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|  |  | ARCHITECTURAL, CIVIL & STRUCTURAL DESIGN BASIS | P.017398/ P.017399 G11061 C001 |
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6. Roof Drainage

Water from the roof surface shall be drained by a system of roof drain heads, rainwater down corners and necessary fixtures.

Minimum 150 dia. PVC pipe of 4 kgf/cm² pressure shall be provided as per IS 4985.

7. Doors

Anodized aluminum doors shall be provided at appropriate locations as per relevant drawing to prevent dust ingress from outside and to suit the respective system requirement and convenience.

8. Windows

Anodized aluminum windows closefitting shall be provided as per the requirements. The number of windows so decided to allow natural ventilation and lighting. Minimum requirements of natural ventilation and natural lighting shall be as per National building code of India.

15.3 STORM WATER DRAINAGE

The site design of storm water drainage shall be based on maximum hourly precipitation for storm deviation of 20 minutes and roof drainage system shall be designed for hourly precipitation for a storm of 5 min.

Coefficient for design shall be as follows:

- | | | |
|--------------------------------------|---|------|
| 1. Open areas | - | 0.5 |
| 2. Road and paved area/ parking area | - | 0.70 |
| 3. Roof surface | - | 1.0 |

The drainage system shall be so designed so that the velocity of flow shall be within 1 m / sec. to 2.5 m/sec.

Roof drains shall discharge water in to storm water drains. Any drainage outside the building shall be carried away from the building to the nearest storm water drains.

Open brick masonry drains shall be provided on both sides of the road and also on periphery of plot to carry storm water from plot area to the existing nearby drain. The drain shall have slope of 1 in 250 (minimum).

16.0 WATER SUPPLY

1. Potable & Domestic water shall be tapped from the Bore well or from existing Water Supply Facilities.
2. One numbers of roof water tanks of 1000 liters (service water) depending on the number of users shall be provided as per drawings for 48 hours storage shall be provided for Facility Building.
3. Galvanized iron pipes of medium class shall be used for internal piping works for potable water supply.



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17.0 SEWERAGE SYSTEM

1. Sewerage system shall be provided wherever toilet is being provided.
2. The contractor shall design septic tank and soak pit suitable for 10 users/ or as per Client requirement and it shall as per the relevant standard drawing.
3. The system shall be designed as per relevant IS codes. Salt glazed stoneware pipe with lead joints shall be used for sanitary works below the ground of the buildings or below roads/paving.
4. Salt glazed stoneware pipe, lead joints, PVC pipes shall be used for sanitary works above the ground level.
5. Arrangement shall also be provided for discharging treated effluent to the nearest drain.

18.0 STATUTORY RULES

1. All the applicable statutory rules pertaining to factories act (as applicable for the State), Fire Safety Rules of Tariff Advisory Committee, Water Act for pollution control etc. shall be complied with.
2. Provisions for fire proof doors, nos. of staircases, plastering on structural members (in fire prone areas) etc. shall be made according to the recommendations of Tariff Advisory Committee.
3. Statutory clearance of respective NHAI, PWD, PESO and norms of State Pollution Control Board shall be followed.
4. Requirement of sulphate resistant cement for sub-structural works shall be decided in accordance with the Indian Standards based on the recommendations of the detailed soil investigation.

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**BHARAT PETROLEUM CORPORATION LIMITED
(BPCL)**

**CONSTRUCTION OF LNG STATIONS IN THE STATE
OF TAMIL NADU & KERALA**

**ENGINEERING, PROCUREMENT AND CONSTRUCTION OF LNG STATIONS AT
AVINASHI, TIRUPPUR (TAMIL NADU) & PANANCHERY, THRISSUR (KERALA) ON
TURNKEY BASIS**

SPECIFICATION FOR ARCHITECTURAL, CIVIL AND STRUCTURAL WORKS

P.017398/P.017399-G-11061-C001

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| 0 | 24.05.2021 | Issued for Tender | ISH | MKR | KNS |
| REV | DATE | DESCRIPTION | PREPARED | CHECKED | APPROVED |




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1.0 GENERAL

1.1 DEFINITIONS AND INTERPRETATION

This PTS shall be read in conjunction with the General Conditions of Contract (GCC), Special Conditions of Contract (SCC), General Technical Specifications (GTS) of work, drawings, Schedule of rates (SOR), Instruction to Bidders (ITB) and other documents forming part of the tender wherever the context so requires.

Where any portion of the GTS is repugnant or variance with any provisions of the PTS, unless a different intention appears, the provision(s) of PTS shall be deemed to govern the provision(s) of GTS of contract. If there is no variance or repugnance between GTS and PTS, both clauses shall be applicable.


In case of conflict between the requirements of this specification and that of the referred codes, standards and specifications, the requirements of this specification shall govern.

Tractebel Engineering Pvt. Ltd. (TEPL) has been appointed as Project Management Consultant (hereinafter referred as PMC), by BPCL for providing Engineering, Procurement and Construction (EPC) services for a mentioned project.

