load.
- 8.3.3 Guide rope must be used for guiding lifting loads.
- 8.3.4 When guiding a beam or fabricated structure or erection it shall be so held that the employees hands do not get jammed against other objects.
- 8.3.5 Safety belts equipped with suitable life lines must be used by persons working at heights and standing on structural members. Life line must be tied to an independent support. For any further safety measures, for Structural Steel Works, IS : 7205 shall be referred to.
- 9.0 SAFETY APPLIANCES**
- 9.1 Workers employed on mixing asphaltic materials, cement and lime mortars, shall be provided with protective footwear and protective goggles.



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- 9.2 Those engaged in white washing and mixing or stacking of cement bags or any materials which is injurious to the eyes, shall be provided with protective goggles.
- 9.3 Those engaged in welding works shall be provided with welder's protective eye-shields.
- 9.4 Stone breakers shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.
- 9.5 When workers are employed in sewers and manholes which are in use, the Bidder shall ensure that the manhole covers are opened and chambers are ventilated atleast for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to the public.
- 9.6 The Bidder shall not employ men below the age of 18 and women on the work of painting with products containing lead in any form. Whenever men above the age of 18 are employed on the work of lead painting the following precautions shall be taken :
- 9.6.1 No paint containing lead or lead products shall be used except in the form of paste or ready made paint.
- 9.6.2 Suitable face mask should be supplied for use by them when paint is applied in the form of spray on a surface having lead paint dry rubbed and scraped.
- 9.6.3 Overalls shall be supplied by the Bidders to the workmen and adequate facilities shall be provided to enable the working painters to wash during the cessation of work.
- 9.7 The workers going into inspection chamber shall have gas masks, gum boots and rubber gloves while working inside. After coming out they shall have some disinfectant from the first aid box for proper washing
- 9.8 All necessary personnel safety equipment such as safety helmets, safety boots, safety belts, leather gloves for welders, clear glass safety goggles etc., as considered adequate by the engineer have to be kept available for the use of persons employed at the site of work and maintained in condition suitable for immediate use and Bidder shall take steps to ensure proper use of equipment by the workers.
- 9.9 All the persons entering the tunnel shall be provided with protective wear, such as helmets, steel toe safety shoe, gum boots or other suitable type of protective

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foot wear. In the case of steeply inclined tunnels and inshafts, safety belts shall also be provided.

- 9.10 Sign boards 1 x 1.5 m in size with the following wording shall be erected at the access to these areas. "CONSTRUCTION AREA, HELMET REQUIRED BEYOND THIS POINT"
- 9.11 No loose garments or ragged clothing shall be worn by the personnel engaged in tunneling operation.
- 9.12 A telephone system shall provided to ensure a positive and quick method of communication between all control location inside tunnel and portal of the tunnels when longer than 500 m and for shafts when longer than 50 m
- 9.13 Irrespective of length and bends in the tunnel, arrangements shall be made for transmitting of warning signals by any one of the following means.
- 9.13.1 By electrically operated bells, operated by battery/dry cells with the bell placed outside the tunnel and the position of the switch shifting with the progress of the tunneling work. The position of the operating switch although temporary shall be so chosen as to ensure proper accessibility and easy identification.
- 9.13.2 By the use of two field (magnet type) telephone.
- 9.13.3 Any other suitable arrangement like walkie-talkie.
- 9.14 Arrangement for rendering prompt and adequate first aid to the injured persons shall be maintained at every work site under the guidance of a medical officer-in-charge of the project. Depending upon the magnitude of the work the availability of an ambulance at a very short notice (at telephone call) shall be ensured.
- 9.15 First-aid arrangements commensurate with the degree of hazard and with the number of workers employed shall be maintained in a readily accessible place throughout the working hours. At least one experienced first-aid attendant with his distinguishing badge shall be available on each shift to take care of injured persons. Arrangements shall be made for calling the medical officer, when such a need may arise. It is recommended that foreman/assistant foreman/supervisor/permanent workmen who are normally present at each working phase in each shift are given adequate training on first-aid methods to avoid employment of a separate attendant.
- 9.16 Stretchers and other equipment necessary to remove injured persons shall be provided at every shift.

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9.17 Where there are more than 50 persons working in a shift, effective artificial respiration arrangements shall be provided, with trained men capable of providing artificial respiration.

10.0 ELECTRICAL

10.1 Only authorised persons shall handle or otherwise interfere with electrical equipment. Any person detecting electrical apparatus being handled by an unauthorised person or equipment in unsafe condition must report the matter to the Engineer concerned.

10.2 No person shall work on any live electric conductor or apparatus and no person shall assist such person on such work, unless he is authorised in that behalf.

10.3.1 After isolating the equipment from the source of supply before the work begins, a sign 'DONT'T SWITCH ON' must be hung on or near the switch to avoid its being accidentally or inadvertently switched on when persons are working.

10.3.2 Take out the fuses and keep in safe custody.

10.3.3 The switch may be locked if locking arrangement exists.

10.3.4 Earth the equipment, before work, to discharge it and short the terminals as a precautionary measure against accidental switching ON.

10.3.5 After the work is finished take out Earthing and shorting link.



10.3.6 Remove all tools and materials from the site of work. Replace the fuses and unlock the switch.

10.3.7 The switch shall only be put 'ON' by the person who switched it 'OFF' or by the person authorised by him in writing.

10.4 When working on live equipment use one hand only whenever possible, it is advisable to keep the other hand behind the back. Shocks from hand to hand are most dangerous.



10.5 All persons handling electrical gear in elevated position must use safety belts. Even a slight shock may cause loss of balance and fall.

10.6 No one shall attempt to extinguish a fire on or near a live electrical apparatus with water. Water is a good conductor of electricity. Use extinguishers wherever provided. Use sand and blankets etc., if available.

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- 10.7 No person shall use any part of electrical equipment for storing or hanging clothes, umbrellas or other articles. Serious accidents occur from this practice.
- 10.8 For attending the work on O.H. lines or equipment use wooden ladders. Metallic ladders shall not be used.
- 10.9 Use insulated tools and ensure the insulation is in proper condition periodically at least once in three months. Use rubber gloves wherever possible.
- 10.10 As far as possible verbal instructions shall be avoided in case of pre-arranged shut-down of electrical apparatus.
- 10.11 When workers are employed for electrical installations which are already energised, insulating mats, wearing apparel such as gloves, sleeves and boots as may be necessary shall be provided. The workers shall not wear any rings, watches and carry keys or other materials which are good conductors of electricity.
- 11.0 MISCELLANEOUS**
- 11.1 The Bidder shall provide necessary fencing and lights to protect the public from accident.
- 11.2 Fire extinguishers adequate in number shall be kept by the Bidder at the site of works where there is risk of fire hazard.
- 11.3 Adequate washing facilities shall be provided near the place of work.
- 11.4 When the work is done near any place where there is risk of drowning, all necessary equipments shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provisions shall be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.
- 11.5 These safety provisions shall be brought to the notice of all concerned by displaying on a Notice Board at a prominent place at the work spot. The persons responsible for compliance of the code shall be named therein by the Bidder.
- 11.6 To ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by the Bidder shall be open to inspection by the Engineer and Owner.
- 11.7 Notwithstanding the above clauses there is nothing in those to exempt the Bidder from the operations of any other Act or Rule in force in the Republic of India.

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- 11.8 All storage, handling and use of flammable liquids shall be under the supervision of qualified persons. Flammable liquid shall not be stored inside the tunnel
- 11.9 All sources of ignition shall be prohibited in areas where flammable liquids are stored, handled and processed. Suitable warning and 'NO SMOKING' signs shall be posted in all such places. Receptacles containing flammable liquids shall be stacked in such a manner as to permit free passage of air between them.
- 11.10 All combustible materials shall be continuously removed from such areas where flammable liquids are stored, handled and processed. All spills of flammable liquids shall be cleared up immediately. Containers of flammable liquids shall be tightly capped.

12.0 REPORTING OF ACCIDENT

All accidents, major or minor must be reported immediately. The Bidder, will provide first aid to the injured person immediately and the injured person shall report to the first aid station along with the 'INJURED ON WORK' form duly filled in quintuplicate and submit to the Medical Officer of the First Aid Station".

Serious Injury

In case of serious injury, the following procedure shall be adopted by the Bidder :



1. Provide First Aid at his own First Aid Station.
2. Take the injured person to the Hospital along with the "INJURED ON WORK" form duly filled in.
3. Reporting the accident to the Owner/Engineer by the Bidder.

Fatal Accident

Fatal accident must be reported immediately to the Engineer/Owner as well as to the Police.

Penalty



Failure to observe the Safety Rules will make the Bidder liable to penalty by way of suspension of work, fine and termination of contract.

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ANNEXURE - A

LIST OF IS & IRC CODES REFERRED



IS 383	:	Specification for coarse & fine aggregates from natural sources for concrete.
IS 2386 (Part 1 to 8)	:	Method of Test for aggregates for concrete
IS 456	:	Code of practice for plain and reinforced concrete.
IS 712	:	Specification for building limes.
IS 3182	:	Specification for broken brick (burnt clay) fine aggregate for use in lime mortar.
IS 269	:	Specification for 33 grade ordinary Portland Cement.
IS 455	:	Code of practice for Portland Slag Cement.
IS 1489	:	Specification for Portland Pozzolana Cement.
IS 8041	:	Specification for rapid hardening Portland Cement.
IS 8112	:	Specification for 43 grade ordinary Portland Cement.
IS 12269	:	Specification for 53 grade ordinary Portland Cement.
IS 8043	:	Specification for Hydrophobic Portland Cement
IS 12330	:	Specification for Sulphate resisting Portland Cement.
IS 6452	:	Specification for high alumina cement for

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		structural use.
IS 8042	:	Specification for White Portland Cement.
IS 3535	:	Methods of sampling Hydraulic Cement.
IS 4031 (Part 1 to 15)	:	Methods of test for Hydraulic Cement.
IS 4032	:	Method of Chemical Analysis of Hydraulic Cement.
IS 2645	:	Specification for Integral Cement Waterproofing Compounds.
IS 1599	:	Method of Bend Test.
IS 1608	:	Method of Tensile Testing of Steel Products.
IS 6925	:	Method of test for determination of Water Soluble Chlorides in concrete admixtures.
IS 432	:	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement.
IS 1786	:	Specification for high strength deformed steel bars and wires for concrete reinforcement.
IS 1566	:	Specification for hard drawn steel wire fabric for concrete reinforcement.
IS 280	:	Mild steel wire for general engineering purposes.
IS 2062	:	Structural steel (Standard Quality).

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IS 1161	:	Steel Tubes for Structural purposes.
IS 5624	:	Foundation bolts.
IS 1363 - (Part 1 to 3)	:	Hexagon Head bolts, screws, nuts.
IS 2016	:	Plain washers.
IS 3063	:	Single coil rectangular section spring washers.
IS 1239 (Part 1&2)	:	Mild Steel Tubes and other wrought steel pipe fittings.
IS 1367	:	Technical supply conditions for threaded steel fasteners.
IS 1030	:	Carbon steel castings.
IS 3480	:	Flexible steel conduit for electrical wiring.
IS 2667	:	Fittings for rigid steel conduits for electrical wiring.
IS 9537 (Part 3)	:	Conduit for electrical installations - Rigid Plain conduits of insulating materiel.
IS 6946	:	Flexible non-metallic conduits for electrical installations.
IS 3419	:	Fittings for rigid non-metallic conduits.
IS 5913	:	Methods of tests for Asbestos Cement Products.
IS 2098	:	Specification for asbestos cement building boards.

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IS 2096	:	Specification for asbestos cement flat sheets.
IS 9537 (Part 2)	:	Conduit for electrical installations - Rigid steel conduits.
IS 2614	:	Method for sampling of fasteners.
IS 1592	:	Specification for asbestos cement pressure pipes.
IS 9627	:	Specification for asbestos cement pressure pipe (Light duty).
IS 6908	:	Specification for asbestos cement pipes and fittings for sewerage and drainage.
IS 1626 (Part 1 to 3)	:	Specification for asbestos cement building pipes & pipe fittings and roofing fittings
IS 459	:	Specification for unreinforced corrugated and semi corrugated asbestos cement sheets
IS 1077	:	Specification for common burnt clay building bricks.
IS 3495 (Part 1 to 4)	:	Method of Test for burnt clay building bricks.
IS 3620	:	Specification for laterite stone block for masonry.
IS 1121	:	Method of test for determination of strength properties of natural building stone.
IS 1124	:	Method of test for determination of water absorption Sp. Gr. etc. of building stones
IS 1125	:	Method of test for determination of weathering

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		of natural building stones.
IS 1126	:	Method of test for determination of durability of building stone.
IS 1127	:	Recommendation for dimensions and workmanship of natural building stones for masonry work.
IS 2185 (Part-1)	:	Specification for concrete masonry unit Hollow and solid concrete blocks.
IS 2116	:	Specification for sand for masonry mortar
IS 1542	:	Specification for sand for plaster.
IS 2185 (Part-2)	:	Specn. for concrete masonry unit-Hollow and solid light weight concrete blocks.
IS 2185 (Part-3)	:	Specification for concrete masonry unit - Auto claved Cellular Aerated concrete blocks.
IS 6041	:	Code of practice for construction of Auto claved Cellular concrete block masonry.
IS 6441 (Part 1 to 9)	:	Method of Test for Auto claved Concrete Products.
IS 3068	:	Specification for broken brick (burnt clay) coarse aggregates for use in lime concrete.
IS 2114	:	Code of practice for laying in-situ terrazo floor finish.
IS 460 (Part 1 to 3)	:	Specification for Test Sieves.
IS 1237	:	Specification for cement concrete flooring tiles.

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IS 777	:	Specification for glazed earthen ware wall tiles.
IS 1129	:	Recommendation for dressing of natural building stone.
IS 1130	:	Specification for Marble (blocks, slabs and tiles).
IS 809	:	Specification for rubber flooring materials for general purposes.
IS 3462	:	Specification for unbacked flexible PVC flooring.
IS 3461	:	Specification for PVC asbestos floor tiles
IS 2818	:	Indian Hessians.
IS 653	:	Linoleum sheets and tiles.
IS 5389	:	Code of practice for laying hard wood parquet and wood block flooring.
IS 210	:	Grey Iron Castings.
IS 2114	:	Code of practice for laying in-situ terrazzo finish.
IS 1198	:	Code of practice for laying of linoleum flooring.
IS 1003 (Part-2)	:	Specification for timber panelled & glazed shutters, windows and ventilator shutters.
IS 1141	:	Code of practice for seasoning of timber.
IS 1003 (Part-1)	:	Specification for timber panelled & glazed

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		shutters - Door shutters.
IS 287	:	Recommendation for maximum permissible moisture content of timber used for different purposes.
IS 2202 (Part-1)	:	Specification for wooden flush door shutters (Solid core type).
IS 2191 (Part-1&2)	:	Specification for wooden flush door shutters (cellular and hollow core type).
IS 3087	:	Specification for wood particle boards (Medium density) for general purposes.
IS 3478	:	Specification for high density wood particle boards.
IS 3097	:	Specification for veneered particle boards
IS 303	:	Specification for plywood for general purposes.
IS 1328	:	Specification for veneered decorative plywood.
IS 205	:	Specification for non-ferrous metal butt hinges.
IS 1341	:	Specification for steel butt hinges.
IS 362	:	Specification for parliament hinges.
IS 453	:	Specification for double acting spring hinges.
IS 3818	:	Specification for continuous (Piano) hinges.
IS 206	:	Specification for Tee and Strap hinges.
IS 281	:	Specification for mild steel sliding door bolts for use with padlocks.

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IS 1019	:	Specification for rim latches.
IS 2681	:	Specification for non-ferrous metal sliding door bolts for use with padlocks.
IS 204 (Part 1&2)	:	Specification for tower bolts - Ferrous and Non-ferrous metals.
IS 208	:	Specification for door handles.
IS 2209	:	Specification for mortice locks (vertical type).
IS 6607	:	Specification for rebated mortice locks (vertical type).
IS 1823	:	Specification for floor door stoppers.
IS 1837	:	Specification for fan light pivots.
IS 207	:	Gate and shutter hooks and eyes.
IS 6343	:	Specification of door closers (pneumatically regulated) for light door weighing upto 40 Kg.
IS 8756	:	Specification for ball catches for use in wooden Almirah.
IS 6315	:	Specification for floor springs (hydraulically regulated) for heavy doors.
IS 7197	:	Specification for Double action floor spring (without oil check) for heavy doors
IS 364	:	Specification for fan light catch.
IS 3828	:	Specification for ventilator chains.
IS 363	:	Specification for hasp and staples.

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IS 9899	:	Specification for hat, coat and wardrobe hooks.
IS 729	:	Specification for drawer locks, cup-board locks and box locks.
IS 3564	:	Specification for door closers (Hydraulically regulated).
IS 4351	:	Specification for steel door frames.
IS 419	:	Putty for use on window frames.
IS 5187	:	Specification for flush bolts.
IS 3847	:	Specification for mortice night latches.
IS 4621	:	Specification for indicating bolts.
IS 1038	:	Specification for steel doors, windows and ventilators.
IS 1977	:	Structural steel (ordinary quality).
IS 1361	:	Specification for steel windows for industrial buildings.
IS 7452	:	Hot rolled steel sections for doors, windows and ventilators.
IS 1948	:	Specification for aluminium doors, windows and ventilators.
IS 1148	:	Specification for hot rolled rivet bars for structural purposes.
IS 1949	:	Specification for aluminium windows for industrial buildings.

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IS 204 (Part 1)	:	Specification for tower bolts-non-ferrous metal.
IS 733	:	Wrought aluminium and aluminium alloy bars, rods and sections (for general engineering purposes).
IS 6248	:	Specification for metal rolling shutters and rolling grills.
IS 1081	:	Code of practice for fixing and glazing of metal doors, windows and ventilators.
IS 2339	:	Specification for Aluminium Paint for general purpose in dual containers.
IS 2835	:	Flat Transparent sheet glass.
IS 5437	:	Wired and figured glass.
IS 101 (Part 1 to 8)	:	Method of sampling and test for paints, varnishes and related products.
IS 2074	:	Ready mixed paint, air drying, red oxide zink chrome, priming.
IS 5410	:	Cement paint, colour as required.
IS 427	:	Distemper, dry, colour as required.
IS 428	:	Distemper, oil emulsion, colour as required.
IS 348	:	French polish.
IS 5411 (Part 1&2)	:	Plastic emulsion paint.
IS 702	:	Industrial Bitumen.
IS 73	:	Paving Bitumen.

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IS 217	:	Cut Back Bitumen.
IS 454	:	Specification for Digboi type cutback bitumen.
IS 5467	:	Specification for shellac Wax.
IS 3384	:	Specification for Bitumen primer for use in water proofing and damp proofing.
IS 290	:	Specification for Coal Tar Black Paint.
IS 341	:	Specification for Black Japan, Type A, B & C.
IS 1322	:	Specification for bitumen felts for water proofing and damp proofing.
IS 218	:	Specification for creosote oil for use as wood preservative.
IS 3037	:	Specification for Bitumen mastic for use in water proofing of roofs.
IS 1580	:	Specification for Bituminous compound for water proofing and caulking purposes.
IS 8542	:	Specification for polish for wooden furniture paste.
IS 9862	:	Ready mixed paint, brushing etc.
IS 782	:	Specification for caulking lead.
IS 405 (Part 1&2)	:	Lead sheet and strips.
IS 5134	:	Bitumen impregnated paper.
IS 2849	:	Specification for non load bearing gypsum partition blocks.

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IS 8591	:	Specification for floor polish paste.
IS 2095	:	Specification for gypsum plaster boards.
IS 77	:	Specification for linseed oil, boiled for paints.
IS 533	:	Gum Spirit of turpentine (oil of Turpentine).
IS 1504	:	Bees Wax.
IS 3536	:	Ready mixed paint, brushing, wood primer pink.
IS 8273	:	Specification for gypsum plaster for use in the manufacture of fibrous plaster board.
IS 5871	:	Specification for bitumen mastic for tanking and damp proofing.
IS 651	:	Specification for salt glazed stoneware pipe and fittings.
IS 1729	:	Sand cast iron spigot and socket soil pipe.
IS 771 (Part 1 to 7)	:	Specification for glazed fire clay appliances.
IS 1230	:	Cast iron rain water pipes and fittings.
IS 774	:	Flushing cisterns for water closets and urinals.
IS 2548 (Part 1&2)	:	Specification for plastic seats and cover for water closet.
IS 1726	:	Specification for cast iron manhole cover and frames.
IS 1239 (Part 1&2)	:	Mild steel Tubes and fittings.
IS 4984	:	Specification for high density polyethylene

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		pipes for potable water supplies: Sewerage and industrial effluents.
IS 2556 (Part 1 to 15)	:	Specification for vitreous sanitary appliances (vitreous china).
IS 7328	:	High density polyethylene materials.
IS 4985	:	Specification for unplasticised PVC pipes for potable water supplies.
IS 3076	:	Specification for low density polyethylene pipe for potable water supplies.
IS 9762	:	Specification for polyethylene floats for ball valve.
IS 3395	:	Code of practice for fire safety of industrial buildings.
IS 7834 (Part 1 to 8)	:	Specification for injection moulded PVC fittings with solvent cement joint for water supplies.
IS 8008 (Part 1 to 7)	:	Specification for injection moulded HDPE fittings for potable water supplies.
IS 8360 (Part 1 to 3)	:	Specification for fabricated high density polyethylene fittings for potable water.
IS 784	:	Specification for prestressed concrete pipe.
IS 1703	:	Specification for copper alloy float valves (horizontal plunger type) for water supply fittings.
IS 12234	:	Specification for plastic equilibrium float valve for cold water services.

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IS 778	:	Specification for copper alloy gate, globe and check valves for water works purposes.
IS 1536	:	Centrifugally cast (spun) iron pressure pipes.
IS 1537	:	Vertically cast iron pressure pipes for water, gas and sewage.
IS 1538 (Part 1 to 23)	:	Sand cast iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS 3589	:	Electrically welded steel pipes for water, gas and sewage.
IS 781	:	Specification for cast copper alloy screw down bib taps and stop valves for water services.
IS 1239 (Part 1&2)	:	Mild steel tubes and fittings.
IS 779	:	Specification for water meters.
IS 1795	:	Specification for pillar taps for water supply purposes.
IS 1363 (Part 1 to 3)	:	Dimensions for screw thread run-outs and undercuts.
IS 2016	:	Plain washers.
IS 638	:	Sheet rubber jointing and rubber insertion jointing.
IS 4127	:	Code of practice for laying of glazed stoneware pipes.
IS 458	:	Specification for precast concrete pipes.