Definitions

The terms used in the technical document must be understood as follows:

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| AGREEMENT | Designates the agreement concluded between the OWNER and the CONTRACTOR, under which the latter undertakes to the former the GOODS and/or SERVICES according to the stipulations which are agreed and specified in the form of an order. |
| OWNER | Designates the purchaser of the GOODS and/or SERVICES which are the subject of the AGREEMENT. |
| CODE | Designates a set of systems and Indian rules or international standardization documents for design, materials, tests, etc. |
| CONTRACTOR | Designates the individual or legal entity with whom the order has been concluded by the OWNER. The term "CONTRACTOR" may be used indifferently for a supplier, a manufacturer, an erection CONTRACTOR, etc. |
| DAYS - WEEKS - MONTHS | Specify the number of calendar days, weeks or months and not of working days, weeks or months. |

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| OWNER'S REPRESENTATIVE | Designates the individual or legal entity to which the OWNER has entrusted various tasks in relation with the carrying out of his PROJECT. |
| GOODS and/or SERVICES | Designate, depending on the case, all or part of the drawings or documents, substances, materials, material, equipment, structures, plant, tools, machinery,... to be studied, designed, manufactured, supplied, erected, built, assembled, adapted, arranged or put into service by the CONTRACTOR under the AGREEMENT, including all the studies, tasks, works and services specified by the order. The terms GOODS or SERVICES may be indifferently used one for the other as required by the context. |
| PROJECT | Designates the aggregate of GOODS and/or SERVICES to be provided by one or more CONTRACTORS. |
| STANDARD | Designates a set of models or references, corresponding to common practice and generally used by the OWNER'S REPRESENTATIVE. This can be typical standard drawings or documents. |
| SPECIFICATION | Designates a document describing in some details general or particular requirements for specific type of works. |


1.2 LAWS –CODES –RULES & STANDARDS

Basically, the following are applicable:



Basic Laws – Codes – Rules & Standards, mandatory by law in State of Tamil Nadu and Kerala of India.

Codes & Standards (Latest editions):



| | | | |
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| 1 | IS:875 (Part I to V) | : | Code of Practice for design loads (other than earthquake) for building and structures. |
| 2 | IS:1893 | : | Criteria for Earthquake resistant design of structures. |
| 3 | IS:2911 | : | Code of Practice for design and construction of pile foundation. |
| 4 | IS:456 | : | Code of practice of Plain and Reinforced Concrete. |
| 5 | IS:1786 | : | Code of practice of specifications for high strength deformed steel bars and wires for concrete reinforcement. |
| 6 | IS:1566 | : | Code of Practice of hard-drawn steel wire fabric for concrete reinforcement. |

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| 7 | IS:432 | : | Code of Practice of specifications for mild steel and medium tensile steel bars and hard-drawn steel wires for concrete reinforcement. |
| 8 | IS:13920 | : | Code of practice for ductile detailing of reinforced concrete structures subjected to seismic forces. |
| 9 | IS: 800 | : | Code of practice for general construction in steel. |
| 10 | IS: 806 | : | Code of practice for use of steel tubes in general building construction |
| 11 | IS: 2062 | : | Code of practice for Steel for general structural purposes |
| 12 | IS: 3502 | : | Code of practice for Steel chequered plates. |
| 13 | IS: 1363 | : | Code of practice for Hexagonal head bolts, screws and nuts of product grade C. |
| 14 | IS: 1367 | : | Code of practice for Technical supply conditions for threaded steel fasteners |
| 15 | IS: 5624 | : | Code of practice for Specification for foundation bolts. |
| 16 | IS: 2016 | : | Code of practice for Plain washers |
| 17 | IS: 277 | : | Code of practice for Galvanized steel sheet (Plain and corrugated) |
| 18 | IS: 1230 | : | Code of practice for Cast Iron rain water pipes and fittings |
| 19 | IS: 269 | : | Ordinary, Rapid Hardening And Low Heat Portland Cement |
| 20 | IS: 383 | : | Coarse And Fine Aggregates From Natural Sources For Concrete |
| 21 | IS: 455 | : | Portland Blast Furnace Slag Cement |
| 22 | IS: 650 | : | Standard Sand For Testing Of Cement |
| 23 | IS: 1489 | : | Portland Pozzolana Cement |
| 24 | IS: 1727 | : | Methods Of Tests For Pozzolanic Materials |
| 25 | IS: 2386 - III | : | Test For Specific Gravity, Density, Voids, Absorption And Bulking Method Of Test For Aggregate For Concrete |
| 26 | IS: 2386 - II | : | Test For Estimation Of Deleterious Materials And Organic Impurities |
| 27 | IS: 2386 - I | : | Test For Particle Size And Shape |

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| 28 | IS 4031 | : | Methods Of Physical Tests For Hydraulic Cement |
| 29 | IS 4032 | : | Method Of Chemical Analysis Of Hydraulic Cement |
| 30 | IS 1322 | : | Bitumen Felts For Water Proofing And Damp Proofing |
| 31 | IS 2645 | : | Specifications For Integral Water Proofing Compounds |
| 32 | IS 516 | : | Methods Of Test For Strength Of Concrete |
| 33 | IS 1139 | : | Hot Rolled Mild Steel, Medium Tensile Steel And High Yield Strength Steel Deformed Bars For Concrete Reinforcement |
| 34 | IS 1199 | : | Method Of Sampling & Analysis Of Concrete |
| 35 | IS 1566 | : | Hard Drawn Steel Wire Fabric For Concrete Reinforcements |
| 36 | IS 2502 | : | Code Of Practice For Bending And Fixing Of Bars For Concrete Reinforcement |
| 37 | IS 1077 | : | Common Burnt Clay Building Bricks |
| 38 | IS 2212 | : | Code Of Practice For Brick Work |
| 39 | IS 3102 | : | Classification Of Brunt Clay Solid Bricks |
| 40 | IS 1122 | : | Method For Determination Of Specific Gravity & Porosity Of Natural Building Stones |
| 41 | IS 1124 | : | Method Of Test For Water Absorption Of Natural Building Stones |
| 42 | IS 1130 | : | Marble (Blocks, Slabs & Tiles) |
| 43 | IS 205 | : | Non Ferrous Metal Butt Hinges |
| 44 | IS 206 | : | Tee And Starp Hinges |
| 45 | IS 287 | | Recommendation For Maximum Permissible Moisture Contents Of Timber Used For Different Purpose |
| 46 | IS 303 | | Plywood For General Purpose |
| 47 | IS 451 | | Technical Supply Condition For Wood Screw |
| 48 | IS 723 | | Steel Counter Sunk Head Wire Nails |
| 49 | IS 1003 | | Timber Paneled And Glazed Shutter |

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| 50 | IS 1141 | | Code Of Practice For Seasoning Of Timber |
| 51 | IS 1200 | | Glazing |
| 52 | IS 1341 | | Steel Butt Hinges |
| 53 | IS 1659 | | Fibre Hard Board |
| 54 | IS 1761 | | Transparent Sheet Glass For Glazing & Framing Purpose |
| 55 | IS 1911 | | Schedule Of Unit Weights Of Building Material |
| 56 | IS 3618 | | Phosphate Treatment Of Iron And Steel For Protection Against Corrosion |
| 57 | IS 4021 | | Timber Door, Window And Ventilator Frames |
| 58 | IS 63 | | Whiting For Paints |
| 59 | IS 226 | | Structural Steel (Standard Quality) |
| 60 | IS 277 | | Specification For Galvanized Steel Sheets (Plain And Corrugated) |
| 61 | IS 800 | | Code Of Practice For Use Of Structural Steel In General Building Construction |
| 62 | IS 806 | | Code Of Practice For Use Of Steel Tube In General Building Construction |
| 63 | IS 813 | | Scheme Of Symbols For Welding |
| 64 | IS 814 | | Covered Electrodes For Metal Arc Welding Of Structural Steel |
| 65 | IS 815 | | Classification And Code Of Covered Electrodes For Metal Arc Welding Of Mild Steel And Low Alloy High Tensile Steel |
| 66 | IS 818 | | Code Of Practice For Safety And Health Requirements In Electric And Gas Welding And Cutting Operation |
| 67 | IS 1938 | | Steel Doors, Windows And Ventilators |
| 68 | IS 1608 | | Method For Bend Test For Steel Products Other Than Sheet, Strip, Wire And Tube |
| 69 | IS 1977 | | Method Of Tensile Testing Of Steel Products |
| 70 | IS 2062 | | Structural Steel (Ordinary Quality) |
| 71 | IS 4351 | | Structural Steel (Fusion Welding Quality) |



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| 72 | IS 777 | | Steel Door, Door Frames |
| 73 | IS 1130 | | Glazed Earthen Ware Tiles |
| 74 | IS 120-XI | | Marble (Blocks, Slabs And Tiles) |
| 75 | IS 1443 | | Cement Concrete Flooring Tiles |
| 76 | IS 1661 | | Code Of Practice For Laying And Finishing Of Cement Concrete Floor In Tiles |
| 77 | IS 2571 | | Code Of Practice For Application Of Cement Lime Plaster Finishes |
| 78 | IS 102 | | Code Of Practice For Laying In Situ Cement Concrete |
| 79 | IS 103 | | Ready Mixed Paint, Brushing, Red, Lead Non-setting, Priming |
| 80 | IS 133 | | Ready Mixed Paint, Brushing, White Lead, For Priming And General Purpose |
| 81 | IS 137 | | Enamel, Interior (A) Under Coating (N) Finishing Color As Required |
| 82 | IS 158 | | Ready Mixed Paint, Brushing, Matt Or Egg Shell Flat, Finishing, Interior, To Indian Standard Color As Required |
| 83 | IS 218 | | Ready Mixed Paint, Brushing Bituminous, Black, Lead Free, Acid Alkali, Water And Heat Resisting For General Purpose |
| 84 | 1200 (PT XII) | | Creosote And Anthracite Oil For Use As Wood |
| 85 | IS: 1728 | : | Code of practice for Specification for sheet metal rainwater pipes, normal size gutters, fittings and accessories |

2.0 SCOPE OF WORK

The scope of work shall be broadly, but not limited to, the following:

1. Cable trenches: complete civil works for cable trench including providing inserts plates, conduits (GI, PVC or HDPE etc.) And PVC coated MS Chequered cover plate / Pre cast concrete covers as per requirement.
2. Construction of Single and double SS Tube Trench as per drawing.
3. Construction of Dispenser Island, LNG Storage tank & Vaporiser foundation, Foundation for Check Metering Skid, Canopy foundation ,Fire water tank structure, Fire Water Pump Shed, Control Cum Electrical Building and other associated work as per relevant drawings.
4. Construction of cable pit drain pits etc. as per requirement.
5. Construction of LNG dyke along with foundation for LNG tanks and pumps
6. Construction of Septic Tank along with Soak Pit and connections.

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7. Laying of Hume pipes for drainage as per drawing and requirement of site.
8. Construction of Utility / office building - control room, office room, storeroom, UPS and battery room, electrical room etc. as per relevant architectural drawings.
9. Laying PCC kerb stones over PCC base as specified.
10. Grouting of all base plates/frames of equipment foundations and structural bases.
11. Providing of all inserts, conduits, pre-cast covers, fixing of free issue items into permanent works etc.
12. Providing of approved quality sand/ Rubble Soling below Foundation as per requirement.
13. Clearing all construction debris and handing over completed work site.
14. Any other work not specifically mentioned but required to make the station functional.
15. Preparation of as-built details/drawings with respect to construction drawings.