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IRC 19	:	Standard specification and code of practice for water Bound macadam.
IRC 29	:	Tentative specification for 4 cm Asphaltic concrete surface course.
IRC 15	:	Standard specification and code of practice for construction of concrete roads.
IS 6313	:	Code of practice for antitermite measures in building.
IS 1054	:	Dieldrin emulsifiable concentrates.
IS 1308	:	Aldrin dusting powders.
IS 6439	:	Hepta chlor emulsifiable concentrates.
IS 2632	:	Crotonaldehyde.
IS 1791	:	Specification for batch type concrete mixers.
IS 10262	:	Recommended guidelines for concrete mix design.
IS 7861 (Part 1)	:	Code of practice for extreme weather concreting - Recommended practice for hot weather concreting.
IS 1199	:	Methods of sampling and analysis for concrete.
IS 516	:	Method of test for strength of concrete.
IS 7861 (Part 2)	:	Code of practice for extreme weather concreting. Recommended practice for cold weather concreting.

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IS 2502	:	Code of practice for bending and fixing of bars for concrete reinforcement.
IS 2751	:	Recommended practice for welding of mild steel plain and deformed bars for reinforced construction.
IS 800	:	Code of practice for general construction in steel and deformed bars.
IS 816	:	Code of practice for use of metal arc welding.
IS 814	:	Covered electrodes for manual metal arc.
IS 3370 (Part 1&2)	:	Code of practice for concrete structures for the storage of liquids.
IS 2911 (Part 1 to 4)	:	Code of practice for design and construction of pile foundations.
IS 1343	:	Code of practice for prestressed concrete.
IS 1785 (Part 1&2)	:	Specification for plane hard drawn steel wires for prestressed concrete.
IS 2250	:	Code of practice for preparation and use of masonry mortars.
IS 1635	:	Code of practice for field slaking of building lime.
IS 2212	:	Code of practice for brick work.
IS 1597 (Part 1&2)	:	Code of practice for construction of stone masonry.
IS 4101 (Part 1 to 3)	:	Code of practice for external facing and veneer.

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IS 737	:	Wrought aluminium and aluminium alloys, sheet and strips (for general engineering purposes).
IS 2572	:	Code of practice for construction of hollow connect block masonry.
IS 1661	:	Code of practice for application of cement finishes.
IS 5766	:	Code of practice for laying of burnt clay brick flooring.
IS 5491	:	Code of practice for laying of in-situ granolithic concrete flooring topping.
IS 3316	:	Specification for structural granite.
IS 1196	:	Code of practice for laying bitumen mastic flooring.
IS 1195	:	Specification for bitumen mastic for flooring.
IS 3462	:	Specification for unbacked flexible PVC flooring.
IS 1198	:	Code of practice for laying fixing and maintenance of linoleum floor.
IS 848	:	Specification for synthetic resin adhesive for plywood.
IS 4457	:	Specification for ceramic unglazed vitreous acid resisting tiles.
IS 851	:	Specification for synthetic resin adhesive for construction work (non structural) for wood.

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IS 2202 (Part 1&2)	:	Specification for wooden flush door shutters.
IS 102	:	Ready mixed paint.
IS 1081	:	Code of practice for fixing and glazing of metal doors.
IS 6248	:	Specification for metal rolling shutters and rolling grills.
IS 1868	:	Anodic coatings on aluminium and its alloys.
IS 2065	:	Code of practice for water supply in buildings.
IS 2064	:	Code of practice for selection, installation and maintenance of sanitary appliances.
IS 7634 (Part 1 to 3)	:	Code of practice for plastic pipes.
IS 1742	:	Code of practice for building drainage.
IS 5330	:	Criteria for design of anchor blocks for penstocks with expansion joints.
IS 3114	:	Code of practice for laying of cast iron pipes.
IS 783	:	Code of practice for laying of concrete pipes.
IRC-SP11	:	Hand book of quality control for construction of roads and run-ways.
IRC-63	:	Tentative guidelines for use of low grade aggregates and soil aggregate mixtures in road pavement construction.
IRC-60	:	Tentative guidelines for use of Lime Fly Ash Concrete as pavement base or sub-base.

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IRC-74	:	Tentative guidelines for use of Lean Cement Concrete and lean concrete Fly Ash Concrete as pavement base or sub-base.
IS 6509	:	Code of practice for installation of joints in concrete pavement.
IS 1838 (Part 1)	:	Specification for performed filler for expansion joint in concrete pavements and structures.
IRC-43	:	Recommended practice for Tools, Equipment and appliances for concrete pavement construction.
IRC-15	:	Standard specifications and code of practice for construction of concrete road.
IS 3036	:	Code of practice for laying lime concrete for a water proofed roof finish.
IS 1346	:	Code of practice for water proofing of roofs with bitumen felts.
IS 1609	:	Code of practice for laying damp proofing treatment using bitumen felt.
IS 4365	:	Code of practice for application of bitumen mastic for waterproofing of roofs.
IS 9103	:	Specification for admixtures for concrete.
IS 2645	:	Specification for integral cement water proofing compounds.
IS 1834	:	Specification for hot applied sealing compound for joint in concrete.

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IS 278	:	Specification for Galvanized barbed wire for fencing.
IS 2721	:	Specification for Galvanized steel chain link fabric.
IS 280	:	Specification for Mild steel wire.
IS 4826	:	Specification for hot dipped galvanized coating on round steel wires.
IS 1200 (Part 1 to 28)	:	Method of measurement of building and Civil Engineering Works.
IS 4081	:	Safety code for blasting.
IS 5916	:	Specification for cast iron gratings for drainage purposes.
IS 4130	:	Safety Code for demolition of building.
IS 3764	:	Safety code for excavation work.
IS 5121	:	Safety code for piling.
IS 4014 (Part 2)	:	Code of practice for steel tubular scaffolding.
IS 3696 (Part 1&2)	:	Safety code of scaffolds and ladders.
IS 6922	:	Criteria for safety and design of structures subject to underground blast.
IS 5499	:	Code of practice for construction of underground raid shelter.
IS 4138	:	Safety code for working in compressed air.
IS 7293	:	Safety code for working with construction

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		machinery.
IS 8989	:	Safety code for erection of concrete framed structures.
IS 4756	:	Safety code for Tunneling work.
IS 7205	:	Safety code for erection of structural steel works.



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05.00.00 ERECTION OF STEEL STRUCTURE

05.01.00 SCOPE OF WORK

The scope of work under erection includes, but not limited to, the following:

- a) Supply of tools and tackles, consumables, materials, labour and supervision.
- b) Receiving, unloading, checking and moving into storage at site including attending to insurance matters as necessary for all materials arriving at site.
- c) Storing and stacking of all fabricated structural components/units/assemblies at site storage yards till the time of erection.
- d) Transportation of structures from storage yard to site of erection, including multiple handling, if required.
- e) All minor rectification / modifications.
- f) Removal of bends, kinks, twists etc. for parts damaged during transportation and handling.
- g) Reaming of holes which do not register or which are damaged, for use of next higher size bolt.
- h) Plug-welding and re-drilling of holes which do not register and which cannot be reamed for use of next higher size bolt.
- i) Drilling of holes which are either not drilled at all or are drilled in incorrect position during fabrication.
- j) Fabrication of minor missing items as directed by the owner.
- k) Verification of the position of embedded anchor bolts and inserts with respect to benchmarks/ based on Geodetic Scheme.
- l) Assembly at site of steel Structural components wherever required, including temporary supports and staging.
- m) Making arrangements and bearing cost for providing all facilities for conducting ultrasonic, X-ray or gamma ray tests of welds; getting the tests conducted by Owner approved testing laboratories making available test films / graphs, reports and interpretation.
- n) Rectification at site damaged portions of shop primer by cleaning and application of primer and touch-up paint.

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- o) Erection of structures including making connections by bolts / High Strength Friction Grip bolts/welding as per drawing.
- p) Alignment of all structures true to line, level, plumb and dimensions within specified limits of tolerance.
- q) Application at site after erection, required number of balance coats of primer, intermediate and finishing paint as per specification and drawing.
- r) Rectification of structures as per Preliminary acceptance report and Final acceptance report.

05.02.00 STORAGE AND HANDLING



- 05.02.01 Storage of structures shall be preferably be done in such a manner that erection sequence is not affected.
- 05.02.02 While storing, care shall be taken so that structures do not come in direct contact with the earth surface and accumulated water. Girders, beams, columns shall be placed and stored in such a manner that during rain, no accumulation of water on the structures takes place.
- 05.02.03 Stacking of the structures shall be done in such a way that, erection marks are visible easily and handling does not become difficult. Wherever required, wooden sleepers / grilles may be used.
- 05.02.04 Handling and storage of materials shall be as per IS: 7969-1975, to ensure safety.

05.03.0 GENERAL INSTRUCTIONS FOR ERECTION

- 05.03.01 Erection shall be carried out in accordance with IS: 800 and other relevant standards referred to therein apart from this specification.
- 05.03.02 The Bidder shall be responsible for checking the alignment and levels of foundations, correctness of foundation; centres of anchor bolts etc. well in advance of starting erection work and shall be responsible for any consequence for non-compliance thereof. Discrepancies, if any, shall immediately be brought to the notice of the Owner. Any mistake subsequently found in alignment and levels of the structural steelwork due to non-verification of foundation before erection shall be corrected by the Bidder at his own expense.
- 05.03.03 One set of reference axes and one bench mark level will be furnished to the Bidder. These shall be used for setting out of structures.



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- Maintenance of such bench mark level shall be the responsibility of the Bidder.
- 05.03.04 The Bidder at his own expenses shall provide measuring instruments for setting out, levelling and aligning steelwork. He shall provide one exclusive survey team for alignment of structural works.
- 05.03.05 For safe and accurate erection of structural steelwork, staging, temporary support, false-work etc. shall be erected as required.
- 05.03.06 Erection should start preferably from braced bays
- 05.03.07 The fabricated materials received at erection site shall be verified with respect of marking on the key plan/markings plan or shipping list.
- 05.03.08 Any material found damaged or defective shall be stacked separately and the damaged or defective portions shall be painted in distinct colour for identification and the same shall be brought to the notice of the Owner.
- 05.03.09 The approved erection drawings and any approved arrangement drawing, specification or instruction accompanying them shall be followed in erecting structures.
- 05.03.10 Erection work shall be taken up after receipt of clearance from the owner.
- 05.03.11 For safety requirements during erection, provisions in IS: 7205 - 1974, IS: 7969 - 1975 and other relevant Indian standards shall be followed.
- 05.03.12 Erection shall be carried out with the help of maximum mechanisation possible.
- 05.03.13 Prior to commencement of erection, all the erection equipment, tools, tackles, ropes etc. shall be tested for their load carrying capacity. Such tests may be repeated at intermediate stages also if considered necessary and frequent visual inspection shall be done of all vulnerable areas and components to detect damages or distress in the erection equipment, if any.
- 05.03.14 Temporary bracing, whenever required, shall be provided to sustain forces due to erection loads and equipment etc. Erected parts of the structures shall remain stable during all stages of erection when subjected to the action of wind, dead weight and erection forces etc. Specified sequence of erection of vertical and horizontal structural members shall be followed. Erected members shall be held securely in place by bolts ./ guy ropes etc to take care of dead load, wind

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load and erection load during all stages of erection, alignment, welding & painting.



- 05.03.15 All connections shall achieve free expansion and contraction of structures wherever provided.
- 05.03.16 No final bolting or welding of joints shall be done until the structure has been properly aligned. Structures shall be aligned true to plumb and level and shall be checked by using theodolite and a scheme shall be submitted for approval of the owner. Final welding / bolting shall be done only after obtaining approval of the alignment scheme from the owner.
- 05.03.17 Welding shall be carried out as specified in the Chapter “Welding of Steel Structures” in this specification.
- 05.03.18 All erection bolts shall be retained in position or the holes shall be plug welded. No un used holes shall be left.
- 05.03.19 For positioning beams, columns and other steel members, the use of steel sledges is not permitted.
- 05.03.20 Instrumental checking of correctness of initial setting out of structures and adjustment of alignment shall be carried out in sequence and at different stages as required, by deploying independent survey team. The final levelling and alignment shall be carried out immediately after completion of each section of a building using survey instruments.
- 05.03.21 All structural members shall be erected with erection marks in the same relative position as shown in the appropriate erection and shop drawings.
- 05.03.22 The bidder shall manufacture, erect and provide false-work, staging temporary support etc. required for safe and accurate erection of structural steel work and shall be fully responsible for the adequacy of the same in strength for transferring temporary and erection loads.
- 05.03.23 The Bidder shall also provide facilities such as adequate temporary access ladders, gangways, tools & tackles, instruments etc. to owner for his inspection at any stage during erection.
- 05.03.24 All materials & consumables shall confirm to the specification in Annexure-E.
- 05.03.25 Notwithstanding any assistance rendered to the Bidder by the Owner, if at any time during progress of the Work, any error should appear or rise therein, on being required to do so, Bidder at his own cost shall remove and amend the work to the satisfaction of the Owner.

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05.03.26 The bidder shall fully abide by the safety procedures and any accident whatsoever concerned to erection shall be full responsibility of the bidder.

05.04.0 FIELD CONNECTIONS

- 05.04.01 The numbers of washers on permanent bolts shall be one for the bolt head side and one or two for the nut side.
- 05.04.02 Where bolting is specified on the drawing, the bolts shall be tightened to the specified limit. The threaded portion of the each bolt shall project through the nut by at least three threads. Tapered washers shall be provided for all heads and nuts to achieve uniform bearing on sloping surface. Minimum two bolts shall be provided at any bolted connection.
- 05.04.03 To prevent loosening of nuts, spring washers or lock- nuts shall be provided as specified in the design/shop drawings.
- 05.04.04 All machine-fitted bolts shall be perfectly tight and the ends shall be checked to prevent nuts from becoming loose. No unfilled holes shall be left in any part of the structures.
- 05.04.05 All field assembly by welding shall be executed in accordance with the requirements for shop fabrication. Where the steel has 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 to be welded.
- 05.04.06 The mating surfaces shall be prepared in accordance with the requirements of design in order to achieve required properties to develop adequate friction between the surfaces.
- 05.04.07 The mating surfaces shall be absolutely free from grease, lubricant, dust, rust etc. and shall be thoroughly cleaned before assembly.
- 05.04.08 The nuts shall be tightened up-to the specified torque with the help of torque -wrench or by half- turn method with the help of pneumatic wrench lever.
- 05.04.09 The direction of tightening of the nuts shall be from the middle toward the periphery of assembly.
- 05.04.10 After desired tightening the bolt heads, nuts and edges of the mating surfaces shall be sealed with a coat of paint to obviate entry of moisture.

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05.05.00 ACCEPTANCE STANDARD OF WELDING

05.05.01 Acceptance standard of welding shall be as specified in “Welding of Structures” section of this specification.

05.06.00 BEDDING AND GROUTING

05.06.01 Base plates shall be set to elevations shown on the drawings, supported aligned and levelled using steel wedges and shims or by other approved methods. Plates shall be levelled properly, positioned and the anchor bolts tightened.

05.06.02 Pack plates below base plates should cover at least 50% area of the base plate unless noted otherwise and all such material shall be accounted as per special conditions of contract.

05.06.03 The gap between the base plate and the foundation shall be pressure grouted by approved method, after thorough cleaning of the gap, duly checked by site Engineer. The concrete mix shall be minimum M30 or as per instruction / drawings and to be supplied by the bidder. Such grouting shall be carried out strictly under the supervision of site Engineer.



05.06.04 Bedding/grouting shall not be carried out until sufficient number of columns have been properly aligned, levelled and plumbed and sufficient number of girders, beams, trusses and bracings have been put in position to the satisfaction of owner.

05.07.00 CRANE RAIL JOINTS

05.07.01 The crane rail joints shall be butt-jointed (either by thermit or fusion welding) or by fish plates as per specification/ drawings.

05.07.02 For butt-welding, the Bidder shall take prior approval of the owner regarding method of edge preparation, welding procedure and sequence of welding to be done. Edge preparation shall be done by oxy- acetylene flame and shall be neatly finished by chipping and grinding.

05.07.03 All position low hydrogen electrode conforming to IS: 814-2004 shall be used for welding. The rail ends shall be preheated to 250`C before welding .The electrode shall be preheated as per manufacturer's instructions. The welded joint shall be allowed to cool slowly. It is recommended that the initial and intermediate layers of deposits may be built by using Ferron V, super chord or equivalent. Top 3 mm layer shall

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be deposited with Duroid 2A or equivalent, to obtain good wearing surface.

05.07.04 The joints shall be free from kinks, twists etc. and shall be ground properly after welding to ensure smooth running of the crane.

05.08.00 PAINTING AFTER ERECTION

05.08.01 The painting shall be as per specification and instructions stated in the drawings.



05.09.00 ERECTION TOLERANCES

05.09.01 Maximum permissible tolerances in erected steel structures shall be as given in ANNEXURE-D

05.10.00 GUIDELINES FOR SAFE ERECTION PRACTICE:

(a) DO'S

- (1) Carry out erection only after structures are thoroughly inspected and cleared.
- (2) Start erection from braced bay.
- (3) Ensure proper packing below the columns to have correct levels (to be checked by survey schemes)
- (4) Ensure proper anchoring of column base by tightening of all anchor bolts.
- (5) Ensure that guying is done at d2/3 height in 3 directions 120 deg apart.
- (6) Ensure that guy ropes are fully tight and anchored .Size of the guy rope should be adequate to take loads
- (7) Provide temporary bracing wherever needed.
- (8) Outstanding of flanges of beams /columns are to be protected against local bending at location of slinging during erection.

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- (9) Ensure that cross beam/bracings are erected only after the cleats/gussets are fully welded.
- (10) Do the welding of cross beams with cleats, only after ensuring all bolts are in position and are tightened fully.

(b) DON'TS



- (1) Don't leave the structures without proper guying in all directions till they are braced.
- (2) Don't miss to anchor properly at the base of columns with anchor nuts fully tightened.
- (3) Don't use manila ropes in place of steel ropes for guying.
- (4) Don't support the cross beams with temporary jigs. Ensure all the bolts are provided and tightened.
- (5) Don't use bracings/tie members for fixing lifting tackles/diversion pulleys/cable trays to avoid damages due to erection loads.
- (6) Avoid indiscriminate cutting/notching of erected and loaded structures.
- (7) Don't use column bases for anchoring guy ropes of structures.

05.11.00 ACCEPTANCE OF WORK



- 05.11.01 Acceptance of erected steel structures shall be either after completion of erection of the whole building or in blocks.

05.12.00 DOCUMENTATION

- 05.12.01 The following documents shall be prepared at the time of acceptance of erected structures.
- a) Documents showing actual deviations made during execution of erection work and approval of competent authority.
 - b) Alignment schemes prepared, verified by qualified surveyor and approved by owner.

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- c) Copies of site modification sketches, test reports of all welds tested during erection.
- d) Documents showing acceptance of embedded structures.
- e) Test reports of all materials procured and used such as paints, electrodes, colour coated sheets, poly carbonate sheets, bolts, nuts & washers etc. The test reports shall indicate conformance to specifications / IS codes etc.
- f) Copies of Radiographic Test reports for welds carried out at site along with films..
- g) DFT record of paint applied measured at random for each area of structures shall be submitted.
- h) Deviations, if any, observed in foundations, anchor bolts etc.
- i) Copies of "As-Built" drawing showing thereon all additions and alternations, which took place between approval of drawing and erection of structures.

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07.00.00 SURFACE PREPARATION AND PAINTING OF STEEL STRUCTURES

07.01.00 PAINTING OF STEEL SURFACES EMBEDDED IN CONCRETE

- a) 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).
- b) 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.

07.02.00 PAINTING OF STEEL SURFACES OTHER THAN THOSE EMBEDDED IN CONCRETE

- a) All Steel surfaces shall be provided with two component self curing Inorganic Zinc ethyle Silicate Primer Coat (Solid by Volume Minimum 62+2% and Zinc Dust %age on dry film minimum 80%). Zinc dust pigment shall conform to ISO 3549 and Zinc dust pigment content shall be determined in accordance with ASTM D 2371. Minimum Dry Film Thickness (DFT) of primer coat shall be 60 Micron. It shall be applied over shot blast cleaned surface to near white metal finish conforming to Sa 2 ½ finish of Swedish standard SIS-05-5900 and shall have profile of 20 to 30 micron. The Primer Coat shall be applied in Shop immediately after blast cleaning by Airless spray technique.
- b) Primer Coat shall be followed with the application of Intermediate Coat of Polyamide Cured pigmented Micaceous Iron Oxide (MIO content minimum 30%) Epoxy based Paint (Solid by Volume Minimum 62+2%) 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 airless spray. Colour and shade of the Coat shall be as approved by the Owner.
- d) Finish Coat shall be followed with the application of Final Finish Coat of Polyurethane based colour pigmented Paint (Solid by Volume Minimum 55+2%) of Minimum 50 Micron DFT. This

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Coat shall be applied within Seven (7) days (from the completion of Finish Coat), after Erection by brush and / or airless spray. Colour and shade of the Coat shall be as approved by the Owner.

07.03.00 TOUCH-UP PAINTING

07.03.01 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.

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.

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



- 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.

07.04.00 GENERAL

07.04.01 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.

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- 07.04.02 Coating for Mild Steel parts in contact with Water.
- 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.
 - 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.
- 07.04.03 Gratings
All gratings shall be blast cleaned to Sa 2 ½ finish of Swedish standard SIS-05-5900 and shall be hot dip galvanised at the rate of 610 Gms / Sq. M.
- 07.04.04 Hand Railings and Ladders
All handrails and ladders shall be galvanised at the rate of 610 Gms / Sq. as per IS : 4736.
- 07.04.05 Sea Worthiness
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.
- 07.04.06 All structural steel members in switchyard (excluding fencing and gate) shall be hot dip galvanised as specified elsewhere.