3.0 PREAMBLE TO SCHEDULE OF RATES



The Preamble to Schedule of Items is an integral part of the schedule of quantities and rates and this is to be considered incorporated into the description of items themselves. The Contractor's rate for any item of work in the schedule of item shall, unless stated otherwise be held to include the cost of all Engineering Aspects for Civil Structure and Architecture design of LNG Facilities

4.0 GENERAL REQUIREMENT

4.1 Reinforced Cement Concrete – Sub Structure

Brief description of major items shall be as follows:

1. Earth Work in excavation including back filling using serviceable surplus/ borrow material, disposal of surplus earth (wherever required), including bailing out water (wherever required), shoring / strutting etc.
2. 100 mm thk. PCC M-10 in mud mat.
3. Providing shuttering and strutting of all types.
4. RCC M25 as per drawing. & specification including supply of cement, coarse aggregate, fine aggregate and placement of concrete at all levels and depths, all inclusive & testing of concrete and other materials.
5. Providing and fixing of all anchor bolt and nuts into permanent works etc.
6. Providing and fixing of all inserts, conduits, precast covers into permanent works etc.
7. Provision of chequered plates, gratings into permanent works as per SOR item of Structural works.
8. Grouting of all base plates/frames of equipment foundations as per requirement.
9. Application of two coats of hot bitumen on surfaces in contact with soil.

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Note:

- a. For all these items only net RCC quantity in m³ shall be measured for payment.
- b. Earth work with borrowed earth shall be paid vide respective SOR item.
- c. Anchor bolts and nuts shall be paid vide respective SOR item.
- d. Grouting with non-shrinkable compound shall be paid vide respective SOR item.

4.2 Reinforced Cement Concrete – Super Structure

Brief description of major items shall be as follows.

1. Providing shuttering and strutting of all types
2. RCC M25 as per drawing. & specification including supply of cement, coarse aggregate, fine aggregate and placement of concrete at all levels, all inclusive & testing of concrete and other materials.
3. Grouting of all base plates/frames of equipment foundations and structural bases as per requirement.
4. Providing and fixing of all anchor bolt and nuts into permanent works etc.
5. Providing and fixing of all inserts, conduits, precast covers into permanent works etc.
6. Provision of chequered plates, gratings into permanent works as per SOR item of Structural works.

Note:



- a. For all these items only net RCC quantity in m³ shall be measured for payment.
- b. Anchor bolts and nuts shall be paid vide respective SOR item.
- c. Grouting with non-shrinkable compound shall be paid vide respective SOR item.

4.3 Reinforcement Steel

1. Reinforcement bars for RCC shall be HYSD (High yield strength deformed) of grade Fe 500D conforming to IS: 1786 (minimum yield strength 415 N/mm²) and MS round bars for grade I conforming to IS: 432-part I
2. Straightening, Cutting, Bending, Cranking, Binding, Welding, Provision of necessary Chairs and Spacers for reinforcement bars as per drawing and construction requirements.
3. Preparation of bar bending schedule Drawings and getting the same approved by Site Engineers as directed by EIC

Note:

- a. Rate to include cost of all labour, tools, tackles, equipment, hire charges, supply of all materials such as steel Reinforcement, binding wire and other minor construction materials, testing etc. all bye works and sundry works complete in all respects.
- b. Chairs, laps, spacers, wastage etc. shall be to contractor's account.

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- c. Only net Reinforcement bars as per approved BBS / as laid at site shall be considered for payment.

4.4 Brick Work in Sub Structure

Complete works in brick masonry sub structure is included in the scope Construction Contractor

Brief description of major civil items shall be as follows:

1. Earth work in excavation including back filling using serviceable surplus material or approved borrow material and transportation of excess earth beyond plot limits. Preparation of sub-base including dewatering and compaction.
2. Brick work in sub structure with not less than M-7.5 grade bricks in 1:4 cement sand mortar (in coarse sand).
3. 150 mm thk PCC 1:4:8 (M-10) in levelling course.
4. DPC 40 mm with cement concrete M-15 (1:2:4) as per requirement with water proofing compound and application of bituminous paint
5. 20 mm thk plastering in CM (1:4) (in coarse sand) on exposed brick surfaces, 12 mm for Internal Brick Surface and 6 mm for ceiling or RCC Surface.
6. Application of two coats of hot bitumen on surfaces in contact with soil Or As per Soil report recommendation.
7. Applying Cement based paint / weatherproof paint /washable distemper on plastered faces in sub structure as specified in drawings.
8. Making weep holes with 75mm dia. PVC pipe stone filter pack at 1.0 m intervals in both the directions.

Note:



- a. Only net brick masonry quantity excluding plaster thickness shall be measured in M³ for payment purpose.
- b. Earth work in backfilling with borrowed earth shall be paid vide respective SOR item.
- c. The construction of brick work shall be done as per detailed construction drawings to be issued to the successful tenderer. Offer to be prepared by the tenderer based on work described above.

4.5 Brick Work In Super Structure

Complete works in brick masonry super structure is included in the scope.

Brief description of major civil items shall be as follows:

1. Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in sub-structure & Super Structure Cement mortar 1:6 (1 cement : 6 coarse sand).
2. 20 mm thick plastering in CM (1:4) (in coarse sand) on exposed brick surfaces.
3. All niches, offsets, pockets etc shall be considered part of the work.

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4. Providing shuttering / supports etc. as per requirement
5. Applying Cement based paint / weatherproof paint / oil bound distemper/Acrylic paint on plastered faces in super structure as specified in drawings.

Note:

- a. Only net brick masonry quantity excluding plaster thickness shall be measured for payment purpose.
- b. The construction of brick Masonry work shall be done as per detailed construction drawings to be issued to the successful tenderer. Offer to be prepared by the tenderer based on work described above and payment will be made on rate (per M) of brickwork done.

4.6 RCC Kerb Stone In Specified Areas

Brief description of major works to be considered in this item is as follows.

1. Supplying and fixing M-30 Kerb Stone Blocks 125 mm x 300 mm over 75 mm thk PCC – M 10 grade.
2. Filling joints between the blocks with cement mortar (1:3) (in coarse sand).
3. Actual work shall be carried out as per certified construction drawings to be issued to successful tenderer.

Note:



Complete civil works for Kerb Stone including, earth work in excavation, preparation of base i.e., compacted sub grade, 75 mm thk. PCC, etc. are included in the works & payment shall be made in RM. under Kerb Stone item.

4.7 RCC Grade Slab in Forecourt

Complete civil works and other finishes in the fore court are included in the scope.

Brief description of major civil items shall be as follows.

1. WBM (225 mm thick) compacted with road roller and river sand filling in voids.
2. 100 mm thick PCC M-10 (1:3:6).
3. Laying of all required conduit, cables, pipes etc. and fixing them securely to the reinforcement bars (payable under separate item).
4. RCC M25 (to be procured from batching plant/site prepared mix) 150 mm thick laid to slope including reinforcement and inserts, PVC sleeves, expansion joints and brush finish.
5. Providing & laying 50 mm thick M25 screed over RCC floor with 4 mm dia and 75 X75 mm wire mesh (payable under separate item).
6. Applications of non-metallic compounds, as per manufacturer's specifications to make the surface hard enough to bear abrasion, improve permeability & resist weathering. The compound to be used shall be non-metallic hardener of Roff/ Fosroc/ STP/ CICO or equivalent (payable under separate item).

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7. Providing non-deteriorating board in expansion joints with polysulphide sealant (payable under separate item).
8. Making of cable and steel tube trench with RCC precast covers with lifting arrangement (payable under separate item but area of trench will be deducted from forecourt).
9. Making dispenser islands including Granite/Vitrified tile top fixing and all its finishes (payable under separate item).
10. Concrete paver blocks laid over PCC (payable under separate item).
11. Fixing of concrete kerb stone blocks. Kerb stone blocks shall have niche with reflective material fixed in it (payable under separate item).
12. Manhole, gully trap including RCC covers.

Note:

Only area of completed forecourt shall be measured for payment.



The construction of fore court shall be done as per approved detailed construction drawings to be issued to the successful tenderer. Offer to be prepared by the tenderer based on the enclosed architectural drawings and on lump sum unit rate (per Sq. m) for complete work.

4.8 Roadwork

Complete works in making of road over well-compacted sub grade (CBR 4.0 – 5.0 in soaked condition) is included in the scope.

Brief description of major items shall be as follows.

1. Preparation of sub grade including dressing to camber, making good all undulations, re-rolling with power road roller of 8 to 12 tons capacity etc.
2. Supply and laying of 225 Thick WBM over Compacted Soil and river sand of 200mm thick over WBM.
3. Providing and laying 100 mm thick cement concrete of 1:3:6 over sand.
4. Providing and laying 200mm thick RCC of Grade M25 over PCC.
5. Providing & laying 25 mm dowel bars with metal cap @200 mm c/c across the full road width at expansion joint location as per drawing.
6. Providing and laying cap cell of Supreme make board of or equivalent sealing in expansion joints at all locations including sand fill, edge preparation, cleaning, drying complete in all respects.
7. Road making shall be done as per approved detailed construction drawings to be issued to the successful tenderer. Offer to be prepared by the tenderer based on the enclosed drawings and on lump sum unit rate (per Sq. m) of premix carpet surface laid.

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|  |  | <p>SPECIFICATION FOR ARCHITECTURAL, CIVIL AND STRUCTURAL WORKS</p> | <p>P.017398/ P.017399 G11061 C001</p> |
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4.9 RCC Pre-Cast Slab

Brief description of main items shall be as follows:

Factory made precast RCC slab having concrete of strength not less than M-25, of size 1000x450x50 mm, reinforced with 8 mm dia four nos longitudinal & 9 nos. cross sectional TMT hoop bars, with 50 mm dia perforations @ 100 to 125 mm c/c of approved make shall be provided and fixed as per instruction of Engineer-in-charge.

4.10 Providing and Laying Floor Hardener

Heavy duty non- metallic hardener compound of STP, Roff, Fosroc, CICO of approved manufacture or equivalent laid in panels at all locations over well compacted concrete bed complete with all works, with minimum coverage as per manufacturers' specifications, drawings and as directed by EIC shall be provided and laid. All preparation and laying to be done under specialist supervision and a performance guarantee be furnished for a long-term service life.

4.11 Grouting with Non-Shrinkable Compound

Brief description of major items shall be as follows:

Ready mix non-shrink cementitious grout of compressive strength 30N/mm² /45N/mm² as per SOR shall be provided and laid manually or by pumping at all positions. This shall include shuttering, compacting, edging, repairing, sealing and curing for shutdown repairs, base grouting of rotating equipment and other installation complete. This shall be as per specifications, site sketches/ drawings and direction of the EIC.

Minimum coverage as per manufacturers' recommendations shall be applied in absence of actual field consumption data.