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09.00.00 SPECIAL CONDITIONS OF CONTRACT

09.01.00 GENERAL

- 09.01.01 The bidder should ascertain himself, by a visit to the site if necessary, the actual site conditions, local factors etc. The Bidder shall bear full responsibility for deductions and conclusions as to the nature and conditions under which the work is to be executed, including effect of climate, rainfall etc. Failure to do so will not absolve the Bidder of his responsibilities about the proper execution of the job. No claims for extra payments due to any special site conditions and ignorance of site conditions will be considered after the acceptance of his quotation.
- 09.01.02 Bidder has to make a thorough erection planning taking into consideration, the works of other departments like civil, mechanical, electrical etc. working in the erection area, so that erection of any structure is not hampered due to ongoing works of other departments. In this connection, any logistic help required from the Owner shall be extended, if requested well in advance.
- 09.01.03 Bidder shall confirm their clear acceptance of Technical Specification in totality with no deviation from the same, and submit a copy of TS duly signed on each page as token of acceptance.
- 09.01.04 The enclosed bid drawings / description as given package TS are deemed to be sufficient for the bidder to assess the nature and quantity of work involved and to quote his prices for the above job. No payment on account of deviations from the bid drawings will be admissible.
- 09.01.05 The cost of all materials including MS bolts / High strength bolts (permanent and erection), pack plates under columns, shims, washers, electrodes, putty, gases, cost of straightening the raw materials (hot bending not permitted), cutting of flats from plates and providing splices, paints, tool, plants, etc. as required for the work shall be deemed to be included in the quoted price.
- 09.01.06 All types of labour, handling and transport charges of raw materials and fabricated structures, including double /multiple handling if required, for completion of the work in accordance with time schedule are deemed to be included in the quoted price.
- 09.01.07 Cost of NDT of welds as per specification, irrespective of film length shall be borne by the Bidder. For the welds found defective, the cost of retest

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shall be borne by the bidder in addition to the cost of rectification or replacement of the defective part.

09.02.00 VOID
09.03.00 PROGRAMME

- 09.03.01 A monthly time bar chart for various activities like procurement of steel, preparation and approval of fabrication drawings, fabrication, despatch to site, erection and alignment, sheeting and painting etc. giving starting and completion dates of all activities, shall be submitted.
- 09.03.02 The bidder shall also furnish his overall planning of construction programme, the capacity of equipment he proposes to deploy on various components of work etc. for prior approval of owner.
- 09.03.03 The bidder shall also furnish details of proposed list of equipment to be deployed / supervisory staff / engineers for each activity of the job such as planning, quality control, fabrication , erection, inspection, painting , billing etc
- 09.03.04 All programmes on procurement of raw steel and other materials, preparation of drawings, fabrication and despatch shall match with the sequence of erection of different structural components and different building/units, of the project as per network planning.
- 09.03.05 The owner may change or alter the detailed working programme for the sequence of work and for the fabrication of components of structures, within the frame work of the agreed schedule, which will be binding on the Bidder.
- 09.03.06 If due to design or other stipulations in the bid or requirements at site, a particular sequence of overall construction has to be followed due to which certain interruptions to any one or more items of work are inherent, no claims for such interruption will be admissible.

09.04.0 MATERIAL



- 09.04.01 The Bidder shall arrange and procure all material required from major steel producers as agreed and approved by the Owner.
- 09.04.02 If assistance is required by the Bidder in obtaining permits/proprieties in allotment of controlled/scarce materials, if any, the same may be extended by the Owner by way of issue of recommendation letter, essentiality it certificate etc. to Government Authorities. Delay, if any, in

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obtaining the materials will not constitute a ground for claiming any compensation or extension of time.

09.05.00 BIDDER'S RESPONSIBILITY

- 09.05.01 The Bidder shall at his own cost make his own site office with storage space for proper storage of all materials brought by him to the work site/ Fabrication shop to prevent damage due to rain, wind, direct exposure to sun etc. and also from theft/pilferage etc.
- 09.05.02 The structures shall have to be erected suitably detailed with erection of equipment or construction of civil works. The Bidder shall ensure spirit of co- operation with other bidders and strict adherence to the schedule so that erection schedules of the other parties are not affected.
- 09.05.03 Providing/arranging all necessary drawings/documents/data required for obtaining all statutory clearances and extend Technical assistance to Owner in getting the statutory clearances from statutory authorities like Directorate of Factories, Central Electricity Authority, Inspectorate of Explosives, Directorate General of Mines & Safety, Inspectorate of Boilers, etc., and to obtain licenses as required under Contract Labour act etc.
- 09.05.04 Submission of all stability certificates duly signed as required under the Factories Act, 1948 and amendments thereof etc. for the units engineered by the Bidder and ensure submission of the same to Owner.
- 09.05.05 The detailed engineering shall be based on the basic engineering, soil investigations, geological data, survey data with regard to the steel plant site, and on any additional data furnished by Owner or as may be given by Owner. in course of detailed engineering to the Bidder. Provision is to be made for the future expansion wherever feasible, in consultation with Owner. and the same is to be indicated in all the Layout drawings accordingly.
- 09.05.06 Prepare and submit total list of drawings for the units engineered and the date-wise submission schedule of drawings for Owner's approval.
- 09.05.07 All working drawings including those for foundation & civil engineering works shall be supplied in the sequence in which they are required for construction at site.
- 09.05.08 All erection drawings shall contain relevant safety instructions, "DO'S" and "DON'T'S" for erection, testing and commissioning.



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- 09.05.09 The Bidder shall effect necessary modifications to any or all drawings issued by them as and when necessitated by site conditions and prepare supplementary details in consultation with Owner so as to facilitate construction, fabrication & erection at site and submit the sketches/revisions made within three (3) days.
- 09.05.10 Engineering & issue of working drawings for modification of the existing units, if any, required for interfacing with the new units.
- 09.05.11 The Bidder shall submit three (3) sets of soft copies on CD and one (1) plastic film along with six (6) prints of “As-built” drawings in respect of all those drawings prepared in respect of all the units engineered by them and incorporating all the modifications authorized by the Owner during the execution of the work. “As-built” drawings shall be submitted in stages after completion of individual units.
- 09.05.12 The drawings prepared by the Bidders shall be suitable for transmitting electronically and digitization for storage.
- 09.05.13 The Bidder shall follow the codification system, for all drawings and documents, made in consultation with Owner for indexing and storage in and easy retrieval from Technical Documentation & Information Section of Owner.
- 09.05.14 All correspondence, data, drawings, documents etc. shall be in English language and all technical data must be in SI units.
- 09.05.15 The bidder shall comply with the various schedules for supply of drawings, required feedback data, QAP, delivery of equipment, etc. till their obligations are fulfilled as per their respective contracts and agreements.
- 09.05.16 The bidder shall assist Owner in technical matters arising out of the drawings / data / documentation supplied by them.
- 09.05.17 The Bidder shall ensure submission of final distribution copies in eleven (11) sets of prints, two (2) soft copies in CD and one (1) plastic film by them for all design and detailed / working drawings.
- 09.05.18 All designs must comply with latest national and international standard/practices pertaining to safety, health and environment.
- 09.05.19 The bidder shall ensure supply of all items like structural steel, sheeting and all consumables etc well in advance of the requirement, for the all structural works for the units engineered / supplied by them.
- 09.05.20 All the data / documents / test-certificates / external inspection reports etc., obtained from manufacturers/equipment suppliers at the time of

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inspection shall be handed over to Owner along with the Inspection Certificate (IC) in the format mutually agreed to.

- 09.05.21 The Bidder shall ensure repair/replacement of inferior/sub-standard material received at site. All expenses for repair/replacement will be borne by the bidder.
- 09.05.22 The Bidder shall provide site supervision for the construction and erection activities for the project right from the start of site activities till completion of structural works. The scope of work under site supervision shall include and not limited to deployment of adequate number of experienced surveyors, graduate engineers, diploma holders, supervisors, skilled technicians and such other technical / non-technical staff as may be necessary for supervising the site activities so as to ensure full compliance with the proposed plant layouts / drawings / specifications / standards and work practices and to maintain the quality of work and to ensure completion within the schedule.
- 09.05.23 The Bidder shall ensure workers wearing safety appliances during work.
- 09.05.24 Tools & tackles used by bidders in erection are tested/certified by statutory authorities.
- 09.05.25 The Bidder shall ensure regular cleaning of various work sites at every stage of construction by bidders.
- 09.05.26 The Bidder shall ensure maintenance of daily record of manpower deployed in all the units by the bidder.
- 09.05.27 The Bidder shall ensure compliance with all statutory laws of the land viz., payment of minimum wages/PF remittances/labour license/insurance including third party/ Workmen Compensation Act etc. by the bidder.
- 09.05.28 The consultant shall ensure arrangement of adequate number of all the required instruments e.g. Elecometer, weld gauges, binoculars, vernier calipers, micrometer screw gauges etc., for their supervisory personnel for quality assurance of site work.
- 09.05.29 Engineers and Supervisory personnel must be deployed round the clock. In case of emergency jobs, mobilization of additional personnel/equipment must be done as per requirement even at short notices.
- 09.05.30 The Bidder shall arrange for experienced teams of personnel with all necessary survey equipment for ensuring the lines and levels at different stages of the construction activities, setting out schemes, pre and post construction / erection survey schemes for all the construction/ erection activities of the entire scope of work to avoid any inter-discipline

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mismatch and to achieve the accuracy as per drawings and good engineering practice.

- 09.05.31 The Bidder shall ensure overall quality of work by taking samples of all consumables such as bolts & nuts, electrodes, paints, sheets, construction materials, NDT of weld joints etc., and obtaining the test results from Quality Assurance & Technology Development (QA&TD) department of Owner or any other standard laboratory as specified in the contracts. All such activities shall be formulated and scheduled with the prior approval of the authorized representative of Owner from the concerned unit. The cost of the same shall be within the quoted price.
- 09.05.32 The Bidder shall be responsible for ensuring the safety of all the contract workmen and supervisory personnel deployed at all construction sites of the project and shall ensure compliance with all the relevant laws of the land, viz. Factories Act, IE Rules, labour license etc. and shall sign all documents required to ensure compliance with statutory obligations by Owner. All safety rules, fire protection procedures as prevailing in the plant as amended from time to time by the Owner shall also be complied with.
- 09.05.33 Submission of weekly, monthly and quarterly progress reports as per formats mutually agreed upon, indicating the progress of design, fabrication, erection, of the structures. The progress reports shall indicate the progress of item-wise manufacture / fabrication /erection/alignment/painting/punch list liquidation activities at site. The report shall indicate specific remedial actions to be taken to maintain the project on schedule.
- 09.05.34 The Bidder shall be responsible for ensuring the safety of all their workmen and supervisory personnel deployed at all construction sites of the project and shall ensure compliance with all the relevant laws of the land, viz. Factories Act, PF Act, IE Rules, labour license, etc., and shall sign all documents required to ensure compliance with statutory obligations by Owner.
- 09.05.35 Bidder for his services either at the Plant or anywhere else is found to be unsatisfactory, then such an employee shall be replaced suitably within fifteen (15) days of such a request made by Owner.
- 09.05.36 The Bidder shall be responsible for the entire design / construction / erection / testing and commissioning of all the units and for the safety, stability and serviceability of all the structures / equipment / plant / machinery under all operating conditions and under varying conditions of soil and weather conditions.
- 09.05.37 Should there be any deficiency in the design, engineering or quality or any operational deficiency affecting the performance of any unit in part or



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as an independent unit or when integrated with the other upstream & downstream units, the re-engineering for effecting the necessary revisions / rectifications shall be carried out by the Bidder without any additional remuneration so as to enable the unit / plant to operate at its designed capacity without any defects or constraints in its operating parameters. The cost towards any replacements / repairs / modifications etc., shall, however, be borne by the bidder concerned which shall be decided on case-to-case basis and the decision of Owner shall be final and binding on all the parties concerned.

- 09.05.38 All the clauses of this General Technical Specification (GTS) are binding for the Bidder unless any of them is explicitly superseded by the Contract Technical Specification (CTS). If any confusion arises regarding which clause is superseded and which is not, in this regard, Owner's interpretation/ decision shall be final & binding.

09.06.00 EQUIPMENT



- 09.06.01 All construction and equipment once brought by the Bidder within the Project Area, are not to be removed from there without the written authority from the owner.

09.07.00 DESPATCH OF FABRICATED MATERIALS

- 09.07.01 The Bidder is solely responsible for any loss or damage during transit to any of the fabricated members, and as such proper precautions shall be taken by him to guard against such mishaps.

09.08.00 SETTING OUT

- 09.08.01 The Bidder shall be responsible for checking the alignment and levels of foundations, correctness of foundation; centres of anchor bolts etc. well in advance of starting erection work and shall be responsible for any consequence for non-compliance thereof. Discrepancies, if any, shall immediately be brought to the notice of the Owner. Any mistake subsequently found in alignment and levels of the structural steelwork due to non-verification of foundation before erection shall be corrected by the Bidder at his own expense.
- 09.08.02 One set of reference axes and one bench mark level will be furnished to the Bidder. These shall be used for setting out of structures. Maintenance of such bench mark level shall be the responsibility of the Bidder.
- 09.08.03 The Bidder at his own expenses shall provide measuring instruments for setting out, levelling and aligning steelwork. He shall provide one exclusive survey team for alignment of structural works.

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09.09.00 STAGING



Any staging necessary for the pre-assembly work of structures shall be provided by the Bidder at his own expense.

09.10.00 RULES & REGULATIONS OF SAFETY, ELECTRICITY BOARDS, FACTORY ETC.

The Bidder shall at all time comply with all relevant factory acts, electricity rules, and safety regulations etc. as per statutory regulations of Central / State Government.

09.11.00 DEVIATIONS

Should the Bidder wish to deviate from any specification or details shown on the owner's approved drawings and / or Technical Specifications, he shall obtain the owner's written authority before proceeding with the deviations.



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ANNEXURE – A

PERMISSIBLE DEVIATIONS IN PITCH AND GAUGE OF HOLES FOR BOLTS AND RIVETS OF NORMAL ACCURACY (HIGH STRENGTH BOLTS INCLUDED)

Description	Hole diameter (mm)	Permissible deviations in spacing (mm)	Permissible deviations in each group of holes		
			Mild Steel	Low Alloyed Steel	
				Rivets	Bolts
Deviation in the hole diameter	Upto 17 Above 17	+1 +1.5	No limits		
Ovality (difference between the biggest and the smallest dia)	Upto 17 Above 17	+1 +1.5	No limits		
Curves, exceeding 1 mm and cracks on the hole edges			Not Permissible		
Non-coincidence of holes in separate details of the assembled unit, <ul style="list-style-type: none"> upto 1mm 1-1.5 mm 			Upto 50% Upto 10%	Upto 10% Not Permissible	Upto 50% Upto 10%
Slope of axis		*	No limits	Upto 20%	No limits



* Upto 3% of the thk. of unit but not exceeding 2mm in case of automatic and 3mm in case of manual pneumatic riveting. Anything exceeding the above mentioned figures is not permissible.

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ANNEXURE –B

TOLERANCE OF ASSEMBLED COMPONENTS OF STRUCTURES

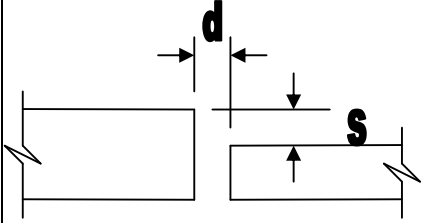
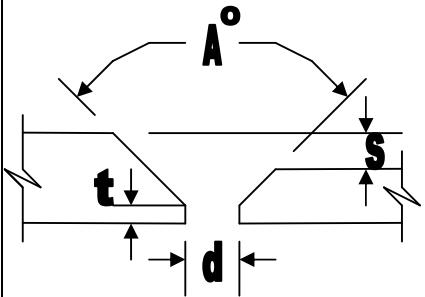
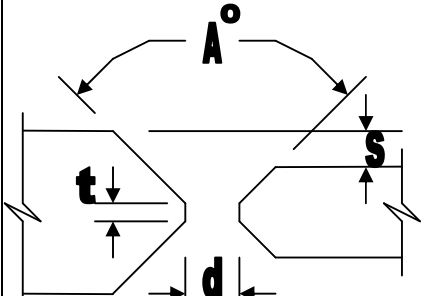
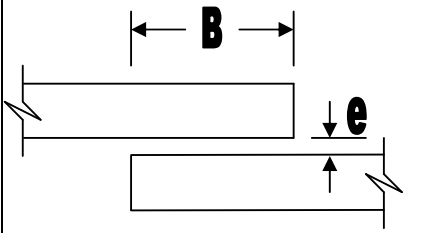
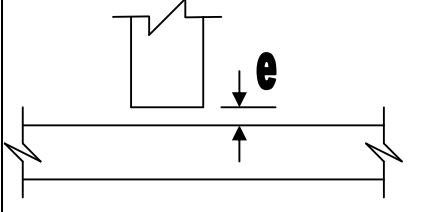
Description of <i>Components of Structures</i>	Deviation(±) in mm for the Elements of Structures (Length in Metres)						
	<1	1-5	5-10	10-15	15-20	20-25	>25
Deviations from the dimensions assembled. Length & width of the Details Cut : <ul style="list-style-type: none"> • Manual gas Cutting as per marking • With shears or with a saw as per marking • With shears or saw with a stop • Machine Gas Cutting Length and width of planed ends processed on Edge Planing Machine	3	3.5	4	4.5	5	-	-
Distance between the Centres of the End holes <ul style="list-style-type: none"> • Drilled according to marking • Drilled according to a gauge with bushing 	2	2.5	3	3.5	4	-	-
Distance between the centres of Adjacent holes <ul style="list-style-type: none"> • Drilled according to marking • Drilled according to a gauge with bushing 	1.5	-	-	-	-	-	-
Deviation in the dimensions of despatch elements after completion of fabrication, Assembled in positioners or in other devices with clamps in fixed positioners and also <ul style="list-style-type: none"> • According to guide blocks with pins • Assembled with bolts • Size (length & width) between Milled surface (for all cases of assembly) • The same made in separate details during machining & fixed during the assembling 	2 3 1 2 1	3 5 1.5 3 1.5	5 8 2 5 2	7 11 2.5 7 2.5	8 12 3 8 3	9 14 3.5 9 3.5	10 15 4 10 4



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<p>work with clamps</p> <ul style="list-style-type: none"> The same drilled according to positioners in finished str 							
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ANNEXURE –C

	Description	Permissible Deviation	Diagram
1	Square Butt Joints <ul style="list-style-type: none"> Gap between the ends of plates (d) Stepping of one plate over the other (s) 	± 1 mm 1.0 mm	
2	Single V-groove Joints <ul style="list-style-type: none"> Bevel angle (A) Gap betn. Two (d) Stepping of one plate over the other (s) Root thickness 	$\pm 5^\circ$ ± 1.00 mm 2.00 mm 1.00 mm	
3	Double V-groove Joints <ul style="list-style-type: none"> Bevel angle (A) Gap betn. Two (d) Stepping of one plate over the other (s) Root thickness 	$\pm 5^\circ$ ± 1.00 mm 2.00 mm 1.00 mm	
4	Lap Joints <ul style="list-style-type: none"> Overlap (B) Gap between the surfaces (e) 	5.00 mm 1.00 mm	
5	Tee Fillet Joints <ul style="list-style-type: none"> Gap between the edge of the web and the surface of the flange (e) 	2.00 mm	



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ANNEXURE – D

TOLERANCES IN ERECTED STEEL STRUCTURES

A. COLUMNS

S. N	Description	Tolerance (mm)
1.	Deviation of column axes at foundation top level with respect to true axes in Longitudinal / Lateral direction.	± 5
2.	Deviation in the level of bearing surface of columns at foundation top with respect to true level	± 5
3.	Out of plumbness (vert.) of column axis from true vertical axis and measured at column top : a) For columns without any special requirements : <ul style="list-style-type: none"> • Upto and including 30m • Over 30 m height b) For column with special requirements like cranes or such similar requirements : <ul style="list-style-type: none"> • Upto and including 30m • Over 30 m height 	$\pm H/1000$ subjected to $\pm 25\text{mm}$ maximum $\pm H/1200$ subjected to $\pm 35\text{mm}$ maximum $\pm H/1000$ subjected to $\pm 20\text{mm}$ maximum $\pm H/1200$ subjected to $\pm 35\text{mm}$ maximum
4.	Deviation in straightness in longitudinal & transverse planes of columns, at any point along the height.	$\pm H/1000$ subjected to $\pm 10\text{mm}$ maximum
5.	Difference in the erected position of adjacent pairs of columns along length or across width of building, prior to connecting trusses / beams, with respect to true distance.	± 5
6.	Deviation in any bearing or seating level with respect to true level.	± 5
7.	Difference in bearing levels of a member on adjacent pair of columns both across and along the building, from the true difference.	
NOTES: Tolerance specified under 3(a) and 3(b) should be read in conjunction with 4 and 5. "H" above is the column height in mm.		



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B. TRUSSES

Sl. No	Description	Tolerance (mm)
1.	Shift, at the centre of top chord member of truss with respect to the centre of span or vertical plane passing through the centre of bottom chord.	$\pm 1/250$ of height of truss in mm at centre of span subjected to ± 15 mm maximum.
2.	Lateral shift of top chord of truss at the centre of span from the vertical plane passing through the centre of supports of the truss	$\pm 1/1500$ of span of truss in mm subjected to ± 10 mm maximum.
3.	Lateral shift in location of truss from its true vertical position.	± 10
4.	Lateral shift in location of purlins from true position	± 5
5.	Deviation in difference of bearing levels of trusses or beam from the true difference.	$\pm L/1200$ subjected to ± 20 mm maximum. (where L=span)

C. CRANE GIRDERS & RAILS

Sl. No	Description	Tolerance (mm)
1.	Shift in the centre line of crane rail with respect to centre line of web of crane girder.	$\pm (\text{web thickness in mm} + 2) / 2$
2.	Shift in plan of alignment of crane rail with respect to true axis of crane rail at any point.	± 5
3.	Deviation in crane track gauge with respect to true gauge <ul style="list-style-type: none"> For track gauge upto and including 15 m. For track gauge more than 15 m. 	± 5 $\pm (5 + 0.25(S - 15))$, subject to maximum of +10 mm, where S in meters is the true track gauge
4.	Deviation in the crane rail level at any point from true level	± 10
5.	Difference in levels between crane track rails (across the bay) at <ul style="list-style-type: none"> Supports of crane girders Mid span of crane girders 	15 20
6.	Relative shift of crane rail surfaces at a joint in plan and elevation	2 mm subject to grinding of surfaces both for smooth transition

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7.	Relative shift in the location of crane stops (end buffers) along the crane tracks, along track gauge.	1/1000 of track gauge S in mm subject to maximum of 20 mm
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D. TOWERS

S. N	Description	Tolerance (mm)
1.	Out of plumbness vertically from the true vertical axis	1/1000 of the height

E. BUNKERS

S. N	Description	Tolerance (mm)
1.	Deviation in length of bunker from true length	$\pm 1/1000$ of length
2.	Deviation in width of bunker from true width	$\pm 1/1000$ of width
3.	Deviation in height of bunker from true height	$\pm 1/1000$ of height

F. DOWN COMERS

S. N	Description	Tolerance (mm)
1.	Erection and sag of down comers	0.0015 L but not more than 80 mm (L is length of pipe)

G. GAS PIPE LINE SUPPORTS

S. N	Description	Tolerance (mm)
1.	Deviations of support axes from vertical planes	0.002 h but not more than 20 mm



H. GAS AND AIR

S. N	Description	Tolerance (mm)
1.	Distortion of flanges /surfaces (except for the surfaces top one) with respect to branch pipe/pipe socket axis	2 mm per 1 m of flange diameter

NOTES: -



- The tolerances specified do not apply to steel structures where deviations from true positions are intimately linked with or directly influence the technological

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process. In such cases, the tolerances on erected steel structures shall be as per recommendations of process technologists / equipment suppliers.