4.12 Providing and Laying Cap cell Board

CAPCELL board sealing in expansion joints of 12 mm/25 mm thickness and required depth shall be provided and laid. All preparation, protection, sealing and sand bed separation will be part of the work.

4.13 Supply Fabrication and Erection of Steel Structure

This Specification shall apply to supply, fabrication and erection of steel structures in LNG Station and general structural work.

The steel structures shall consist of but not limited to columns, column bracing, portals, LCV Stand, loading unloading platforms, walkways, stairs, ladders, handrails, chequered Plate, Grating for platforms, welded mesh fencing and fencing gate, colour coated steel, steel false ceiling gutter, down take pipes, hoarding, etc.

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This Specification covers the structural steel work mainly mentioned below. The structural work shall not be limited to the following description but shall be guided by technical/ technological aspects for the total scope of work.

Any other work not specifically mentioned but required to make the station functional. Making as-built details/drawings on one set of construction drawings and return to owner.

4.14 Supply, Fabrication and Erection of Miscellaneous Steel Structural Works

Brief description of major items shall be as follows:

1. Supply, Fabrication and erection of Loading unloading platform, LCV Stand, Hoarding, cat ladder for approach on building, safety guard for dispenser, pipe supports, chequered plate cover, Grating, etc. shall be fabricated from rolled Steel section and built up section conforming to IS:2062 Grade-A and pipes conforming to IS:1161, as per requirement.
2. Painting of steel structure as per specification and drawing.
3. All steel structure shall be fabricated and erected as per detailed construction drawing to be issued to the successful tenderer.


Note:

- a. All works shall be considered for payment on MT basis
- b. The cost of MS bolts (permanent and service), washers, electrodes, putty, gases, cost of straightening the raw materials, cutting of flats from plates and providing splices, paints, tools, plants, electric power, water. Other consumables, as required for the work shall be deemed to be included in the quoted rates.
- c. All handling and transport charges of raw materials and fabricated structures including double handling, as required, for completion of work in accordance with time schedule, are deemed to be included in the quoted rates.

4.15 Water-Proofing Works in Fire Water Storage Tank

20 to 25 mm thick rough Shahabad box type waterproofing treatment shall be provided on vertical outside faces of RCC walls of Fire Water Storage Tank. The gap of 25 mm between rough Shahabad and R.C.C. walls shall be filled with cement grout mixed with water proofing liquid Algae proof or other alike with one tile lift method and brushing the joints horizontally with cement slurry mixed with water proofing liquid for width 30 to 35 mm and sloping coping over topmost tile with cement mortar 1:3, butting the bottom most with cement concrete 1:2:4 mixed with water proofing liquid.

Integral cement based treatment for waterproofing shall be provided on horizontal surface of RCC walls of Fire Water Storage Tank, consisting of 1st layer of 20-25mm thick box type Shahabad stone slab over a 25mm thick base of CM 1:3 mixed with waterproofing compound 'Impermo' of snowcem or equivalent conforming to IS:2645 in the recommended proportion. Joints sealed and grouted with cement slurry mixed with waterproofing compound. 2nd layer shall be of 25mm thick CM 1:3, mixed

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with waterproofing compound in recommended proportion. Finishing top layer shall be with stone aggregate of 10 to 12mm nominal size spreading @ 8Cu. M./Sq.M. thoroughly embedded in the second layer.

4.16 Aluminium Doors, Windows, and Ventilators.

1. Door

a) Single Leaf Door

35 mm thick 1st quality water proof Single Leaf Flush Door shall be provided as per detailed drawings with 1.5mm thick laminate on both sides and colour shall be approved from EIC, all necessary beads, moulding and lipping with 12x35mm lipping patti on all edges. Rate is inclusive of S S fixtures & fittings, such as handles on both sides, tower bolts, locking arrangement,, door stopper of make (ozone,Hettich,Hafle) and finishing with French polishing etc. complete (EXCLUDING FRAME).

b) Double leaves door

Solid core flush door shutters shall be provided in double leaves 35mmthick, decorative type of exterior grade, as per detailed drawings, conforming to I.S.:2202–1966(Revised) including approved laminates on both sides, without glazing and venetians including mat finish stainless steel fixtures and fastening, stoppers and finishing with french polishing etc. (Excluding door frame) (Sample to be got approved from Ex. Engineer before use)
Commercial Hard Wood shutter

2. Windows



a) Partially Openable & Partially fixed window

Partly openable and partly fixed aluminium window of any size as per detailed drawing shall be provided/installed as directed by Engineer-in-charge with all necessary alluminium sections including necessary fixtures and fastening with 5 mm thick float glass etc. complete. a) Without powder coating Note While arriving at the rate of item of item weight at 6.90 Kilogram/Square Metre is considered.

b) Sliding Window

Aluminium sliding window shall be provided in accordance with the I.S.1868 / 1982 of two tracks with rectangular pipe having overall dimension 63.50 x 38.10 x 1.02 mm at weight 0.547 Kilogram/Running metre and window frame bottom track section 61.85 x 31.75 x 1.20 mm at weight 0.695 Kilogram/Running metre. Top and side track section 61.85 x 31.75 x 1.30 mm at weight 0.659 Kilogram/Running metre.

The shutter should be of bearing bottom 40 x 18 x 1.25 mm at weight 0.417 Kilogram/Running metre. Inter locking section 40 x 18 x 1.10 mm at weight 0.469 Kilogram/Running metre. And handle section 40 x 18 x 1.25 mm at weight 0.417

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Kilogram/Running metre. and top section 40 x 18 x 1.25 mm at weight 0.417 Kilogram/Running metre. As per detailed drawings and as directed by Engineer in charge with all necessary Aluminium sections fixtures and fastenings such as roller bearing in nylon casting and self-locking catch fitted in vertical section of shutter including 5 mm thick plain glass with all required screws and nuts etc, complete. With colour Anodising with box.

3. Anodising Treatment



Anodising treatment Shall be provided to aluminium sections of the doors , windows, and ventilators including all the intermediate supports , side supports, screws and all the necessary fixtures with all leads, lifts, fixing charges etc. complete

4. Aluminium Ventilator

Anodised Aluminium fixed staggered (Z Type) Ventilator (as per IS 1868/1982) shall be provided with aluminium rectangular pipe 63 mm x 38.10 mm x 1.22 mm at weight 0.650 Kilogram/Running metre, Aluminium angle of size 15 mm x 15 mm x 1 mm, aluminium channel of 9 mm sizes, S.S. mosquito net of 304 Grade, 4 mm thick float glass per detailed drawing and as directed by Engineer in charge etc. Complete.

5. Fire Rated Door

Fire Rated door shall be provided at location as mentioned in Detailed drawing for Facility building. Refer the following specification for Fire rated Door and should be relevant with the given Indian Standards. 2 Hour Insulated, Flame, Smoke Radiation check Lead Lined Fire Door of 57mm 2HR FRL (120/120) 3 Criteria - INTEGRITY / INSULATION/ STABILITY WOODEN DOOR - Fire Door Tested in accordance to IS: 3614 Part 2. with prior approval of concerned Superintending Engineer Providing of 120 min Fire rated lead lined doors system duly tested for 3 criteria - Integrity, In Rs. Insulation and Stability Criteria as per the IS: 3614 Part 2 and BS: 476 part 22 with standard heating conditions as specified in IS:3614 Part II 1992 and BS: 476 part 20 & 22 1987 to achieve the required integrity, insulation and stability (i.e. to restrict the heat radiation, temperature rise on the non fire side to the maximum of 140° C above the ambient temperature on the exposed surface of the shutter. The fire doors are tested with NCBN technology ("Non Combustible by Nature"). Lead lined to check radiation. Code No; 2 Hour Insulated, Flame, Smoke Radiation check Lead Lined Fire Door 57mm 2HR FRL (120/120) 3 Criteria - INTEGRITY / INSULATION/ STABILITY WOODEN DOOR - Fire Door Tested in accordance to IS: 3614 Part 2.

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a) Door Frame

Provide Frames for Lead Lined Fire resistant door shutters 1st class Malaysian Hardwood Frame densified and pressure treated with fire retardant chemicals in vacuum impregnation vessel under 160 PSI pressure as per IS:401 and kiln seasoned to moisture below 15% as per IS:1141 of section 140 X 70 mm with 45mm thick two layered 3mm Lead Line Sheets with 10mm overlap from either side & spray coated with 2 coats of Intumescent paint of minimum 200 micron, with 1 row of Brush- Type Astroflame intumescent strip (imported) of size 10mmx4mm concealed in the groove of the Frame for fire and hot and cold smoke sealing, etc. complete as per direction of Engineer in Charge.

b) Shutter


Providing of 57mm thick asbestos free composite, 'TUFWUD' brand - 3 criteria - fire, heat and smoke check Lead Lined Door Shutter with flame guard of 120 minutes IS3614 part -II comprising of 2x9mm Calcium Silicate boards, Chemical treated internal timber with Fire retardant chemicals in pressure impregnation vessels under 160 PSI pressure as per IS:401 and kiln seasoned to moisture below 15% as per IS:1141 frame work of 100x30 mm with 30mm thick infill of ceramic fibre (density 128 Kilograms/CMT) vermiculite mix, 3mm thick Lead Sheet on one side faced & 3mm Fire retardant High Density Fibreboard, internally lipped with hardwood beading, and pasted in Hydraulic Press under 50 tonnes pressure, spray coated with 2 coats of Intumescent paint of minimum 300 micron, and with 1 row of Brush- Type Astroflame intumescent strip (imported) of size 10mmx4mm concealed for fire and smoke sealing in the grooves in the shutter on all edges except bottom, without any external lipping.

6. Louvered windows / ventilator



Powder coated aluminium louvered windows / ventilator of various sizes shall be provided with powder coating as per detailed drawing and specifications including aluminium frames 80 x 38 mm x 1.22 mm box type, 5 mm thick sheet glass louvers, of approved quality etc. complete.

5.0 LIST OF APPROVED MANUFACTURERS AND QUALITY OF MATERIAL TO BE USED



| S. No. | Item | Make |
|--------|--|--|
| 1. | Cement Op:43 Grade IS : 8112 OPC : 53 Grade IS : 12269 PPC : 455/ IS : 1489 | ULTRATECH/JK/ACC/AMBUJA/BINANI/B IRLA/CHETTINAD |
| 2 | White Cement | BIRLA/. J.K. |