2. The observed or calculated values of deviations of steel structures from their true positions shall be rounded off in accordance with IS:2-1960 for comparison with permissible tolerances specified in this table. The number of significant places retained in the rounded off value should be same as that specified in this table.
3. Alignment of all structures true to line, level plumb and dimensions within specified limits of tolerances as per IS :12843 “Tolerance for Erection of Steel Structures”.

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ANNEXURE – E

MATERIAL OF CONSTRUCTION (AS APPLICABLE)

1. Unless otherwise specified in the drawing :
 - (a) All rolled sections and plates up to 20 mm thick shall conform to Grade- E250 & quality A of IS:2062-2006 and shall generally be of tested quality(semi-killed).
 - (b) Plates beyond 20 mm thick and up to 40 mm thick subjected to dynamic loading shall conform to Grade-E 250 & quality B as per IS:2062-2006. (rolled in killed condition)
 - (c) Plates beyond 40mm shall conform to Grade-E 250 & quality B as per IS: 2062-2006 in normalized and ultrasonically tested quality.
 - (d) High strength micro-alloyed steel shall conform to SAIL-MA 350 HYA/HYB (SAIL product).
1. Steel sheets shall conform to IS: 1079-2009.
2. Chequered plates shall conform to IS: 3502-1994.
3. All gratings shall be of MS pressure locked electro forged.
4. The electro-forged gratings shall be of approved brand and of approved manufacturer unless otherwise agreed by owner. The type of grating selected shall be based on the loading, for the area in which the grating is provided and shall be subject to approval of owner.
5. Steel tubes for structural purposes shall conform to IS: 1161-1998 Grade YST-240).
6. Crane rails shall conform to IS: 3443-1980.
7. Collectors and down-comers shall be ERW410 pipes conforming to IS:3589-2001
8. Sheets used for cladding may be of the following types:
 - a. **Permanent Color coated (non-insulated) metal sheets** shall be troughed (Minimum depth of trough= 28 mm & Maximum pitch of trough= 200 mm) zinc-aluminium alloy (55% Aluminium, 43.4% Zinc and 1.6% Silicon) coated, not less than 150 gm/sq m, having High Tensile sheet (Fy=550 MPa) of 0.5 mm (minimum) Base Metal Thickness. These shall be used for the cladding system at roof & sides.

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The outer (exposed face) shall be permanently color coated with PVF2 paint of minimum DFT 20 microns over minimum 5 microns of primer and the inner side (inner face) shall be coated with same paint of minimum DFT 12 microns over minimum 5 microns of primer. These shall be fixed directly to purlins and side runners. The sheets shall meet the general requirement of IS: 15965 and shall conform to class 3 for the durability. The paint shall have medium gloss, minimum 40% GU with 60° head. All flashings, trim closures, caps etc. required for the metal cladding system shall be made out of plain zinc-aluminium alloy coated sheets having same specification as mentioned above.



- b. Translucent sheets (complementary to colour coated sheets)-** The polycarbonate translucent sheets, conforming to IS: 14443 shall be used for cladding / glazing / translucency purpose and shall have troughed profile to match with metal cladding profile. Minimum 3 mm thick fire retardant and UV resistant poly carbonate. Translucent sheet shall be installed along with metal cladding so as to have a water tight lapping. The sheets shall have min 80% translucency.
- c. Fire retardant sheets-** Poly carbonate sheets of minimum 6.0mm thick twin wall fire retardant sheets shall be used for temperatures around 100 degree Celsius.
- d. Glazing** shall be 6 mm thick rough cast wired glass as per IS: 3548-1988.
- e. Insulated panels for Roofing and Side Walls:** Prefabricated sandwich panels comprising troughed profile with outer sheet matching with permanent color coated (non-insulated) metal sheet specified above at point “a” and inner sheet made up of slight profiled linear tray of 0.5mm BMT 340 Mpa galvanized steel of 150 gsm zinc coating (total on both sides) with RMP color coating of 25 microns on the exposed side over the primer and 12 microns on the covered side over a 5 microns primer coat. The insulation material shall be of high density CFC- free 30mm (at the valley position of the outer sheet) thick polyurethane foam insulation of density 40 – 42 Kg/m³ sandwiched in between the two sheets. The panel should be finished with a male-female jointing system. The panels shall be fixed to the purlins with hexa-headed self-drilling fasteners of required size with synthetic washers at the crests. Flashing and capping (top and bottom) shall be made of pre-coated Galvalume sheet in plain form but in required shape

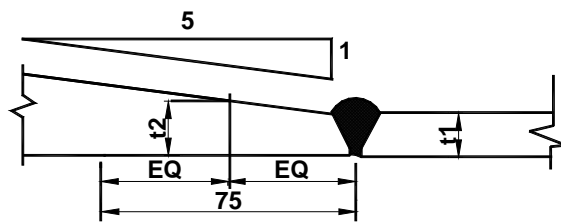
9. All permanent bolts shall be of Grade B (semi precision) conforming to IS:1364(Part 2)-2002. Material of bolts shall be of Class 4.6 or as per requirement and conforming to IS: 1367(Part 3) – 1991 unless noted

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otherwise. Hexagonal nuts for permanent bolts shall conform to IS: 1364(Part 3) – 1983. High strength bolts shall confirm to class 10.6 / 8.8. / 6.8 as specified in drawings.

10. All erection bolts shall be black hexagonal bolt of Grade C conforming to IS:1363(Part 1)-2002. Material of bolts shall be of Class 4.6 and conforming to IS:1367 unless noted otherwise. Hexagonal nuts for erection bolts shall conform to IS: 1363(Part 3)-2002.
11. All washers shall conform to IS: 6610-1972.
12. All HSFG bolts shall conform to IS: 3757-1985. Nuts for these bolts shall be of high strength conforming to IS: 6623-2004 and hardened steel washers to IS: 6649-1985.
13. All paint materials shall be conforming to Indian Standards and of approved make. For the paints where IS code doesn't exist , the manufacturer shall submit complete information of paint in the form of a catalogue and manufacturer's test certificate. The same shall specify quality of matching thinner, covering capacity, DFT etc. The make of the paint shall be approved by owner / consultant.
14. Covered electrodes for arc welding shall conform to IS: 814 - 2004 Electrode to be used for submerged arc welding shall confirm to specification IS: 7280-1974. Coding of electrodes shall be as follows :-
 - a) ER 421 'C' x for mild steel of Grade E250 quality A and B as per IS:2062-2006.
 - b) EB 542 'C' x H3X for
 - i) Mild Steel of Grade E250 quality B as per IS: 2062-2006 for dynamically loaded structures (arising out of crane, vibratory screen, equipment etc.)
 - ii) For SAIL-MA micro alloyed steel 350 HYA/HYB.
 - i)When combined thickness (CT) for steel conforming to IS: 2062-2006 exceeds 40mm as per Fig.1 below.
15. The MS / GI gratings shall be electro-forged and shall be of approved brand and manufacturer unless otherwise agreed by the owner. The type of grating selected shall be based on the loading area in which the grating is provided and shall be subject to approval of owner.

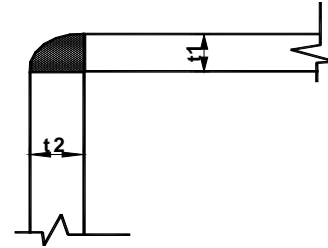
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$t2 = \text{Average thk. over 75 mm.}$

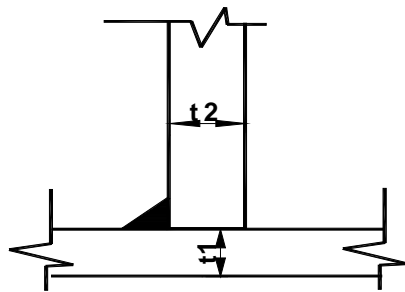
$$CT = t1 + t2$$

CASE 1



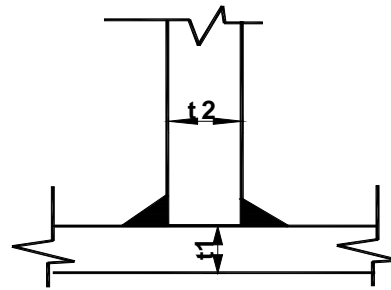
$$CT = t1 + t2$$

CASE 2



$$CT = 2 * t1 + t2$$

CASE 3



$$CT = \frac{1}{2}(2 * t1 + t2)$$

CASE 4

Fig. 1 – For Calculation of Combined Thickness (CT)



Where "C" in the electrode specification, is the designating digit for welding current & voltage conditions, as recommended by the electrode manufacturer.

Alternatively,

Electrodes may also confirm to AWS specifications and shall be as follows.

- E6013 for all fillet welds of IS2062 steel , gr E250 quality A & B
- E 7018 for all fillet welds of SAIL-MA 350 HYA Steel
- E7018 for all butt welds including site welds irrespective of quality of steel viz IS 2062 gr E250, quality A, B or SAILMA 350 HYA steel

However, electrodes, after their date of expiry or older than six months from date of manufacture, shall not be used.

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ANNEXURE- F

GENERAL COLOUR SCHEME FOR FINISHING PAINT



The following colour scheme shall be adopted.

S.No.	Structure	Colour	Colour No. as per IS:5
1	Roof structure including roof rafters, roof girders, roof legs, monitor trusses, purlins, sag rods and bracings, side girts, louvers etc.,	Air Craft Grey	693
2	Colours and associated intermediate column & column bracings.	Air Craft Grey	693
3	Crane girders including Auxiliary girders	Azure Blue	104
4	Doors and Window frames	Aluminum	-
5	Crane Walk-Way, surge and tie bracings along crane girders	Azure Blue	104
6	Monorails with maintenance Walk-Way	Post office Red	538
7	Gutters and rain collecting pipes	Black bituminous Aluminum	-
8	Hoppers, Chutes and Bin Structures except supporting beams	Post office Red	538
9	Floor beams and other working platforms with staircase not included in (5) above	Air Craft Grey	693
10	Fire escape platforms and all ladders & Crane stops	Signal Red	537
11	Crane stops	Post office Red	538
12	Hand rails a) Horizontal runners b) Vertical posts	Lemon Yellow Black	355 -
13	All conveyor gallery structures (except coke handling conveyor system)	Air Craft Grey	693
14	Trestle, Towers and Bridges for supporting lines	Dark Admiralty Grey	632
15	Members blocking passages	Lemon Yellow	355

VOLUME : IIF

Part - C

Architecture

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PRINCIPAL FEATURES OF BUILDING AND OTHER FACILITIES

01.00.00 General & Architectural Concepts for Buildings



Design and construction of buildings, structures etc. shall take into account requirement for operation and maintenance of all equipments and its users. The buildings shall have good architectural features. The surrounding areas shall be properly micro leveled and graded.

The architectural design concept of buildings structure shall be evolved considering the functional, technological and other requirements for efficient operation ensuring comfortable working environment for personnel, satisfying the aesthetic requirements. Special care shall be taken to provide elegance and aesthetics, with effective use of appropriate treatment, materials fittings and finishes. To achieve above objective, contractor shall employ a qualified architect/ architectural firm to carry out all design and hold all other architectural responsibilities for the project.

- i. Due consideration shall be given for providing adequate natural lighting and ventilation for plant and non-plant buildings both.
- ii. Internal finishes shall be provided with latest available materials with due consideration of the functional aspect of the area.
- iii. External finishes shall be provided with latest materials for improving the aesthetics. However, superior type finish shall only be applied to restricted areas for curtailment of cost.
- iv. The orientation of the important buildings shall be in line with the existing site condition and function as such each building shall have its own identity. However, a total homogeneity shall be maintained in the design in the all plant and non-plant buildings.

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- v. Adequate frontage shall be provided to all important buildings to create a better visual impact.
- vi. All other civil and structural buildings shall be developed in conjunction with the above aspects.
- vii. Water tank to be provided as per NBC guidelines.
- viii. Projection (500mm) to be provided over each window and ventilator.
- ix. Drop slab (550 mm clearance) should be considered for toilet block.
- x. Canopy to be provided wherever required.
- xi. All air-conditioned areas shall have false ceiling as per specification
- xii. RCC roof slab will be rendered water proof with water proofing treatment
- xiii. PCC apron should be provided all round the buildings with side drain.
- xiv. Exhaust fans of suitable ventilation capacity should be provided in toilets, pantry, etc. and in places where forced ventilation is required.
- xv. Inserts and cutouts should be provided to suit requirement
- xvi. Suitable access road should be provided for the buildings
- xvii. Requirement for illumination, civil part, ventilation and A/C for the buildings shall be provided as elaborated in the respective chapters.
- xviii. All service lines like electrical wiring, water pipe lines, etc. should be concealed.
- xix. Suitable openings / vents for window / split type air-conditioner and exhaust ventilation systems / exhaust fans shall be provided in the respective rooms as shown in the drawings.
- xx. Suitable drainage connection from the sink units and water tapping points to the building drainage system shall be provided in the respective rooms as shown in the drawings.
- xxi. Guidelines in point “G” shall also be followed along with the above points

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A) Administrative Building

a) Design Concept for Building:



The design of the Admin building has been envisaged as centrally air conditioned considering the administration & functional requirement (Refer General layout & technological requirement & write-up) for proper utilization and efficient operation ensuring sufficient lighting & ventilation for conducive working environment satisfying the overall modern befitting building aesthetics.

b) Planning & space organization:

The building envisaged to be 2 storied structure having total floor area of all floor about 600 sqm. for 20 nos of users (aprox) , Suitably planned with a central atrium and peripheral corridor providing circulation and access to the following tentative use areas mentioned floor-wise below:

i) Ground Floor:

- a) Centrally located atrium which could be used as reception-cum-lounge.
- b) Toilet block for male & Female
- c) Telephone exchange & Elect room
- d) Security & Utility Room
- e) Hall for employees
- f) 2 nos of rooms for higher officials
- g) Pantry
- h) AHU Room

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ii) First Floor:



- a) Room for GM with attached toilet & Conference hall
- b) 4 nos. rooms for higher official
- c) One discussion room
- d) Hall for employees
- e) Separate toilets for male & female
- f) AHU Room

iii) Interconnected sky walk way between new & old building to be provided

iv) Separate Parking Shed shall be provided for Cars (20 nos) & Scooters (20 nos).

v) Other design Consideration :



- i) A car porch having 4m height from road has to be provided at main entrance.
- ii) The building shall be accessed through an entrance lobby which will adjoin a centrally located atrium.
- iii) The atrium may be used as reception cum lounge where visitors waiting space along with toilets could be provided.
- iv) Staircases will be suitably located to have easy access from all the useable areas following NBC guidelines including approach to roof. One fire- escape staircase will also be suitably located.

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- v) Design will be an open-office planning concept with provisions for separate rooms for higher officials and other use-areas like conference room (for approx 30 persons), Discussion Spaces, Stores & Utilities, Pantry along with Entrance Lobby etc. to be suitably located.
- vii Service areas and Separate toilets will be provided for male & female employees along with space for drinking water facilities in each floor with easy access.
- vii) Stair lobby and lift lobby shall be segregated to each other.
- viii) False ceiling will also to be provided in the A/C Rooms like Conference Room, Top executives , In-Charges' Rooms etc.
- ix) Security room, telephone exchange, electric room to be provided at appropriate locations.
- x) Department-wise sitting arrangement and space allocation to be provided. Separate cubicles with attached toilet and PS office to be provided

B) SECURITY OFFICE

The Security office will be a single storied building having area of **200 sqm**, should be designed for office accommodation of about 20 security persons along with the facility of drinking water, toilet and pantry.

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C) GATE COMPLEX

There shall be one Gate Complex along with Time Office having area about **80 sqm** comprising of facilities such as Time punching (20sqm apprx each during entry and exit ,Reception/Pass section (15 sqm apprx) Time office (15 sqm apprx),Room for Security officer , Gents & Ladies Toilet (10 sqm apprx)

D) CONTROL ROOMS (Civil Building)



There shall be control rooms for various technological buildings, sizes of the control room shall be decided as per technological requirement (Refer General arrangement drawing and refer relevant technological TS). However the finishing items shall be in line with the followings:

E) SPECIFICATION OF FINISHES

i) Flooring

- a. Providing and laying full body/double charge Vitrified tiles in different sizes with water absorption less than 0.08 % and conforming to I.S. 15622, of approved make in all colours & shade in skirting, riser of steps, over 12 mm thick bed of cement mortar 1:3 (1 cement: 3 coarse sand), including grouting the joint with white cement & matching pigments etc. complete.(Preferable Size of Tile 600x600 x 9.25thick (approx) mm.)
- b. Acid / alkali resistant tiles 300x300x14 mm thick, jointed with acid / alkali resistant cement mortar. Bedding will comprise of potassium silicate mortar conforming to IS:4832 (Part-1) and resin based mortar like epoxy for jointing.
- c. 52 mm thick cement concrete flooring with concrete hardener topping, under layer 40 mm thick cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) and top layer 12 mm thick

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cement hardener consisting of mix 1:2 (1 cement hardener mix : 2 graded stone aggregate 6 mm nominal size) by volume, .hardening compound mixed @ 2 litre per 50kg of cement or as per manufacturers specifications.

- d. Marble stone flooring with 18mm thick marble stone in risers (sample of marble shall be approved by Engineer-in-charge) over 20mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) laid and jointed with grey cement slurry including rubbing and polishing complete.
- e. Providing and laying gang saw cut 18 mm thick, mirror polished pre moulded and pre polished machine cut granite stone of required size and shape of approved shade, colour and texture in footpath, flooring cut granite stone of required size and shape of approved shade, colour and texture in footpath, flooring in road side plazas and similar locations, laid over 20mm thick base of cement mortar 1:4 (1cement : 4 coarse sand) including grouting the joints with white cement mixed with matching pigment, epoxy touch ups etc.

ii) Painting



- a. All painting on masonry or concrete surface shall preferably be applied by roller. If applied by brush then same shall be finished off with roller.
- b. All paints shall be of approved make including chemical resistant paint. Minimum 2 finishing coats of paint shall be applied over a coat of primer.
- c. Premium Acrylic Smooth Exterior Paint: The paint should be applied in minimum 2 coats @1.43litre/10 sqm over and including priming coat of exterior primer applied @ 2.20 kg/10 sqm, on new plastered surfaces inclusive of all required tools, material, scaffolding and other painting accessories etc. The paint shall be applied as per the manufacturer's specifications and instructions

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and to the entire satisfaction of engineer-in-charge. The paint shall have excellent water resistant property.



- d. Stone work for wall lining etc. (Veneer work) over 20 mm thick bed of cement mortar 1:3 (1 cement: 3 coarse sand) and jointed with grey cement slurry @3.3kg/sq.m, including rubbing and polishing in complete. (Black polished granite stone slab, 20 mm thk / polished Sadarhally grey granite slab 20 mm thk). The final, finished coating shall be fungus resistant, UV resistant, water repellant, alkali resistant, and extremely durable with colour fastness.
- e. Acrylic emulsion paint shall be as per IS:15489. Acrylic distemper shall be as per IS:428. Cement paint shall conform to IS:5410, white wash/colour wash shall conform to IS:627.
- f. Fire resistant transparent paint as per IS:162 shall be provided on all wood work over French polish or flat oil paint. French polish shall conform to IS:348. Flat oil paint shall conform to IS:137.
- g. All fire exits shall be painted in post office red/signal red colour shade, which shall not be used anywhere else except to indicate emergency or safety measure.
- h. For painting on concrete, masonry and plastered surface IS: 2395 shall be followed. For painting on wood work IS: 2338 shall be followed.
- i. For painting on steel work and ferrous metals, BS: 5493 and IS: 1477 shall be followed. The type of surface preparation, thickness and type of primer, intermediate and finishing paint shall be according to the painting system adopted.

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- j. Bitumen primer used in acid/alkali resistant treatment shall conform to IS:158.
- k. All internal paints shall be of low VOC content conforming to GRIHA rating for reduction of VOC content.

iii) False ceiling

- a. Providing and fixing in position false ceiling with LUXALON 84 C ceiling system comprising of 84 mm wide x 16mm deep perforated panels roll of approved colour formed of 0.5mm thick Aluminium alloy stove enamelled on both sides fixed on panel carriers 62 mm wide x 29mm deep out of 0.95mm thick enamelled Aluminium satin black with cutouts to hold panels in a module of 100mm (16 mm gap between panels) at maximum 1.3 M c/c carriers to be suspended from roof by 4mm dia galvanised steel wire hangers with special height adjustment clips made of spring steel at maximum 1.3 M c/c hangers fixed to roof by "J" hook and Nylon inserts with provision of openings for fixing light fittings, air conditioning grills etc. complete with all bye works as per drawing and manufac-turer's specification.
- b. False ceiling of 12.5 mm thick tapered/square edge glass fibre reinforced gypsum board conforming to IS : 2095 having fine texture finish, including providing and fixing of frame work at all levels, for all kind of work, consisting of light weight galvanised steel member (minimum 0.8 mm thick and galvanised as per IS : 277) having maximum grid size of 1200 mm x 600 mm for supporting panels of specified size, suspended from RCC structural steel or catwalkway grid above, with 4 mm (minimum) galvanised wires (rods), with special height adjustment clips, providing angle section of minimum 25 mm width along the perimeter of ceiling, supporting grid system (minimum 0.8 mm thick and galvanised as per IS : 277), expansion fasteners for suspension arrangement from RCC, providing openings for AC ducts, return

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air grills, light fixtures, etc., all complete. (concealed grid and finished flat seamless and curve shape (dome etc.), finished smooth(seamless) along with the galvanised light gauge steel supporting system laid in profile to suit the profile of dome)

- c. False ceiling of 15 mm thick mineral fibre board, in tile form of size 600mm x 600mm, along with galvanised light gauge rolled form supporting system in double web construction pre painted with steel capping, of approved shade and colour, to give grid of maximum size of 1200x600. as per manufacturers details including supporting grid system, expansion fasteners for suspension arrangement from RCC, providing openings for AC ducts, return air grills, light fixtures, etc., all complete.
- d. False ceiling of 12 mm thk calcium silicate board of 'HILUX' or equivalent with suspension system as per manufacturers details including supporting grid system, expansion fasteners for suspension arrangement from RCC, providing openings for AC ducts, return air grills, light fixtures, etc., all complete. (With concealed grid and finished flat seamless).

iv) Wall Panelling

a. Aluminium Composite Panel

Aluminum Composite Panels for external wall cladding at all heights and elevation shall be fixed on to the supporting steel members, masonry wall, fastening material and hardware complete with all labour, material, equipment, handling, transportation, workmanship, preparation of working drawings, staging, scaffolding, etc., all complete. The aluminum composite panel should consist of 3mm thick thermoplastic core of anti oxidant LDPE sandwiched between 2 skins of 0.5mm thick aluminum alloy sheet making a total panel thickness of 4mm. The surface shall be finished with PVDF based coating of

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minimum 30 micron on the topsides and services coating on the reverse side shall be with polymer paint. Coating shall conform to ECCA or AAMA. the surface shall be protected with self adhesive peel of masking foil. The system shall be designed to withstand a wind pressure of 200kg/Sqm and shall be fixed to the Masonry/RC walls with necessary clamps, brackets and anchor fasteners. All clamps and brackets shall be Hot dip galvanized minimum 80 microns thick and shall conform to IS: 4759-1996. The extruded aluminum section shall be anodized in approved colour with a anodic coating of minimum 20 microns. Extruded section shall be 6063 T5 or T6 alloy conforming to ASTM B221. Any other fastening straps, nuts, bolts, rivets, washers, etc. shall be in stainless steel SS304 grade. EPDM gaskets, open cell polyethylene backer rods, weather sealant etc. shall be provided as per requirement.

Aluminium Composite Panel for internal encasement shall be with II B fire rated LDPE core mixed with mineral fibre.

F) COMMON ARCHITECTURAL DESIGN PARAMETERS FOR ALL ABOVE BUILDINGS:



a. Natural lighting & ventilation

Total window areas shall be a minimum of 15% to 20% of the floor area to ensure adequate lighting & ventilation.

b. Services

There shall be adequate space for services like Electrical Room, Maintenance Room, Utility, Store etc. Main stairs shall be easily accessible from the entrance. Toilet & Rainwater Pipe Lines (which may be enclosed or clubbed in semi-open ducts) shall be easily accessible for maintenance purpose & shall not spoil the aesthetics of the buildings.

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c. Roof Access

Building Roof shall be accessed through the staircase.

d. (i) Stairs

Stairs, having each flight width of minimum 1500 mm, shall not have normally more than 15 risers in one flight, with riser of 150 mm (apprx.) and a minimum tread width of 280 mm. Proper edge protection has to be ensured. A fire-escape stair shall also be provided at suitable location.

(ii) Railings

a. SS Railing

Providing and fixing stainless steel (Grade 304) 1000 mm height of knock down fixing system railing made of 38 mm dia stainless steel Handrail (Wall Thickness 1.5mm), 40mm x 40mm SS Square Baluster @ 900mm (maximum) c/c with complete fixtures, 16mm dia x 3 Nos. SS Horizontal Member. (The make shall be ARCH BRAND or Approved Equivalent Make) as per approval of Engineer-in-charge.

b. MS Railing



The details of MS handrail is provided in Civil technical rule part

e. Vertical Headroom

All accessible areas shall be provided with a minimum clear headroom as follows, unless otherwise specified:

- i) Floor height - 4000 mm (underside of beam)
- ii) Door opening, Walkways, platform etc. - 2100mm (Structural)

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- | | | | |
|------|------------------------|---|-------------------|
| iii) | Mumpty | - | 2500 mm (minimum) |
| iv) | Canopy | - | 3600 mm (minimum) |
| v) | Lintel level of window | - | 2100 mm (minimum) |

f. Roof Drainage

Roof drainage system shall be provided for quick and efficient draining of rainwater from roof to avoid seepage and damage to roof. The gradient for the roof shall not be less than 1 in 100. Roof System shall be designed to handle design requirements for the specific site.

g. Overhead water tank

Overhead water tank of required size will be provided at the roof top to meet the water requirements of the building.

Capacity of overhead water tank – 1 day's storage

h. Building Codes



The referenced publications given below shall be followed for the designing purpose:

BIS, NBC, BPE & British codes shall be followed.

i. Toilet facilities

Exhaust fans of suitable ventilation capacity shall be provided in toilet etc. and in places where forced ventilation is required.



- Separate toilets for ladies as well as gents shall be provided & shall have on each floor of service building. Attached toilets shall be provided for all senior executive rooms and conference rooms. The facilities provided in the toilet block shall depend on the number of users. However, minimum facilities to be

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provided shall be as stipulated below. IS: 1172 shall be followed for working out the basic requirements for water supply, drainage and sanitation. In addition, IS: 2064 and IS: 2065 shall also be followed.

Each toilet block shall have the following minimum facilities calculated based on minimum 25 persons as per stipulations of National building code . The facilities shall be suitably increased based on the stipulation of NBC for every increase of 25 users. Unless specified all the fittings shall be of chromium plated brass (fancy type).The toilet blocks shall be provided with adequate capacity exhaust

- i) All the facilities such as WC, Urinals, wash basins etc. shall be of approved colour .
- ii) WC (Indian type) Orissa pattern (580x440mm) as per IS: 2556 (Part-3) with all fittings including flushing arrangement of appropriate capacity and type
- iii) WC western type 390 mm high as per IS: 2556 (part 2) with toilet paper roll holder and all fittings including flushing system of appropriate capacity and type
- iv) Urinal with all fittings with photo voltaic control flushing system as per IS: 2556 (Part-6, Sec.1).
- v) Wash basin (oval shape) with all fittings as per IS: 2556 to be fixed on concrete platform finished with 12 mm thick polished granite stone.
- vi) Wall to wall Bathroom mirror (5.5 mm thick float glass) with bevelled edges including all fittings.
- vii) Stainless steel towel rail (600 x 20mm)
- viii) Stainless steel liquid soap holder cum dispenser
- ix) Janitor room.
- x) Installation of water cooler of adequate capacity.

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- xi) Provision of ventilation shaft.



Attached toilets provided for senior executive rooms and conference rooms shall have 1 WC, 1 urinal, 1 washbasin, 1 mirror, 1 no. Towel rail, 1 liquid soap holder cum dispenser. WC shall be of western type 390 mm high as per IS: 2556(Part-2) with toilet paper roll holder and all fittings including flushing valve of appropriate capacity and type. Roof water tank of minimum 1000 litres capacity shall be provided for each building toilet. Where number of toilets are to be served by the same tank the tank shall have capacity to cater to 8 hours requirement considering minimum 25 persons per toilet block Polyethylene water storage tank conforming to IS: 12701 shall be used. The tank shall be complete with all fittings including float valve, stop cock etc.

All plumbing sanitary fittings, connections and service lines shall be provided as per requirement. All service lines, water supply, plumbing lines and other utility lines shall be concealed with in the brick /concrete work and removable wooden panels shall be provided at intervals for access. Two stack system shall be provided for the toilets .

G. LANDSCAPING

To enhance the overall site environment a beautifully articulated landscape of the surrounding area has to be developed. Whole premises must be properly micro leveled and graded to help in cooling and enhance the microclimatic condition of the site.

- Adequate Trees/Plants those can grow in the local soil & climatic conditions will be planted in proper sequence to provided greenery to site location.
- Water tapping points will be provided at convenient locations for watering the plants.

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- c. Seasonal plants for gardening will be provided at strategic locations near office premises only.
- d. Water fountain will be provided in front of Office/Admin. building.
- e. Green Hedge will be provided on both sides of the roads near office premises only.
- f. Gardening with fencing without boundary wall around the buildings and vacant spaces, turfing and peripheral border plantation for the remaining area will be provided.

H. STATUTORY REQUIREMENTS

All the applicable statutory rules pertaining to Indian Factories act, Factory rules of state government, Fire safety rules of LPA, Water act of Pollution Control Boards, Explosives act etc. and stipulations of other relevant statutory authorities will be taken into consideration at the time of design.



Provisions of safety, health and welfare according to factories act will be complied with design stage. These will include provision of fire escape, locker room for workmen, pantry, toilets rest room etc.

Adequate number of fire escapes will be provided in a building. Fireproof doors, number of staircases, fire separation walls, lath plastering on structural steel member (in fire prone areas) will be made according to the recommendation of LPA. For fire safety requirements of buildings IS: 1641 and IS: 1642 will be followed in addition to LPA requirements. All masonry firewalls will be minimum 345 mm thick and RCC firewall will be minimum 200 mm thick.

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I. DRAWINGS

i.	Site Plan and Landscape drawings to be furnished during detailed engineering	Suitable scale
ii.	Floors + Roof Plans	1 : 100 scale
iii.	Elevations	1 : 100 scale
iv.	Sections	1 : 100 scale (through stairs & toilets must)
v.	Part sect. & details, sch. & details of doors, windows & finishes, detail of water supply & sanitation fixtures and service lines – to be furnished during detailed engineering	1 : 50, 1 : 25, 1 : 10 or any suitable scale



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J. INTERIOR FINISHING SCHEDULE FOR OTHER USE AREAS



SL. No.	Description of area	Flooring	Skirting/Dado	Wall	False Ceiling	Ceiling
1	Main power house Building.					
	a) Unloading Bay	Cement concrete with Metallic hardener topping		Acrylic distemper		--
	b) Cable vault	Cement concrete with Metallic hardener topping		Acrylic distemper		Acrylic distemper
	c) Balance area including passage	-do-		-do-		-do-
	d) SWAS Room	Vitrified tiles.	150mm high vitrified tiles matching with floor tiles	Acrylic emulsion paint.		Mineral fiber board false ceiling.
	e) Equipment Area, ESP , SWGR/ACP Room/UAF Room	Cement concrete with Matallic hardener topping	150mm high cement concrete	Acrylic distemper		Acrylic distemper
	f) UPS Battery charger room	Vitrified tiles.		Acrylic emulsion paint.		
	g) Deaerator floor	Cement concrete with Metallic hardener topping.	150mm high cement concrete			Metal deck roofing (bottom of sheeting with RAL 9002 finish)
	h) Operating Floor	20 mm thick	150 mm high	Colour		-do-

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SL. No.	Description of area	Flooring	Skirting/Dado	Wall	False Ceiling	Ceiling
		Granite stone (polished & shot blasted in ratio of 80:20).	with same material matching with floor	coated Metal cladding on A-Row & Gable end, up to crane girder level.		
	General circulation and movement areas	20mm thk. Polished granite stone/marble stone/Vitrified Ceramic tiles.	-do-			Acrylic distemper (except metal deck area).
	i) Switchgear room	Cement concrete with Metallic hardener topping	-do-	Acrylic distemper		Acrylic distemper
	j) MCC Room	-do-		-do-		-do-
	k) Control room area including control room, computer room,	Vitrified tiles	150 mm high with same material matching with floor	Partition in Fire rated glass & Aluminum composite panel cladding for columns	Luxalon 84c	White wash
	l) Control equipment room,	Vitrified ceramic tiles	150 mm high with same material matching with floor	Vitrified ceramic tiles for wall cladding & Aluminium composite panel cladding for columns	Luxalon 84c	White wash
	m) Conference room, senior executive room.	Vitrified ceramic tiles	150 mm high with same material	Glazed partition with anodized	Luxalon 84c	White wash

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SL. No.	Description of area	Flooring	Skirting/Dado	Wall	False Ceiling	Ceiling
			matching with floor	Aluminum frame/Acrylic emulsion paint.		
	n) Record room	Heavy duty dust pressed ceramic tiles	150 mm high with same material matching with floor	Acrylic distemper		White wash
	o) Locker room	Heavy duty dust pressed ceramic tiles	150 mm high with same material matching with floor	Acrylic distemper	-	Acrylic distemper
	p) Toilet area	Anti skid Heavy Duty ceramic tiles and 18mm thick. Polished granite in one piece for wash platform	Designer ceramic wall tiles upto 2.1m ht.	Acrylic distemper for balance height.		White wash
	q) Office Room, Staff Room/Library	Vitrified ceramic tiles.		Acrylic emulsion paint.	Luxalon 84c	White wash
	r) Laboratory area	Heavy duty ceramic tiles.	Designer ceramic wall tiles upto 1.2m. ht.	Acrylic distemper/chemical resistant paint.	Gypsum board false ceiling as/profile or chemical resistant paint.	White wash
	s) RCC Stair Case	a. Tread-Kota stone with bull nosing b. Riser-White marble	Vitrified Ceramic Tiles upto 1.2 ht	Resin bonded granular texture finish for balance height.	-	Acrylic Distemper
	t) Lift areas	20mm thick polished Marble		Acrylic emulsion	Luxalon 84c	

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SL. No.	Description of area	Flooring	Skirting/Dado	Wall	False Ceiling	Ceiling
		Stone/granite stone as/pattern		paint or 18mm thick polished marble/granite cladding.		
	u) Passages and general circulation areas.	20mm thick polished Marble Stone/granite stone	150 mm high with same material matching with floor	Acrylic Distemper/acrylic emulsion paint.		Acrylic emulsion paint
	v) Battery Room	Acid and alkali resistant tile	150 mm high with same material matching with floor	Acid and alkali resistant epoxy coating up to 1.2m height and chemical resistant paint for balance height.		Chemical Resistant paint.
	w) Pathways including area.	22 mm thick concrete chequered tiles.	150 mm high with same material matching with floor	-	-	-
2.	Admin Building					
	a) Entrance Lobbies and areas/Foyer/Exhibition space/Canteen	20mm thick polished marble stone/granite stone as/pattern.	150 mm high with same material matching with floor	Textured paint/acrylic emulsion paint or 18 mm thick polished marble/granite cladding.	Mineral Fiber Board False Ceiling	White wash

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SL. No.	Description of area	Flooring	Skirting/Dado	Wall	False Ceiling	Ceiling
	b) Conference room, senior executive room.	Vitrified tiles	150 mm high with same material matching with floor	Glazed partition with Aluminium frame/Acrylic emulsion paint	Mineral Fiber Board False Ceiling.	White wash
	c) Office Room, Staff Room/Library.	Vitrified ceramic tiles.	150 mm high with same material matching with floor	Acrylic emulsion paint	Gypsum Board False Ceiling as/profile	White wash
	d) Passage	Vitrified ceramic tiles.	150 mm high with same material matching with floor	Textured paint/acrylic emulsion paint.	Mineral Fiber Board False Ceiling	White wash
	e) RCC Stair case	Marble stone/granite stone. (Riser & Tread)	-	Marble stone/granite stone up to 1.2m. ht. & Textured paint above.		Acrylic Distemper
	f) Toilet/Pantry/ Kitchen	Anti skid Heavy Duty ceramic tiles and Granite stone in one piece for wash basin platform.	Designer ceramic wall tiles dado upto 2.1 m. height	Acrylic distemper for balance area height.		White wash
	g) AHU/A.C. Plant room/MCC Room/Store	Cement concrete with Metallic hardener topping.	150 mm high with same material matching with floor	Acrylic distemper/W all Insulation in AHU		Acrylic distemper
	h) Covered parking area	Pavers interlocking cement concrete block.		External finish		Acrylic distemper
	i) Pathways	22mm thick				

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SL. No.	Description of area	Flooring	Skirting/Dado	Wall	False Ceiling	Ceiling
	including roof area.	concrete chequered tiles.				
3.	ESP control building/Air compressor house/ARCW. building					
	a) Operating/Maintenance areas	Cement concrete with Metallic hardener topping	150 mm high with same material matching with floor	Pre color metal panel cladding.	-	Acrylic distemper (except metal deck area)
	b) Office Room, Staff Room	Vitrified -tiles.	150 mm high with same material matching with floor	Acrylic emulsion paint	-	Acrylic emulsion paint
	c) Control Room	Vitrified - tiles.	150 mm high with same material matching with floor	Vitrified tile cladding on walls up to false ceiling & column encased with ACP.	Luxalon84c	White wash
	d) MCC room	Cement concrete with Metallic 150 mm high with same material matching with floor hardener topping 150 mm high with same material matching with floor		Acrylic distemper		Acrylic distemper (except metal deck area)
	e) RCC Stair case	Marble stone/granite stone.		Vitrified tile up to 1.2m. ht. & Acrylic Distemper		Acrylic distemper
	f) Battery Room	Acid, Alkali		Acid, Alkali		Acrylic

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SL. No.	Description of area	Flooring	Skirting/Dado	Wall	False Ceiling	Ceiling
		resistant tile.		resistant tile		distemper
	g) AHU/AC Plant room/Cable vault	Cement concrete with Metallic hardener topping		Acrylic distemper		Acrylic distemper
	h) Toilets	Anti skid Heavy Duty ceramic tiles and Granite stone in one piece for wash basin platform.	Designer ceramic wall tiles dado upto 2.1m	Acrylic distemper for balance height.		Acrylic distemper /Calcium Silicate false ceiling.
4.	Gate					
	a) Reception/Waiting	Marble stone/granite stone.	150 mm high with same material matching with floor	Textured paint/acrylic emulsion paint	Mineral fiber board false ceiling -	White wash
	b) Office/Guard Room/Conference/ Viewing Gallery/Staff room	Vitrified -tiles.	150 mm high with same material matching with floor	Acrylic distemper/ Acrylic emulsion paint		Acrylic distemper
	c) Sitting and General Area	Granite stone/Vitrified ceramic tiles.	Designer ceramic wall tiles up to 1.2m	Textured Paint for balance height . Glass mosaic tiles for murals & Glass blocks for interior purpose.		Acrylic distemper /Gypsum board false ceiling/Al uminium False ceiling
	f) Toilets	Heavy Duty Dust pressed ceramic tiles and Granite stone in one piece for wash basin platform.	Designer ceramic wall tiles.	Designer ceramic wall tiles.		
	g) Stores	Cement concrete	150 mm high	Acrylic	-	Acrylic

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SL. No.	Description of area	Flooring	Skirting/Dado	Wall	False Ceiling	Ceiling
		with Metallic hardener topping.	with same material matching with floor	distemper.		distemper
	CHP Maintenance Building / Permanent / store / Workshop building.					
	a) Workshop / Stores	Cement concrete with Metallic hardener topping.	150 mm high with same material matching with floor			Acrylic distemper (except metal deck area)
	b) Office Room, Staff Room	Vitrified Tiles.	150 mm high with same material matching with floor	Acrylic emulsion paint.	Mineral fiber board false ceiling / Acrylic distemper.	
	c) Passages	Vitrified Tiles.	150 mm high with same material matching with floor	Acrylic distemper.	Mineral fiber board false ceiling / Acrylic distemper.	
	d) RCC Stair case	a) Tread 18mm thick polished with flomming b) Riser - 18mm marble stone.	-	Vitrified Ceramic Tiles 1.2 m. ht. & Distemper above.	.	Acrylic distemper
	e) Toilets	Anti skid Heavy Duty ceramic tiles and Granite stone in one piece for wash basin platform.	Designer ceramic wall tiles dado upto 2.1 m. height	Acrylic distemper for balance area height.	-	Acrylic distemper
	Mill & Bunker building / Track Hopper / T.P. / Conveyer's / gallery /					

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SL. No.	Description of area	Flooring	Skirting/Dado	Wall	False Ceiling	Ceiling
	Crusher					
	a) Toilets	Anti skid Heavy Duty ceramic tiles and Granite stone in one piece for wash basin platform.	Designer ceramic wall tiles dado upto 2.1 m. height	Acrylic distemper for balance area height.	-	Acrylic distemper
	Fire water pump house					
	a) Maintenance / Pump floor / PLC	Cement concrete with Metallic hardener topping.	150 mm high with same material matching with floor	Acrylic distemper.		Acrylic distemper (except metal deck area)
	b) Control room / PLC	Vitrified tiles	150 mm high with same material matching with floor	Acrylic Emulsion paint.	Mineral fiber board false ceiling.	White wash
	c) Toilet area	Anti skid Heavy Duty ceramic tiles and Granite stone in one piece for wash basin platform.	Designer ceramic wall tiles upto 2.1 m / ceiling ht.	Acrylic distemper for balance height.	-	Acrylic distemper
8.	Fire water booster water pump house / Foam pump house.					
	a) Maintenance / Pump floor / PLC	Cement concrete with Metallic hardener topping.	150 mm high with same material matching with floor	Acrylic distemper for balance height.	-	Acrylic distemper
	b) Control room / PLC	Vitrified Ceramic Tiles.	-do-	Acrylic Emulsion paint.	Mineral fiber board false ceiling.	-
	c) Toilet area	Anti skid Heavy Duty ceramic tiles	Designer ceramic wall	Acrylic distemper for	-	-

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SL. No.	Description of area	Flooring	Skirting/Dado	Wall	False Ceiling	Ceiling
		and Granite stone in one piece for wash basin platform.	tiles upto 2.1 m / ceiling ht.	balance height.		
9.	Ash slurry pump house / Ash water pump house / Silo Area Utility Building / Ash Water recirculation Pump House / Transport air compressor house / HCSD pump house / Ash Dyke Maintenance building.					
	a) Operating / Maintenance areas / MCC room.	Cement concrete with Metallic hardener topping	150 mm high with same material matching with floor	Acrylic distemper	-	
	b) Office Room, Staff Room	Vitrified ceramic tiles.	150 mm high with same material matching with floor	Acrylic emulsion paint.		
	c) Control Room	Vitrified Ceramic Tiles.	150 mm high with same material matching with floor	Acrylic emulsion paint.	Mineral fiber board false ceiling.	
	d) RCC Stair Case	a) Tread 18mm thick polished with flomming b) Riser - 18mm marble stone.	-	Marble stone / Granite stone up to 1.2 m ht. & Acrylic emulsion paint.		
	e) Toiler area	Anti skid Heavy Duty ceramic tiles	Designer ceramic wall	Acrylic distemper for	Acrylic distemper.	

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SL. No.	Description of area	Flooring	Skirting/Dado	Wall	False Ceiling	Ceiling
		and Granite stone in one piece for wash basin platform.	tiles upto 2.1 m / ceiling ht.	balance height.		
10.	CWPH & Other auxiliary building.					
	a) Workshop / Operating / Maintenance areas / MCC areas.	Cement concrete with Metallic hardener topping.	150 mm high with same material matching with floor	Acrylic distemper.	-	
	b) Office Room, Staff Room	Vitrified Ceramic Tiles.	150 mm high with same material matching with floor	Acrylic emulsion paint.	Acrylic emulsion paint.	
	c) Control Room	Vitrified Ceramic Tiles.	150 mm high with same material matching with floor	Acrylic emulsion paint.	Mineral Fiber board false ceiling.	
	d) Acid / Alkali storage area / CW treatment area / DM plant area / Regeneration area / Neutralization pit etc.	Acid, Alkali resistant tile as per requirement.	-	Acid / Alkali resistant tile as per requirement.	Acrylic Distemper.	
	e) RCC Stair case	a) Tread 18mm thick polished with flomming b) Riser - 18mm marble stone		Marble stone up to 1.2 m ht. & Acrylic Distemper paint.	Acrylic Distemper.	
	f) Toiler area	Anti skid Heavy Duty ceramic tiles and Granite stone in one piece for wash basin platform.	Designer ceramic wall tiles upto 2.1 m / ceiling ht.	Acrylic distemper for balance height.		
	Note :					

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SL. No.	Description of area	Flooring	Skirting/Dado	Wall	False Ceiling	Ceiling
	<ol style="list-style-type: none"> All wall and roof areas above false ceiling shall be plastered and white washed. The colour and pattern of finish shall be as per approved details. All materials shall be of reputed and established brand approved by Engineer-In-charge. Wherever alternative materials are specified, the final selection rest with Engineer-in-Charge. This finishing schedule shall also be applicable to similar functional areas for all other buildings and facilities. All the finishing materials shall be applied / provided as per manufacturer specification and guidelines under the supervision & guidelines of manufacturer. Requirement given above are suggestive and minimum. Bidder is welcome to suggest alternative scheme conforming to design functional requirement subject to approval of the Engineer-in-Charge. 					
Window	Glazed anodized aluminium window					
Handrails for (Admin building, Control room building)	Providing and fixing stainless steel (Grade 304) 1000 mm height of knock down fixing system railing made of 38 mm dia stainless steel Handrail (Wall Thickness 1.5mm), 40mm x 40mm SS Square Baluster @ 900mm (maximum) c/c with complete fixtures, 16mm dia x 3 Nos. SS Horizontal Member. (as per approved least of preferred makes)					
Handrails for other buildings	Please refer Civil chapter					
External finish						
Sl. No.	DESCRIPTION OF AREA	WALL AND PROJECTIONS		SOFFIT OF PROJECTIONS		
1.	Main plant building & Fire walls in Transformer yard; Other Auxiliary building in steel framed structure.	Premium Acrylic Smooth Exterior plant of approved colour / colour combination over plastered surface on masonry / concrete. Approved colour / colour combination of colour coated metal cladding.		Premium Acrylic Smooth Exterior Paint over plastered surface. Approved colour / colour combination of colour coated metal cladding.		
2.	Building with concrete frame work, etc.	Premium Acrylic Smooth Exterior plant of approved colour / colour combination. For Admin. Bldg. /		Premium Acrylic Smooth Exterior Paint over plastered surface.		

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SL. No.	Description of area	Flooring	Skirting/Dado	Wall	False Ceiling	Ceiling
			Aluminum composite Panel Cladding.			
Note :						
1. The color and pattern of finish shall be as finalized by Engineer.						
2. All materials shall be of reputed and established brand approved by Engineer.						
Pathway/parking	80 mm thick (M-25) interlocking coloured paver block over 150mm thick sand over 100mm thick gravel with kerb stone (400mm high x 300mm width in all edges to be provided).					
Aluminium partition	Aluminum Partition with compact laminate board upto 900mm and glass above 900mm high					
Specification and Finishing item for other technological building refer Civil & Structural write-up.						



K. Doors & Windows

- i. Doors, windows and ventilators of air-conditioned areas, entrance lobby of all buildings(where ever provided), and all windows and ventilators of all buildings (unless otherwise mentioned) shall have, electro colour dyed (anodised with 15 micron coating thickness)aluminium framework with glazing. All doors of toilet areas shall be of steel framed solid core flush shutter. For Mill Bunker Building, transfer points, crusher house, conveyor gallery, steellouvered windows shall be provided.
- ii. Main entrance of the common control room and control equipment room shall be provided with air-locked lobby with provision of double doors of aluminium framework with glazing.Doors shall be of double action floor springs mounted.
- iii. For common control room building 120 minutes Fire Rated Fully Glazed non load bearingfixed partition with valid fire test certificate from national or international lab shall be provided.The Partition Frame shall be manufactured from minimum 2.0mm galvanized steel sheet pressed to form a profile of nominal size 60mm x 70 mm & fixed to the supporting construction by means of M 10 X 120 or bigger steel bolts at 300mm from the edges & every 500mm c/c. The frame shall be finished with etch primer for

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scratch resistance and shall be powder coated of approved shade and color. The glass panels shall be minimum 11mm thick, 120 minute fire rated, with 15 minute full insulation non wired toughened glass having a sound reduction of greater than 37dB, light transmission of 87% and compliant to class 1B1category of impact resistance as per EN 12600. The glass shall be held in position with minimum 1.6mm G.I Beading, clamped or bolted to the frame profile by 4mm x 35mm steel screws at every 250 mm c/c and a ceramic tape of cross section of 5mm x 20mm on both sides of the glass. The item shall include in tumescent putty and fire resistant acrylic sealantsand the total assembly shall satisfy the fire resistance criteria of stability, integrity & partialinsulation. For Auto sliding doors, all necessary hardware with same fire rating shall also be provided. Shop drawings for the item with all construction and anchoring details along with fire rating test reports shall be got approved from Engineer-in-Charge before execution.

- iv. Single glazed panels with aluminium framework shall be provided as partition between two air-conditioned areas wherever clear view is necessary.
- v. a) The doors frames shall be fabricated from 1.6 mm thick MS sheets and shall meet the general requirements of IS:4351.
- b) All steel doors shall consist of double plate flush door shutters. The door shutter shall
be 35 mm (min.) thick with two outer sheets of 1.2 mm rigidly connected with continuous vertical 1.0 mm stiffeners at the rate of 150 mm centre to centre. Side,
top and bottom edges of shutters shall be reinforced by continuous pressed steel channel with minimum 1.2 mm. The door shall be sound deadened by filling the
inside void with mineral wool. Doors shall be complete with all hardware and fixtureslike door closer, tower bolts, handles, stoppers, aldrops, locks etc.
- c) Steel windows and ventilators shall be as per IS:1361 and IS:1038.



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- vi. Wherever functionally required Rolling shutter (fully closed/partly grilled) with suitable operating arrangement (manual/Electric) shall be provided to facilitate smooth operations. Rolling shutters shall conform to IS:6248. M.S sliding doors with suitable mechanical and electrical operations fixtures as per requirement for bigger openings shall be used.
- vii. All windows and ventilators on ground floor of all buildings shall be provided with suitable Aluminium grill.
- Viii. Fire-Proof doors with panic devices shall be provided at all fire exit points as per requirements. These doors shall generally be as per IS:3614 Part-II. Fire rating of the doors shall be of minimum 2 hours. These doors shall be double cover plated type with mineral wool/wood insulation.
- ix. Hollow extruded section of minimum 2 mm wall thickness as per IS: 1285 shall be used for all aluminium doors, windows and ventilators.
- x. Minimum size of door provided shall be 2.1 m high and 1.2 m wide. However for toilets minimum width shall be 0.75 m and office areas minimum width shall be 1.20m.
- xi. Electrically operated, self operable/closing, aluminium framed with tinted glass Automatic Sliding operating system for Glass doors comprising of Advanced DC brushless motor, Automatic Reversing Safety Device, Suitable for door weight 100 kg, Opening speed : 90-110cm /sec (adjustable), Closing Speed : 40-110cm/sec (adjustable), opening time : within 1-9 seconds after door stopped in opening, controller : 8 Bit micro computer, Motor (Dortexorequivalent) : DC12V, 35W brushless motor, Power Voltage : AC 110V - 240V. 50Hz - 60Hz, Power Consumption : 45W including Infra Red Sensors 2 No both sides, make of best and approved quality shall be provided.

L. Glazing



- I. All accessible ventilators and windows of all buildings shall be provided with min. 4mm thick float glass, plain or tinted for preventing solar radiations,

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unless otherwise specified. All inaccessible (where regular maintenance is not feasible) ventilators and windows of all buildings shall be provided with 6mm thick clear toughened glass. 2 mm thick polycarbonate sheet with profile matching with metal sheeting shall be provided in TPs, conveyor galleries and Mill Bunker Building. The Polycarbonate sheets shall be fire and u/v resistant, and suitable for continuous use up to a temperature of 100°C. Suitable aluminium beading shall be used. The open ends of the sheet shall be sealed as per manufacturer's recommendations.

- II. Sky light structure shall be provided as per design in curved shape 1m. wide and in 0.30M height, with 4mm embossed clear translucent polycarbonate IR sheet both side UV coated minimum 55% light transmission, solar control, approved make, texture and shade, fixed top powder coated Aluminium section with 60mm width top & bottom with EPDM rubber gasket as per standard framing including fabrication and erection of structural frame in square M-stubs to obtain the required shape, painting of structural members with adequate provision for expansion including all fittings, anchoring accessories, fixtures, joint sealing with EPDM gasket & weather sealants to make the complete structure water proof, fittings & fixing the complete skylight structure to RCC / Steel structural member, wastages etc. complete with all labour, scaffolding, material, equipments, handling, transportation, workmanship, preparation of working drawings including structural design, all complete, as per specifications, drawings and instructions of the Engineer-in-charge. The contractor shall submit the design and detailing of the structure much in advance (before casting of A-B Bay roof) to Engineer -in -charge to ensure the proper size and placement of insert plate for supporting structure. Supporting structure shall be painted as specified for other steel structures. The metal decking shall be cut smoothly in the area of sky light just before the placement of sky light.



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- iii. All windows and ventilators located in fire prone areas shall be provided with minimum 6 mm thick toughened glass conforming to IS:5437.
- iv. For single glazed aluminium partitions and doors, 8mm or 10 mm thick clear toughened glass shall be used.
- v. Toughened glass of 6mm thickness shall be used for all windows/ventilators in toilets.
- vi. All glazing work shall conform to IS:1083 and IS:3548.
- vii. For main plant glazings, 6mm thk. reflective toughened glass, with following technical characteristics: Solar factor 45% or less, U-value less than 5.7 W/m².K, VLT min 40%: The glass to be used should be from the manufacturers of glass like Saint Gobain (India) or ASAHI (India) or equivalent. The glass should be free from distortion and thermal stress..
- viii. For glazings of Air Conditioned Buildings Composite double glazing shall be 24mm thick consisting of 6mm thick clear toughened glass on inner side and 6mm thick reflective toughened glass on outer side. The two glasses shall be separated by 12mm air-gap and hermetically sealed by beading of anodized aluminium with outer edge sealed with silicon sealant. Outer glass of 6mm thickness shall have following technical characteristics: Solar factor 25% or less, U-value less than 2.268 W/ SQMK, VLT min 30%: The glass to be used should be from the manufacturers of glass like Glavebel (Belgium), Saint Gobain (France) or Fort (USA) Or equivalent. The glass should be free from distortion and thermal stress. For CER & Control room, 24 mm thick hermitically sealed double glazing with toughened, fire resistant plane glass & tinted glass shall be provided. For glazing in non A/C areas of A/C Building single 6mm thick reflective glass shall be provided.
- ix. Glass block masonry work with glass blocks of size 190 x 190 x 90 (min), jointed with suitable adhesive complete as per the best construction practices.
- ix. For internal glazed partition, 8mm thick & 10mm thick clear toughened glass shall be provided



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M . STANDARD ALUMINIUM SECTION

Sl. No.	Description	Size	Weight Kg/mtr.
I.	DOORS		
	A. Normal Door		
1.	Door Vertical Plain	85x44.5x2	1.365
2.	Door Vertical	-do-	1.412
3.	Door Bottom (for upto 1 mtr. Shutter Width)	101.1x44.5x3.1	2.379
4.	Door Bottom (for more than 1 mtr. Shutter Width)	180x44.5x3.18	3.438
5.	Door Top	101.1x44.5x3.1	2.379
6.	Lock Rail	150x44.45x3.2	3.290
7.	Glazing Clip	19.7x17.8x1.3	0.167
	B. Twin Style Door		
1.	Top/Bottom Rail (for 12mm glass thickness)	90x45x3	3.727
2.	Top/Bottom Rail (more than 12mm glass thickness)	90x45x3.0	3.506
	C. Frame	120x80x3	3.143
II	A. Casement Window (Window is Flushing outside wall) – 40mm Series		
1.	Z Shutter	40x28x2.5	0.585
2.	Hollow Z Shutter	41.50x29x1.5	0.636
3.	Mullion	63x40x1.5	0.933
4.	H Shutter/alternative of Sl. No. 2	40x41x2.5	0.638
5.	Crimping Angle	50x50x4.9	1.177
6.	Double glazing clip	25x8x1.2	0.132
7.	Single glazing clip	24x25x1.2	0.166

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	Sl. No.	Description	Size	Weight Kg/mtr.
	B.	Sliding Window		
	1.	2 Track Bottom	61.98x29.70	0.875
	2.	2 Track Side & Top	61.98x29.70	0.778
	3.	3 Track Bottom	92.36x29.70	1.233
	4.	3 Track Side & Top	92.36x29.70	1.067
	5.	4 Track Bottom	123.02x29.70	1.500
	6.	4 Track Side & Top	123.02x29.70	1.293
	7.	Shutter Vertical	39x20x1.5	0.493
	8.	Shutter Interlock	39x20x1.5	0.612
	9.	Shutter Top & Bottom	41x20x1.5	0.472
	PARTITIONS			
	A.	Partition (Height more than 1.5 mtr.)		
	1.	Single Partition (Single Glazing)	101.5x44.45x3	2.34
	2.	Double Partition (Single Glazing)	101.5x44.45x3	2.420
	3.	Single Partition (Double Glazing)	101.5x44.45x2.5	2.03
	4.	Double Partition (Double Glazing)	101.5x44.45x2.5	2.00
	B.	Partition (Height upto 1.5 mtr.)		
	1.	Single Partition (Single Glazing)	63.5x38.1x2.5	1.376
	2.	Double Partition (Double Glazing)	63.5x38.1x2.5	1.443
	3.	Glazing Clip	19.7x17.8x1.3	0.167



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N . SANITARY

Sl. No.	Item	Size
1	EWC with Seat Cover	390(H) x 360 x 430 (App.)
2	IWC (Orissa pan)	580 x 440mm
3	PVC flushing cistern	10/6 Ltr. Capacity
4	Stainless Steel Sink with drain board	1040 x 450 x 200 (d)mm
5	Wash Basin(with pedestal)	550 x 400 mm
6	Counter top wash basin	As per design
7	Urinal	610 x 400 x 380 mm
8	Urinal channel	as per manufacturer's details
9	Bottol Trap	as per manufacturer's details
10	6mm thick Mirror Glass with E Board backing	600 x 450mm
11	6mm thick Mirror Glass with E Board backing	As per design / drawing
12	PVC Moulded Self	550 x 75mm (minimum)
13	Soap Tray	150 x 75mm
14	Towel Rail	600 x 16mm
15	CP Brass Quarter Turn Pillar Tap	As per design / drawing
16	CP Brass Quarter Turn Bib Cock	As per design / drawing
17	CP Brass Quarter Turn Angular Stop Cock	As per design / drawing
18	PVC Water Tank	As per design
19	PVC Rain Water Pipe	As per design
20	CI Floor Trap with Jali	As per IS & design
21	Gully Trap	As per IS & design
22	SW Pipe	As per IS & design
23	G.I. Fittings	As per IS & design
24	Gun Metal Valve	As per IS & design
25	G.I. Pipes	As per IS & design
26	C.I. Pipes	As per IS & design
27	C.I. Fittings or accessories	As per IS & design
28	18mm thick white Marble Urinal Partition	600 x 1200mm
29	Pressmatic Tap for urinal with spreader & connector	As per design

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QUALITY ASSURANCE AND INSPECTION FOR CIVIL WORKS

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QUALITY ASSURANCE AND INSPECTION FOR CIVIL WORKS

1.0.0 INTRODUCTION

- 1.1.0 This part of the specification covers the sampling, testing and quality assurance requirement (including construction tolerances and acceptance criteria) for all civil and structural works covered in this specification.
- 1.2.0 This part of the technical specification shall be read in conjunction with other parts of the technical specifications, general technical requirements & erection conditions of the contract. Wherever IS code or standards have been referred they shall be the latest revisions.
- 1.3.0 The rate for respective items of work or price shall include the cost for all works, activities, equipment, instrument, personnel, material etc. whatsoever associated to comply with sampling, testing and quality assurance requirement including construction tolerances and acceptance criteria and as specified in subsequent clauses of this part of the technical specifications. The QA and QC activities in all respects as specified in the technical specifications/ drawings / data sheets / quality plans / contract documents shall be carried out at no extra cost to the NSPCL.
- 1.4.0 The contractor shall prepare detailed construction and erection methodology scheme which shall be compatible to the requirements of the desired progress of work execution, quality measures, prior approvals if any and the same shall be got approved by the Engineer. If required, work methodology may be revised/ reviewed at every stage of execution of work at site, to suit the site conditions by the contractor at no extra cost to the NSPCL.

2.0.0 QUALITY ASSURANCE PROGRAMME

- 2.1.0 The contractor shall adopt suitable Quality Assurance Programme (QAP) to ensure that the equipments and services under the scope of contract whether manufactured or performed within contractor's works or at his sub-contractor's premises or at the NSPCL's site or at any other place of work are in accordance with the specifications. Such QAP shall be outlined by the contractor and shall be finally accepted by the NSPCL or their authorized representative after discussions before the start of work. The QAP shall be generally in line with IS/ISO Systems.

The contractor shall furnish complete QA & QC programme for the work envisaged which may include the following

- Organization structure for the management and implementation of the proposed quality assurance programme
- Quality System Manual
- Design Control System
- Documentation and Data Control System
- Qualification data / details for Contractor's key personnel
- The procedure for purchase of materials, parts, components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased, etc.
- System for shop manufacturing and site erection controls including process, fabrication and assembly



- Control of non-conforming items and system for corrective actions and resolution of deviations
- Inspection and test procedure both for manufacture and field activities
- Control of calibration and testing of measuring testing equipment
- System for Quality Audits
- System for identification and appraisal of inspection status
- System for authorizing release of manufactured product to the NSPCL
- System for handling, storage and delivery
- System for maintenance of records
- Quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of work/ equipment/component.

3.0.0 QA AND QC MANPOWER

- 3.1.0 The contractor shall nominate one overall QA coordinator for the contract detailing the name, designation, contact details and address at the time of post bid discussions. All correspondence related to Quality Assurance shall be addressed by the contractor's QA coordinator to NSPCL. NSPCL shall address all correspondence related to Quality issues to the contractor's QA coordinator. The contractor's QA coordinator shall be responsible for co-ordination of Quality activities between various divisions of the contractor and their sub-vendors on one hand & with NSPCL on the other hand.
- 3.2.0 The contractor shall appoint a dedicated, experienced and competent QA&QC in-charge at site, preferably directly reporting to the Project Manager, supported as necessary by experienced personnel, to ensure the effective implementation of the approved QAP. An indicative structure of contractor's QA&QC manpower required to be deployed at site is enclosed at Annexure-I. Based on the finalized L-2 network and the approved Field Quality plan, the contractor shall finalize and submit a deployment schedule of QA&QC personnel along with their details to NSPCL for approval/ acceptance and further shall ensure their availability well before the start of the concern activity.
- 3.3.0 The QA&QC in-charge shall have the organizational freedom and authority to implement the requirements of these quality assurance arrangements, free from commercial and programme restraints. The QA&QC setup of the contractor shall consist of qualified and experienced Civil, Electrical, Mechanical Engineers and Laboratory assistants with their supporting staff both at their works and site.
- 3.4.0 The deployment of man power for QA & QC set up shall be affected on the basis of agreed manpower deployment schedule, which shall be prepared by the contractor based on the L-2 network and the same shall be submitted to the engineer-in-charge for acceptance.

4.0.0 SAMPLING AND TESTING OF CONSTRUCTION MATERIALS

- 4.1.0 The method of sampling for testing of construction materials and work / job samples shall be as per the relevant IS / standards / codes and in line with the requirements of the technical specifications / quality plans. All samples shall be jointly drawn, signed and sealed wherever required, by the contractor and the engineer or his authorized representative.
- 4.2.0 The contractor shall carry out testing in accordance with the relevant IS / standards / codes and in line with the requirements of the technical specifications / quality plans.



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Where no specific testing procedure is mentioned, the tests shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer. All testing shall be done in the presence of the engineer or his authorized representative.

- 4.3.0 Before execution of any civil work the contractor shall conduct full-scale suitability tests on various construction and building material such as fine and coarse aggregates, cement, reinforcement, construction chemicals, supplementary cementitious materials and construction water to ascertain their suitability for use and the concrete mix designs conducted from reputed institutes such as NCB-Ballabgarh, CSMRS-Delhi, IIT's, etc. as agreed by the engineer. The test samples for such full scale testing shall be jointly sampled and sealed by the engineer and contractor, thereafter these shall be sent to the concerned laboratory through the covering letter signed by field quality assurance (FQA) representative of the engineer.
- 4.4.0 The contractor shall timely initiate the action with regard to the evaluation of aggregates and other building material including concrete mix design, so as to ensure completion of these tests before start of civil works at site, thereby not affecting any project work. The test reports and recommendations for suitability of the materials including concrete mix design shall be promptly submitted by the contractor to the engineer.
- 4.5.0 Evaluation of aggregate for potential alkali-aggregate reactivity shall be carried out as per following scope of work
- A. Evaluation of Aggregates for Mechanical / Physical Properties
- a) To carry out different tests on coarse aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material; soundness, crushing value, impact value, abrasion value, elongation index and flakiness index, as per IS: 2386.
 - b) To carry out different tests on fine aggregate sample i.e. specific gravity, water absorption, sieve analysis, deleterious material, soundness, silt content, clay content and organic impurities as per IS: 2386.
 - c) To prepare evaluation report based on test results of a) and b) above and to advise regarding suitability of fine and coarse aggregates.
- B. Evaluation of Aggregates for Potential Alkali-Aggregate Reactivity:
- a) To carry out petrographic analysis and accelerated Mortar bar Test on aggregate samples (1N NaOH at 80 deg. Centigrade for 14 days as per ASTM 1260, or the method established/ developed by CSMRS for 22days test).
 - b) If rock type is limestone, alkali carbonate reactivity test shall also be carried out wherein the parameters shall be reported in conjunction with the petrographic analysis. Additionally, X-Ray diffraction test (XRD) shall be carried out to determine critical clay mineral in the rock for preliminary conclusions. For limestone aggregates to be used in dynamic foundations like TG, BFP, Fans, mills and crushers, repeated temperature cycle test shall also be carried out, to determine residual expansion of aggregate for concrete.
 - c) To prepare a report based on test results of a) and b) above and to advise regarding suitability of aggregates to be used and further testing required if any.

5.0.0 LABORATORY AND FIELD TESTING

- 5.1.0 The field laboratory for QA and QC activities shall be constructed and set-up by the contractor in line with the indicative field QA&QC laboratory set-up enclosed at Annexure-II. The Laboratory building shall be constructed and installed with the



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adequate facilities to meet the requirement of envisaged test setup. Temperature and humidity controls shall be available wherever necessary during testing of samples. The quality plan shall identify the testing equipments/ instrument, which the contractor shall deploy and equip the field quality laboratory for meeting the field quality plan requirements. The contractor shall furnish a comprehensive list of testing equipments/ instrument required to meet the planned/scheduled tests for the execution of works for NSPCL acceptance/ approval. The contractor shall mobilize the requisite laboratory equipment and QA&QC manpower at least 15 days prior to the planned test activity as per the schedule of tests.

- 5.2.0 All equipments and instruments in the field shall be calibrated before the commencement of tests and then at regular intervals, as per the manufacturer's recommendation and as directed by the NSPCL. The calibration certificates shall specify the fitness of the equipments and instruments within the limit of tolerance for use. Contractor shall arrange for calibration of equipments and instruments by an NABL / NPL accredited agency and the calibration report shall be submitted to NSPCL.
- 5.3.0 The tests which cannot be carried out in the field laboratory shall be done at a laboratory of repute. This includes all IITs, NCB, CSMRS, reputed government / autonomous laboratories / organizations, NITs and other reputed testing laboratories. The test samples for such test shall be jointly selected and sealed by the engineer and thereafter these shall be sent to the concerned laboratory through the covering letter signed by NSPCL engineer. The test report along with the recommendations shall be obtained from the laboratories without delay and submitted to NSPCL.
- 5.4.0 Based on the schedule of work agreed with the engineer-in-charge and the approved FQP, the contractor shall prepare a schedule of tests and submit them to the engineer-in-charge and organize to carry out the tests as scheduled / agreed.



6.0.0 PURCHASE AND SERVICE

- 6.1.0 The major items/ equipments/ components to be manufactured in the shop of the contractor i.e. in-house items and those procured from sub-vendors / sub- manufacturer / sub-contractors i.e. bought out items (BOIs) shall be listed out by the contractor in their bid proposal.
- 6.2.0 An indicative list of major bought out items (not exhaustive) and services for civil works is enclosed at Annexure- III, for which the contractor shall submit the requisite details / lists of manufacturer's in their bid proposal. The list of manufacturers/ sub-vendors for all the BOIs envisaged in contract including shall be included in the bid proposal by the contractor which shall be discussed / reviewed by the NSPCL during post bid discussions and the list of proposed manufacturers / sub-vendors for each of the BOIs shall be agreed/ approved. If any item is left out or gets included during detailed engineering, the contractor shall propose the manufacturer's / sub-vendor's details for review / approval of NSPCL , prior to initiating the procurement of such materials.
- 6.3.0 Where the manufacturers are placed in details required ("DR") category, the details of the manufacturers / sub-vendors placed in the "DR" category shall be submitted to the NSPCL for approval in the prescribed NSPCL format within the period agreed at the time of post bid discussions. The contractor's proposal shall include vendor's site facilities, expertise, facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-Contractors proposed. The formats for furnishing above

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details shall be given to the Contractor at post bid discussion stage. Monthly progress reports on sub-contractor detail submission / approval shall be furnished. Such manufacturers / sub-vendors approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.

- 6.4.0 To facilitate advance planning of material testing/ approval of bought out items, well before the start of activity as per L-2 network, representative samples shall be procured by the contractor from approved sub-vendors and submitted to the engineer for his approval before bulk procurement at least two months prior to start of works. In case of manufacturers test certificate (MTC) is submitted for acceptance, it shall be clearly traceable and correlated with the consignment received at site. MTC of all bought out items shall essentially contain all the test parameters / characteristics specified in the technical specifications / standards / codes. In case the manufacturer's test certificate does not mention these details, sample from each lot shall be tested for these properties at the third party lab acceptable to NSPCL . Approval of material / sample by the engineer shall not relieve the contractor of his responsibility, for their conformance to the specification, as well as the requisite performance and quality of material.
- 6.5.0 Structural steel and Reinforcement steel shall be procured from Main Steel Producers as agreed and approved by NSPCL in advance.

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7.0.0 MANUFACTURING QUALITY PLAN AND FIELD QUALITY PLAN

- 7.1.0 All materials / components and equipment covered under the scope of work, shall be procured by the contractor for the purpose of the contract, after obtaining the written approval of the NSPCL , which are to be manufactured at shop/ factory of the vendor/sub vendor shall be covered under a comprehensive quality assurance programme. The contractor's purchase specifications and inquiries shall call for Manufacturing Quality Plans (MQP) to be submitted by the sub-contractor/ sub-supplier/ sub-vendor. The MQP called for from the sub-contractor shall detail out for all the components and equipment, various tests / inspection, to be carried out as per the requirements of this specification and standards mentioned therein, quality practices and procedures followed by contractor's / sub-contractor's / sub-supplier's quality control organization, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/ performance testing. Such quality plans of the vendors / sub-vendors shall be submitted to the NSPCL for approval for MQP and such approved quality plans shall form a part of the purchase order / contract between the contractor and sub-contractor. The quality plans shall be submitted on electronic form e.g. CD or E-mail in addition to hard copy, for review and approval of NSPCL . After approval the same shall be submitted in compiled form on CD in addition to hard copy.
- 7.2.0 The contractor shall furnish copies of the reference documents/ plant standards / acceptance norms/ tests and inspection procedure etc., as referred in quality plans. These quality plans and reference documents/standards etc. will be subject to NSPCL approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, NSPCL shall identify customer hold points (CHP), i.e. test/ checks which shall be carried out in presence of the NSPCL engineer or his authorized representative and beyond which the work shall not proceed without consent of NSPCL in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to NSPCL along with technical justification for approval and dispositioning.
- 7.3.0 Within three weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the NSPCL for reference / record by the contractor along with a report of the purchase orders placed so far for the contract.
- 7.4.0 Well before the start of the work, the contractor shall prepare and submit the Field Quality Plans (FQP) and obtain approval of NSPCL , which shall detail out for all the works, equipments, services, quality practices and procedures etc in line with the requirement of the technical specifications to be followed by the contractor at site. This FQP shall cover for all the items / activities covered in the contract / schedule of items required, right from material procurement to completion of the work at site. An Indicative Field Quality Plan for civil works is enclosed at Annexure – IV (Indicative FQP for civil works) & Annexure –V (Indicative FQP for structural steel works).

8.0.0 DISPOSITIONING OF NON CONFORMITIES

- 8.1.0 The non-conformity for the site works on being detected / noted shall be reported by the contractor in the standard format of NSPCL under the system of dispositioning of non conformity report (NCR) to the engineer. The dispositioning of the NCR relating to equipment, assemblies, materials condition or process during construction / erection

shall describe the proposed correction and also include the preventive / corrective action plan for future.

9.0.0 QUALITY AUDIT

- 9.1.0 NSPCL reserves the right to carry out quality audit and quality surveillance of the quality management and control activities, systems and procedures of the contractor or their sub-contractor. The contractor shall provide all necessary assistance to enable the NSPCL carry out such audit and surveillance. The contractor shall also take necessary measures, raise NCRs wherever required based on the audit findings / observations.

10.0.0 QA DOCUMENTATION PACKAGE

- 10.1.0 The contractor shall be required to submit the QA documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓) mark. Typical contents of QA documentation pertaining to field activities as per approved MQP, FQP and other agreed manuals / procedures, prior to commissioning of individual system shall generally contain the Quality Plan, Material mill test reports, Non-destructive examination results / reports, Heat Treatment Certificate/Record, Non-conformance Reports, CHP, Certificate of Conformance (COC) and MDCC.

11.0.0 GENERAL QA REQUIREMENTS

- 11.1.0 The contractor shall ensure that the works, BOIs and services under the scope of contract whether manufactured or performed within contractor's works or at his sub-contractor's premises or at the NSPCL's site or at any other place of work are in accordance with the NSPCL technical specification, applicable standards / codes, approved drawings / data sheets / quality plans and BOQ. All the works, BOIs and services shall be carried out as per the best prevalent engineering practices and to the directions of the Engineer.

11.1.1 STORAGE AND HANDLING OF CONSTRUCTION MATERIALS

All materials shall be stacked and stored by the Contractor as per IS-4082 and as per the requirements specified in NSPCL Technical Specification.

11.1.2 EXCAVATION AND FILLING WORKS

The contractor shall submit a work methodology covering various items of works for all stages of excavation and filling works. This methodology shall broadly include the quantity wise and classification wise identification of source of excavation and filling, suitability tests as per specification requirements, method of stockpiling, transportation, placement, spreading, compaction, equipment, list of protocols, in-situ tests, third party lab test if required, acceptance checks for final clearance.

For blasting work at site if required, the contractor shall associate themselves with the reputed specialized blasting agency such as CMRI, NIRM for trials blasts, design blasts, blasting pattern, monitoring of blast during the blasting operations at site. The contractor shall install and operate equipment (such as tri-axial seismograph) for continuous monitoring and control of blast induced vibrations, noise level/ air pressure, dust, silica and noxious gases during all blasting operations in line with the technical specification requirements in association with the specialized blasting agency. The contractor shall submit the un-priced copy of the award on the specialized blasting agencies to NSPCL

highlighting the scope of services / work awarded to them by contractor. The services of such specialized blasting agency shall be available through out the period in which the blasting work is undertaken at site. The blasting operation shall remain in charge of a responsible, competent, authorized and experienced supervisor (man-in-charge) and thoroughly acquainted workmen. All blasting work shall be done as per approved blasting scheme/ design/ pattern in line with the technical specification requirements and all statutory laws, rules, regulations, relevant standards pertaining to the acquisition, transport, storage, handling along with use of explosives shall be strictly followed by the contractor.

Tolerance for finished surface level shall be within 20 mm of the level shown in the drawing. For an unimportant area, tolerance up to +75mm shall be acceptable at the discretion of the engineer. However, these tolerances shall be applicable for localized areas only.

Acceptance criteria shall be

- When only one set of sample is tested, then all individual samples collected and tested should pass without any deviation
- For retest of any sample two additional samples shall be collected and tested, and both should pass without any deviation.
- Where a large number of samples are tested for a particular test then 9 samples out of every 10 consecutive samples tested shall meet the specification requirement.

11.1.3 MASONRY AND ALLIED WORKS

The execution, finishing, testing and acceptance of masonry related works shall be as per the provisions of technical specifications / relevant practices IS code. Local depressions on account of faulty workmanship, broken / chipped edges shall not be acceptable.

All masonry shall be built true and plumb within the tolerances prescribed as below. Care shall be taken to keep the perpends properly aligned. Unless specified otherwise the tolerances in construction of masonry works shall be as below:

Sl. No.	Type of Check	Tolerance
	Deviation in verticality in total height of any wall of a building	Shall not exceed $\pm 12.5\text{mm}$ (more than one storey) $\pm 6\text{mm}$ per 3m height (within a storey)
	Deviation from the position shown on the plan of any brickwork	Shall not exceed $\pm 12.5\text{mm}$ (more than one storey)
	Relative displacement between load bearing walls in adjacent storeys intended to be in vertical alignment	Shall not exceed 6mm
	Deviation of bed joint from horizontal in any length, and it	Shall not exceed 6mm (upto 12m) Shall not exceed 12.5mm total (in any length over 12m)
	Deviation from the specified thickness of bed-joints, cross-joints or perpends	Shall not exceed $\pm 3\text{mm}$

Finished plastered surface	Deviation not more than 4 mm when checked with a straight edge of 2 m length placed against the surface
The average thickness of plaster	Not be less than the specified thickness
The minimum thickness over any portion of the surface	Not less than the specified thickness by more than 3 mm for plaster thickness above 12mm and 1 mm for ceiling plaster

11.1.4 CONCRETE WORKS

For concreting works provisions of technical specifications and IS: 456 shall apply. A detailed methodology for concrete works shall be submitted by the contractor to NSPCL for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for concrete works shall broadly contain the suitability of source of aggregates, cement, admixture, water and reinforcement steel, etc. The available concrete mix design recommended from a specialist institute, results of trial mix carried out at site, method / control of batching, mixing, transportation, layer wise placement, compaction, fixing / removal of form work, staging, fixing of water stops at appropriate locations along with specials, expansion joints, contraction joints and construction joints, cover blocks and method of curing, methodology of repair of newly placed hardened concrete, testing and sampling of concrete during production and placement and acceptance checks for final clearance.

The equipment, deployment of manpower and machinery shall arranged by the contractor to ensure the continuous rate of placement of specified grade of concrete so as to prevent segregation, bleeding, formation of cold joints, temperature control for concreting in extreme weather conditions and for mass concreting works.

Exposed surfaces of concrete shall be kept continuously in a damp or wet condition for at least seven days from the date of placing concrete in case of ordinary Portland cement, not be less than 10 days for concrete exposed to dry and hot weather conditions, at least 10 days or period may be extended to 14 days where mineral admixtures or blended cements are used. Approved curing compounds may be used in lieu of moist curing with the permission of engineer-in-charge.

Reinforcement steel shall conform to relevant IS codes. Lapping / spacing of reinforcement shall be so staggered that under no circumstances more than 50% of bars at any cross section shall be lapped. Corrosion resistance Steel shall be used for the foundations wherever specified in the technical specification. Sample test for 3% of the number of mechanical bars grips subject to a minimum of three, shall be carried out up to the yield strength of reinforcement of bars.

Test shall be conducted for the water tightness of the liquid retaining structures as per technical specifications, IS 3370 and IS 6494.

All the materials, equipments, processes used in pre cast concrete work shall conform to the requirements for the cast-in-situ concrete.

If fly ash is used in concrete, source of supply shall be checked for suitability as per IS 3812 (Part-I). Routine tests for retention of particles on 45 μ sieve and loss on ignition shall be carried out on each lot of fly ash before its use. The storage of fly ash shall be

similar to that of cement. Separate Silo for fly ash shall be provided in the batching plant. Validation of Mix design using fly ash shall be carried out by an approved specialist agency, before start of concrete production.

The acceptance criteria of concrete shall be in accordance with clause no.16 of IS 456. However in exceptional circumstances and that too in non-critical areas, the engineer may accept concrete work which is marginally unacceptable as per the criteria laid down in IS 456. For such accepted work, payment shall be made at a reduced rate pro rata to the concrete cube strength obtained, against that stipulated.

All records of concreting, reinforcement, testing of materials, as-built dimensions, the details of the rectification, etc, shall be maintained as given below. Four copies of such record in a bound form shall be submitted to NSPCL for their record and future reference.

- a. Testing data / report of aggregates including petrographic examination & potential reactivity of aggregate and repeated temperature cycle tests wherever specified
- b. Mix design details and record of trial mixes carried out at site
- c. Testing records of admixture as per IS-9103 / ASTM C494 including third party test reports.
- d. Approved scheme for concreting
- e. Hourly records of concreting including pour card
- f. Protocol indicating the dimensional tolerance and details of inserts
- g. Records giving the details of rectification giving the location of grouting, the quantity of grout used at each location, type of grout used
- h. Bar bending schedule
- i. Location and details of mechanical anchoring used for reinforcement
- j. Protocol giving the details of checking of reinforcements before concreting and conformance to the reinforcement details as shown in the construction drawings
- k. Photographs showing the areas where rectification works have been carried out. Photographs should be taken before and after rectification
- l. Temperature control record of concrete at the time of placement if applicable
- m. Details of curing, staging and fixing / removal of formwork, checklist for formwork as per Clause 9.9 and Annexure-C of IS 14687 including all machine foundations
- n. Batching Plant shall be calibrated regularly at least once in a 3 months. Computerized output shall be taken for each batch of production of concrete. For concreting works of ash pipe pedestals, mixer with weight batcher may be used. Production and supply of concrete from batching plant shall conform to the provisions of IS 4926
- o. Dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances for pre cast members as per NSPCL Technical Specification. Load test on Pre cast members (except pre- cast tiles to be laid in the reservoir) shall be carried out @ 2% up to 1000 nos., @1% from more than 1000 nos. precast members of one type. The load test shall be carried out as per the provisions of IS-456

TOLERANCES

Description of Item/ Structural Element	Max (mm)	Min (mm)
Cast In Situ Concrete		
1. Faces of concrete in foundations and structural members against which back fill is placed	+25	-10



TOLERANCES

Description of Item/ Structural Element		Max (mm)	Min (mm)
2.	Eccentricity of footing as percentage of footing width in the direction of placement	2% but limited to 50mm	
3.	Top surfaces of slabs and of concrete to receive base plates to be grouted	+5	-5
4.	Alignment of beams, lintels, columns, walls, slabs and similar structural elements	+5	-5
5.	Cross sectional dimensions of walls, slabs and similar structural elements	+5	-5
6.	Deviation from specified dimensions of cross-section of columns and beams	+12	-6
7.	Alignment of holding down bolts without sleeves	+1.5	-1.5
8.	Alignment of holding down bolts with sleeves	+5	-5
9.	Level of holding down bolt assemblies	+10	-10
10.	Embedded Parts (in any direction).	+5	-5
11.	Level of embedment for equipment support	+1.5	0
12.	Level of embedment for other embedded parts	+5	-5
13.	Centers of pockets or holes with greatest lateral dimension not exceeding 150mm	+10	-10
14.	Variation in steps		
	• Riser	+1.5	-1.5
	• Tread	+3.0	-3.0
Pre- Cast Concrete			
15.	Length:	+/- 0.1 percent	+/- 5 + 10
16.	Straightness or Bow	1/750 of the length	+/- 5 +/- 10
17.	Cross-sectional dimensions	+/- 3 mm or +/- 0.1 percent whichever is greater	
18.	Squareness:	When considering the squareness of the corner the length of the two adjacent sides being checked shall be taken as the base line. The shorter side shall not vary in length from the perpendicular by more than 5 mm.	
19.	Flatness:	The maximum deviation from a 1.5m straight edge placed in any position on a nominal plant surface shall not exceed 5 mm.	
Placing of reinforcement and for cover		Clause 12.3.1 and 12.3.2 of IS 456	
Formwork		Clause 9.6 of IS 14687 and 11.1 of IS 456	
Batching		Clause 10.2.2 of IS 456	

11.1.5 STRUCTURAL STEEL WORK

For structural steel works provisions of technical specifications and IS: 800 shall apply. A detailed methodology for structural steel works shall be submitted by the contractor to NSPCL for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The contractor shall submit the welding procedures specification (WPS), heat treatment procedures, NDT procedures etc. at least ninety days before scheduled start of erection

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work at site. All welding and brazing shall be submitted to the NSPCL and carried out as

per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the NSPCL

All brazers, welders and welding operators employed on any part of the contract either in the contractor's / sub-contractor's works or at site or elsewhere shall be qualified as per AWS D1.1/ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the NSPCL .

The records of welding procedure qualification and welder qualification test results shall be furnished to the NSPCL for approval. However, where required by the NSPCL , the tests shall be conducted in presence of NSPCL / authorized representative.

No welding shall be carried out on cast iron components for repair. All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.

All Non-destructive examination shall be performed in accordance with written procedures as per International Standards and as mentioned elsewhere in the technical specification. The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job. The records of RT (Films) and UT (inspection records or printed reports if possible) shall be documented and produced to NSPCL .

Low hydrogen electrode (AWS E-7018) for welding of High/Medium tensile steel, for M.S (IS 2062 Gr. A/Gr. B, IS 8500) sections thickness above 20mm shall be used. Preheating and Post weld heat treatment requirements shall be complied as specified in the technical specification / approved WPS.

The requirements of pre-heating shall be

The following tests / checks shall be carried out for structural steel works



SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD
1.	Physical and chemical properties of material if supply in the scope of contractor	As per relevant codes, review of correlated mill test certificates or check testing in absence of MTC
2.	Ultrasonic test on plates above 40mm	As per ASTM A435
3.	Welding procedure & welders qualification test	AWSD1.1/ASME Section-IX or BS-4871 or other equivalent International Standards
Fillet Weld		
4.	Macro-etch examination on production test coupons for main fillet welds	Minimum one joint per built up beams, columns and crane girder etc.
5.	Tension member of crane girder	Dye penetration test on 25% weld length
6.	All other fillet welds	DPT on 5% of weld length with minimum 300mm at each location
Butt Weld		
7.	DPT	100% after back gouging on all butt welds except for coal bunker bins 10% after back gouging-For coal bunker bins
8.	Mechanical testing of production test coupons	Minimum one joint per built up beam, column and crane girder.
9.	Radiography test on butt welds (In case of failure of any welds in SPOT/RT or UT the % of retesting shall be doubled at that particular location. Acceptance criteria of NDT on welds shall be as per AWS D1.1. Wherever RT is not feasible UT to be carried out with the approval of the engineer)	100% RT on butt welds of tension flange (bottom flange) of crane girders 10% RT weld length of each welder on butt welds, except for crane girders and coal bunker 5% spot RT on butt welds / at inaccessible locations UT on butt welds- For coal bunker bins
10.	Ultrasonic testing on full penetration welds (other than butt welds)	100% UT on the web to flange joint of crane girder 10% UT on other full penetration joints
11.	Control assembly check in shop before erection	1 st and further every 10 th set of identical structure
12.	Dimensional tolerances during fabrication and erection	as per IS-7215 and IS-12843
13.	Surface Preparation and Paint thickness	SA 2 1/2 , By elcometer random after each coat, each member

SL. NO.	TESTS / CHECKS	QUANTUM / STANDARD
CW Liners site fabrication (Field shop) test		
14.	WPS,PQR& welder's Qualification	100%
15.	DPT on root run	100% DPT for pipes upto 1200mm diameter
16.	DPT after back gouging	100% DPT for pipes above 1200mm diameter
17.	UT	Not recommended.
18.	RT	5% RT
19.	DPT on finished butt welds	10% DPT
20.	Hydraulic tests	1.5 times the design pressure or 2 times the working pressure which ever is higher.
CW Liners erection site test		
21.	WPS,PQR& welder's Qualification	100%
22.	DPT on root run	100% DPT for pipes upto 1200mm diameter
23.	DPT after back gouging	100% DPT for pipes above 1200mm diameter
24.	UT	Not recommended.
25.	RT	5% RT
26.	DPT on finished butt welds	10% DPT
27.	Hydraulic tests	1.5 times the design pressure or 2 times the working pressure which ever is higher. In cases where hydraulic test is not possible the same may be substituted with 100%RT
28.	Tolerances	As per approved drawings, as per IS : 7215 for fabrication and IS : 12843 for erection of steel structures

Note: The contractor shall make all arrangements for testing of shop welded joints of fabricated CW liner before erection at site. The erection joints shall also be hydro tested after the laying of CW liner in suitable lengths. The testing methodology for conducting the hydro test shall be submitted well in advance for review.

11.1.5.1 STOPLOG AND TRASH RACKS

Structural design of stop log gate shall be as per IS 5620 and IS 4622 and as per details given in technical specifications. The trash rack to be provided shall be Type-1 trash rack (removable section rack), conforming to IS: 11388 (latest). Filling valves shall be provided in the stop logs to balance the water pressure before lifting the stop log. Leakage test shall be carried out in the stop logs as per the methodology specified in the technical specification. The leakage measured shall not be more than 5 liters/ minute /meter of length of seal under maximum head. Radiographic examination or

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magnetic particle testing or other comparable tests shall be carried out for determining the soundness of steel castings and shall be conducted by the contractor as per the technical specification requirements. The contractor shall submit a manufacturing and field quality plans in NSPCL format incorporating all the quality aspects mentioned in the technical specifications.

The lifting beam is to be tested for twice the weight of the heaviest component to be lifted by the beam. IS 13591 shall be referred for measurement of the deflection and acceptance criteria.

11.1.5.2 COAL TAR ANTI-CORROSION TAPE (if applicable)

Coal tar anti corrosion tape shall conform to the requirements of technical specifications. The Manufacturers test certificate for each lot of supply of the coal tar anti corrosion tape shall contain the softening point, needle penetration, filler content, breaking load in the longitudinal direction, service temperature, direct impact test, cathodic disbanding and solubility. In case the manufacturer's test certificate does not mention these details, sample from each lot shall be tested for these properties at the third party lab acceptable to NSPCL .

Tests for Adhesion, holiday test and thickness shall be carried out at site.

11.1.5.3 EXTERNAL COATING FOR SPECIAL SECTIONS, CONNECTIONS & FITTINGS OF BURIED STEEL PIPELINES

External coatings for special sections, connections & fittings of buried steel pipelines shall conform to the requirements of technical specifications. The manufacturer's test certificate for each lot of supply of the coating material shall contain the test results envisaged in AWWA C 209-00 and as specified in the NSPCL technical specifications. In case the manufacturer's test certificate does not mention these details, sample from each lot shall be tested for these properties at the third party lab acceptable to NSPCL . Tests for thickness of coating system and holiday detection on each special section shall be carried out at site.

11.1.5.4 FIELD JOINT ANTI-CORROSION COATING OF BURIED 3 LPE COATED PIPELINES

Field joint anti-corrosion coating of buried 3 LPE coated pipelines shall conform to the requirements of technical specifications. The manufacturer's test certificate for each lot of supply of the coating material shall contain the test results envisaged in EN 12068 and as specified in the NSPCL technical specifications. In case the manufacturer's test certificate does not mention these details, sample from each lot shall be tested for these properties at the third party lab acceptable to NSPCL .

Qualification of application procedure as per NSPCL technical specifications, visual inspection (mastic extrusion on either ends of the sleeve, appearance, presence of voids by knocking on the sleeves, weld bead profile visible through the sleeve), thickness of coating system on each joint and other routine tests as per finalized field quality plan shall be carried out at site.

11.1.6 PAINTING WORKS

Painting works shall be carried out as per the provisions of technical specifications. A detailed methodology for painting works shall be submitted by the contractor to NSPCL

for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for painting works shall broadly contain the source of approved brand of paints, shot / sand blasting as specified, minimum acceptable size of shot used for blasting, application of primer, intermediate coat and final coat, experience of applicator, etc. testing of painting work and acceptance checks for final clearance. For PU coating works if specified, material shall be procured from NSPCL approved source and the application of the PU coating shall be carried out by an experienced authorized applicator of the material supplier approved by NSPCL . A separate quality plan and methodology for PU coating works shall be submitted by the contractor for approval of NSPCL . Based on the approved quality plan, the tests on material and works shall be got conducted at specialist laboratories like IICT Hyderabad, CECRI Karaikudi.

11.1.7 SHEETING WORKS

All bought out items shall be procured from the manufacturer's approved by engineer and tested as per relevant IS Codes/ Specification. Raw material of colour coated sheets shall meet the chemical & physical properties as per relevant standards / codes referred in the approved data sheet. It shall be tested for colour match, bare metal thickness, weight of Z/AZ coating, thickness of painting system, reverse impact, T-Bend adhesion, scratch resistance, salt spray test for 1000 Hrs and any other test / properties as specified in the technical specifications. Colour coated sheets shall be marked with video jet printing at the interval not more than 2m bearing manufacturer's name, date and time of manufacturing. Fasteners shall also be tested for 1000 hrs salt spray test as per the requirement of technical specifications.

Bonded Mineral Wool Insulation shall meet the requirements of thickness, density, thermal Conductivity, all other tests as per the technical specifications and IS-8183.

For sheet installation no gas cut opening g shall be allowed at the site, whenever opening is specified these shall be properly cut in the factory and shall be filled with lipping / flashing for true shape / dimension etc. The sheets/ packets shall be stacked neatly clear off the ground at an angle to the ground, over a base pallet to provide drainage. Water / moisture should not be allowed to stagnate on surface, or in between layers. This can damage the coating, and cause corrosion.

11.1.8 TILE WORKS

The execution, finishing, testing and acceptance of tile works shall be as per the provisions of technical specifications. The material for tile works shall be procured from the NSPCL approved brand / source. Local depressions on account of faulty workmanship, tiles / natural stones with cracked or broken / chipped edges shall not be acceptable.

The tests shall be carried out on acid resistant bricks / tile- water absorption, compressive strength, resistance to acid, flexural strength, dimensions and all other tests as per IS 4860 and IS 4457, bitumastic ready mixed paint as per IS 158, bitumastic as per IS 9510, potassium silicate, resin type and sulphur type mortars as per IS 4832, part I, II and III, surface preparation for painting as per IS 2395, epoxy painting shall be carried for required coating thickness and dry film thickness.

11.1.9 FIRE PROOF DOORS

Fire Proof doors shall be tested for the requirements mentioned in the Technical Specification. The type test of the doors shall be carried out at CBRI Roorkee for

minimum 2 hours fire rating and its Fabrication drawing shall also be approved by CBRI, Roorkee. DFT of paint of Fire Proof Doors and its fittings and fixtures as per BOQ shall be checked. The doors shall be finished with suitable fire retardant painting system

11.1.10 WATER PROOFING

The execution, finishing, testing and acceptance of water proofing works shall be as per the provisions of technical specifications. The material for the works shall be procured from the NSPCL approved brand / source and the works shall be executed by the authorized applicator of the supplier.

Water proofing shall be tested for water tightness by creating a pond of water minimum 25 mm height on area of 6 m x 6 m, for the period of 48 hrs on fully dried elastomeric membrane surfaces. Minimum 5% area of the roof shall be subjected to water tightness test. Such test necessarily be conducted on vulnerable areas like drain channel / drain head. No dampness shall be visible on the underneath side of roof (i.e. ceiling), parapet and well junctions etc. which have been subjected for testing. The above testing shall be carried out prior to application of wearing course.

11.1.11 PILING WORK



For piling works provisions of technical specifications, approved drawings, BOQs and relevant IS codes / standards shall apply. The piling works shall be executed by the agency meeting the qualifying requirements as specified. A detailed methodology for piling works shall be submitted by the contractor to NSPCL for approval. The methodology may require change / modification based on the site conditions, for which suitable revisions shall be submitted.

The methodology for piling works shall broadly contain the method of boring, stability of bore hole, termination criteria, tests / checks for termination level, fabrication of cage, cage lowering, concrete batching / mixing, transportation, placing, recording of the time of construction operations, method of conducting initial and routine load tests, testing and sampling of concrete during production and placement and acceptance checks on piles for final clearance.

The equipment, deployment of manpower and machinery shall be arranged by the contractor to prevent the collapse of bore hole and to ensure continuous rate of placement of specified grade of concrete.

The piling works shall be executed as per the technical specifications, approved drawings, relevant codes / standards, FQP and BOQ. In addition to the requirements of technical specifications, the following shall also be ensured while execution of piling works:

- a) Time gap between completion of pile boring and start of concreting should be kept to the minimum. However the maximum time gap shall not be more than 6 hours.
- b) Muck Debris should be removed from the pile bore by air lift technique (by keeping the tremie & air pipe as close as to bottom of pile bore) i.e. after completion of boring, after completion of SPT (wherever applicable), after lowering reinforcement cage, but before start of concreting.
- c) Density of bentonite slurry shall be checked from the sample taken from the bottom of pile bore (not at 1.0 m above the bottom of the pile bore)

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- d) Minimum two welding sets shall be kept ready to join the two cages of reinforcement by engaging 3 or more welders. This will ensure the lowering of R/F cage in minimum time.
- e) While lowering the R/F cage into the pile bore, two hooks shall always be used to ensure balanced/symmetrical insertion of cage into the pile bore.
- f) Concrete cover blocks at the junction of two R/F cage shall be ensured before lowering the second segment.
- g) Surge concreting of about 1.0 cum shall be ensured at the start of concreting (i.e. in the first pour), by suddenly allowing to fall through the tremie pipe from the funnel. This will help in displacing left out muck/debris in the pile bore (by the impact).
- h) Continuous feeding of concrete shall be ensured by deploying at least two transit concrete mixers (if required to be deployed) and mixing done through concrete batching plant (if deployed). Cold joints in the pile shall be avoided.
- i) In a pile group, SPT shall be carried out at termination level in the pile, taken up first. j) Bentonite slurry circulation to be ensured from start of boring to start of concreting. Flushing of bentonite slurry will only ensure maintaining of density of bentonite slurry uniformly and will not allow bentonite jelly to settle at the bottom, whereas air lift technique with bentonite circulation will ensure removal of muck debris from the bottom of pile bore.
- k) Properties of drilling mud shall be checked prior to commencement of the piling work and thereafter, minimum once per week or as found necessary by the engineer. One sample consisting of 3 specimens shall be tested for the above.
- l) Low strain pile integrity test on all job piles and test piles shall be conducted as specified in the Technical Specification. This test shall be suitably used to identify the piles for routine tests. High Strain dynamic test shall be done as per the technical specification. The frequency of the test shall be as per the BOQ
- m) For Working Piles: Minimum one sample consisting of 6 test cubes shall be made for first ten piles. Out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength. Minimum one sample of 6 test cubes for every 25 nos. of piles shall be tested, out of these 3 shall be tested for 7 days cube strength and 3 for 28 days cube strength

PILE LOAD TEST

Pile load testing shall conform to the requirements of IS-2911 (Part IV) and the technical specification. Initial load tests as specified in the contract documents shall be conducted to assess the safe load carrying capacity of pile before start of work. To verify the load carrying capacity of the working piles, routine load test shall be conducted.

Pile load-testing procedure and the test setup / scheme shall be submitted for approval of NSPCL . The contractor shall use the test setup having arrangement for anchor piles / rock anchors alone or combination of anchor piles / rock anchors and kentledge for both vertical compression and uplift (tension) Load test (initial) on piles. The cost of reaction system / piles shall deem to be included in the cost of test piles

All the gauges and instruments shall be calibrated before the start of the tests on test piles and working piles and the calibration record shall be verified before start of execution of the test.

11.1.12 WATER SUPPLY, DRAINAGE & SANITATION

Material used for sanitary and plumbing fittings and fixtures shall conform to and be tested as per the requirements of relevant IS Codes specified in NSPCL technical specification.

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

The service pipes shall be slowly and carefully charged with water, allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under test / working condition of pressure and flow, when all draw-off taps are closed. The service pipes shall be checked for satisfactory support and protection from damage, corrosion and frost.

11.1.13 ARCHITECTURAL & MISC. WORKS

Material used for sanitary and plumbing fittings and fixtures, floor finishes and allied work shall conform and tested as per the requirements of relevant IS Codes specified in NSPCL technical specification.

Fabricated item like metal doors, windows, ventilators, louvers, rolling shutters and grills etc. shall be checked for correctness of locations and smoothness of operation and fixtures. All controls and locking devices shall give fault free performance. 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 2.5 mm.

Materials used in glass and glazing shall be procured from source approved by NSPCL

and shall conform to the requirements of the Technical Specification and IS Codes.

False ceiling panels shall be best quality material in thickness and properties called for in the specification / schedule of items. Material Test Certificate to be submitted before bulk supply.

All bought items covered in the scope of contract shall be procured from sources approved by NSPCL and shall conform to the requirements of the technical specifications and referred standards /codes.

11.1.14 ROAD WORK

Quality Assurance and testing requirements for roadwork shall be as per the MOSRTH-Specification (Section 900), IRC specifications or CPWD specifications as specified in the technical specifications and BOQ of the contract.

The testing and sampling shall include the checks on earth work for embankment and subgrade, sub bases and bases and bituminous constructions. The sampling and testing of concrete pavements shall be as per the respective items of earthwork, subgrade / sub-base, concrete, etc.

11.1.15 FABRIC EXPANSION COMPENSATOR:

Each layer of fabric Compensator shall be checked for thickness, unit weight, tensile strength & elongation, composite layer of the expansion joint shall be tested for temperature withstandability test.

Thermal Insulation shall be checked for thickness, density, thermal conductivity test and all other tests as per IS:8183.

Tests and checks on all other items shall be carried out as per relevant codes.

11.1.16 SLIPFORM SHUTTERING

1. The monitoring of the leveling of the yoke and the platform of the slip form shuttering to be done in each shift to avoid tilt during the casting of the chimney shell.
2. Manning of each shift shall be done by at least two experienced operators and a foreman particularly in night shift.
3. Suitable removal/ reduction of overhung / excess yoke beam length shall be affected with the decrease in the diameter of Chimney shell, as per the approved plan.
4. The laser centering method to be deployed for chimney alignment and Monitoring of chimney centre should be done by laser instruments at least two points. Monitoring/Recording of the same shall be done in each shift of 8 hours
5. Shuttering plates to be used for slip form shall be new and the grade of steel shall conform to the specification requirements.
6. The outage of the alignment of chimney centre shall be prevented by creating a counterbalance for alignment purpose to avoid differential loading, arising out of placement of reinforcement bars at one side or unloading of concrete in a hopper at one side of the platform for slip form shuttering.

11.1.17 NOT USED

11.1.18 PRE CAST CONCRETE WORKS



1. All the materials used in Pre cast Concrete work shall be tested and conform to the requirements of IS codes and NSPCL Tech. Specification.
2. Concrete mix for Pre cast members shall conform to IS-456-2000.
3. All relevant QA requirements pertaining to cast insitu concrete shall be applicable.
4. Load test on Pre cast members shall be carried out for the type of members as decided by NSPCL Engineer as per IS-456-2000.
5. Pre Cast Concrete member shall be checked for dimensions (length, cross sectional dimensions, straightness, squareness, and flatness) and tolerances shall be as per NSPCL Technical Specification.

11.1.19 PLASTERING & ALLIED WORKS

1. Materials like sand, lime for preparation of putty, coarse aggregate, gypsum etc. shall confirm to the relevant IS codes specified in NSPCL Technical Specification.
2. Check proper mixing of mortar
3. Plaster surface shall be checked for following defects and the remedial measures for the same shall be adopted as per IS-1661.
 - a) Blistering
 - b) Bond filer or loss of adhesion.
 - c) Cracking and crazing
 - d) Efflorescence
 - e) Grinning
 - f) Irregularity of Surface Texture
 - g) Popping or blowing
 - h) Recurrent surface dampers
 - i) Softness or chalkiness
4. Trueness of Plastering System:
 Finished plaster surface shall not show any deviation more than 4mm when checked with straight edge of 2 m length.
5. Check thickness of plaster.

12.0.0 SHOP TEST EOT Cranes, Other cranes & Hoist

- 1.0 HOOKS
 - 1.01 ALL TESTS INCLUDING PROOF LOAD TEST AS PER RELEVANT IS/BS/DIN SHALL BE CARRIED OUT.
 - 1.02 MPI/DPT SHALL BE CARRIED OUT AFTER PROOF LOAD TEST.
- 2.0 STEEL CASTING
 - 2.01 DPT ON MACHINED SURFACE SHALL BE CARRIED OUT.
- 3.0 GIRDERS, END CARRIAGE, CRAB, GEAR BOX AND ROPE DRUM
 - 3.01 THE PLATES OF THICKNESS 25MM AND ABOVE SHALL BE ULTRASONICALLY TESTED.
 - 3.02 NDT REQUIREMENTS ON WELDMENTS SHALL BE AS FOLLOWS:
 - a) BUTT WELDS IN TENSION:- 100% RT AND 100% DPT
 - b) BUTT WELDS IN COMPRESSION:- 10% RT AND 100% DPT
 - c) BUTT WELDS IN ROPE DRUM:- 100% RT AND 100% DPT
 - d) FILLET WELDS:- RANDOM 10% DPT
- 4.0 FORGING (WHEEL, GEARS, PINIONS, AXLE, HOOKS & HOOK TRUNION)

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- 4.01 ALL FORGINGS GREATER THAN OR EQUAL TO 50 MM DIAMETER OR THICKNESS SHALL BE SUBJECTED TO ULTRASONIC TESTING.
- 4.02 DPT/MPI SHALL BE DONE AFTER HARDFACING AND MACHINING.
- 5.0 WIRE RPOE SHALL BE TESTED AS PER RELEVANT STANDARD.
- 6.0 REDUCTION GEARS SHALL BE TESTED FOR REDUCTION RATIO, BACKLASH & CONTACT PATTERN. GEAR BOX SHALL BE SUBJECTED TO NO-LOAD RUN TEST TO CHECK FOR OIL LEAKAGE, TEMPERATURE RISE, NOISE AND VIBRATION.
- 7.0 THE CRANES SHALL BE COMPLETELY ASSEMBLED AT SHOP FOR FINAL TESTING. ALL TESTS FOR DIMENSION, DEFLECTION, LOAD, OVERLOAD, HOISTING MOTION, CROSS TRAVEL ETC. AS PER IS-3177 SHALL BE CARRIED OUT AT SHOP.
- 8.0 ALL ELECTRIC HOISTS SHALL BE TESTED AS PER IS-3938 AND CHAIN PULLEY BLOCKS SHALL BE TESTED AS PER IS-3832.

13.0.0 CATHODIC PROTECTION

Quality of cathodic protection system shall be as per given table.



IMPRESSED CURRENT CATHODIC PROTECTION

Transformer Rectifier Unit

Attributes/ Characteristics										
Items / Components / Sub- assembly	Make, Model, Type, Rating & Finish	Chemical & Mechanical Tests	Sheet Steel Pretreatment & Painting process checks	Operational & Functional Checks	Conform to relevant Standard	Dimensional check and Paint shade, thickness, adhesion & Finish checks	Complete physical examination for constructional features of TRU as per NSPCL specification	Efficiency Test on TRU & Transformer	Heat Run Test	Ratio & Polarity Test on TRU HV & IR Test
Rectifier Transformer (IS : 2026)	Y				Y			Y		Y
Electronic Components	Y				Y					
PCB & Electronic Cards	Y				Y					
Control & Selector Switches (IS : 6875)	Y			Y	Y					
Indicating Meters (IS : 1248)	Y			Y	Y					
Indicating Lamps (IS : 13947)	Y			Y	Y					
Air Break Switches / Fuses (IS : 13947 / 13703)	Y			Y	Y					
Control Terminal Blocks (IS : 13947)	Y				Y					
Control Transformer (IS : 12021)	Y			Y	Y					
Push Buttons (IS : 4794)	Y			Y	Y					
MCB (IS : 8828)	Y			Y	Y					
PVC insulated Copper control wires (IS : 694)	Y				Y					
Sheet Steel (IS : 513)	Y	Y	Y		Y					
Synthetic Rubber Gaskets	Y	Y			Y					
Annunciator	Y			Y						
Transformer Rectifier Unit	Y					Y	Y	Y	Y	Y

Notes:

- This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
- Makes of all major Bought Out Items will be subject to NSPCL approval.

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ANNEXURE-I

QA&QC ORGANISATION SETUP

1. The organization setup is to be submitted by contractor however their deployment shall be as per the agreed deployment schedule. The contractor shall prepare a manpower deployment schedule in line with the finalized work plan and the same shall be submitted to the engineer-in charge for acceptance/ approval.
2. The contractor shall mobilize the QA& QC manpower in line with the finalized manpower deployment schedule and shall ensure their availability well in advance (15 days approx.) of the beginning of the concerned activity/ work.
3. The contractor shall further mobilize required number of skilled & supporting staff and additional resources, if any to meet the work schedule.
4. * For concrete work 2 Nos (one for foundation work & one for superstructure)
5. ** For lines and levels - 1 No.
6. *** For Finishes and cladding work - 1 No

SECTION-4

SCHEDULE OF TECHNICAL DEVIATION.

BHEL ENQUIRY. NO:

BIDDER:OFFER REFERENCE:

6.1 Deviations

Tick

YES

NO

If yes,

S.No.	Deviation	Clause No.
1		
2		
3		
4		
5		
6		
7		
8		
9		

(Signature & Seal of Bidder)