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| S. No. | Item | Make |
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| 3. | Reinforcement Tor Steel /TMT& Mild Steel Bars Fe 415 | AS PER IS: 2502/ IS: 2751/ IS: 1786 (1979) Re. Steel – TATA/ SAIL/ RINL// VIZAG |
| 4 | Structural Steel sections- Channels, Angles, Plate, Beams, Flats , Bars (Square & Round) | AS PER IS: 226 (1975)/ IS : 961 (1975)/ IS : 1977 (1975)/ IS : 2062 (1984)/ IS : 8500 (1977) / IS : 432 OR SAIL/ TATA/ VIZAG / RINL / JINDAL |
| 5 | Coarse And Fine Aggregate | AS PER IS: 383.or as stipulated in SOR and approved by the Engineer. |
| 6 | Cement Paint | SNOWCEM / ASIAN PAINT / BERGER |
| 7 | Ceramic Tiles | NITCO / SPL / KAJARIA / HR JOHNSON |
| 8 | Tile Grouts | LATICRETE / BAL ADHESIVE |
| 9 | Paint (Emulsion/Distemper/ WP Cement Based) | ASIAN PAINT / ICI/ BERGER PAINT |
| 10 | A.C. Sheets (Asbestos Free) | EVEREST / CHARMINAR/ RAMCO |
| 11 | Rolling Shutters | SWASTIK / SARVODAYA / BHARAT/ SHIVAM/ MILESTONES/ RAMA/ APPROVED MAKE |
| 12 | Fireproof Doors | R.D.G. ENGINEERING / F.T.E./SHAKTI MAT-DOR |
| 13 | Steel Windows | AGEW / SEN HARVIC/ DEVAS METAL/ DHIMAN |
| 14 | PVC Water Stoppers | CALIPLAST/FIXOPAN |
| 15 | Floor Hardener | FOSROC /J.B.ASSOCIATES /MBT / PIDILITE |
| 16 | Floor joint Sealant | FOSROC / J.B.ASSOCIATES/ NINA |
| 17 | Light Gauge Cold Rolled 'Z' Section For Purlins & Cladding Runners | ADVANCE / PMC / NSL / TIGER / KIRBY |
| 18 | Welding Rods | ADVANI / ESSAB |
| 19 | Erection Nuts And Bolts | GKW / F.T. & N.B. LTD. / IS:1367./ HILTI / FISCHER |
| 20 | All Sanitary Fittings Like W.C. Pan/ Wash Basin/ Urinals Etc. | HINDUSTAN SANITARY WARE / PARRY WARE |
| 21 | All Plumbing Fixtures | JAGUAR(CHROME PLATED)/PLUMBER |
| 22 | Glasses For Doors And Windows & Mirrors | MODI GUARD / SAINT GOBAIN / ASAHI |

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| S. No. | Item | Make |
|--------|--|---|
| 23 | Shuttering Plywood | ANCHOR / KITPLY / JAYSHREE / MANGALAM |
| 24 | Anti-Termite Treatment | BAYER/ TRISUL/ NOCIL |
| 25 | Aluminium Glazing And Windows | Sample Approval. |
| 25 | Bricks | APPROVED LOCAL MAKE. |
| 26 | Partition Board | NOVAPAN/ BISON/ GREENPLY |
| 27 | Construction Chemical | FOSROC / PIDILITE / MBT |
| 28 | P.V.C. & uPVC Pipe | FINOLEX / PRINCE / SUPREME/JAIN |
| 29 | G.I. Pipe | TATA / JINDAL /ZENITH |
| 30 | R.H.S. Sections | TATA/ JINDAL |
| 31 | False Ceiling Systems | EVEREST / RAMCO |
| 32 | Vinyl Floor | ARMSTRONG/ L G/ NITTOBO |
| 33 | Sealant- Silicone/ Polysulphide | GE/ PIDILITE/ FOSROC/ JBASSOCIATES |
| 34 | Epoxy Over Flooring | FOSROC/ MBT/CIPY |
| 35 | Water Proofing Membrane – Bitumen Based | STP/ BITUMAT |
| 36 | Non Shrink Grouts | FOSROC/ MBT |
| 37 | FRP Gutter | Everest Vadodara, Jay Raj Vadodara, Roofit |
| 38 | Bitumen | SHALIMAR TAR PRODUCTS/ MATHURA OIL REFINERY |
| 39 | Flush Door | Anchor / KIT / Green |
| 40 | Deleted | |
| 41 | Laminates | NOVAPAN/ GREENPLY/ FORMICA |
| 42 | Plywood | Century / Archid / GREENPLY / DURA |

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| S. No. | Item | Make |
|--------|--|---|
| 43 | Terrazzo Tile | NITCO/SONA |
| 44 | Free Access Flooring | UNITILE - UNITED ACCESS FLOORS P LTD/ TEJAS |
| 45 | Paving Stones | UNISTONE OR EQUIVALENT |
| 46 | Wax Polish | MANSION OR EQUIVALENT |
| 47 | Sanitary Fixtures | HINDWARE/ PARRYWARE/ JAGUAR |
| 48 | Urinal Sensors | SMS DEVICES / ADS/TOSHI |
| 49 | Stainless Steel Hinges | CANON/ UNION |
| 50 | Door Hardware / Closer | GEZE/ DORMA/ BRITON |
| 51 | Locks And Handles | Godrej / DORSET/ Yale |
| 52 | Anchor Fastener / Anchor Bolts | HILTI/ FISHER |
| 53 | Corner Beads & Specials | ARPITHA OR EQUIVALENT |
| 54 | Gypsum Partition & Gypsum Ceiling | INDIA GYPSUM |
| 55 | Electrodes | ADVANI / ESSAB |
| 56 | Mineral Fiber Ceiling System | ARMSTRONG/ NITTOBO/ INDIA GYPSUM/ CELOTEX |
| 57 | H.T. Bolts | UNBRAKO |
| 58 | Steel Doors | UNBRAKO/SHAKTI MAT –DOR/ DHIMAN |
| 59 | Aluminum Sections | INDAL / JINDAL/ HINDALCO |
| 60 | Bare Galvalume sheets for roof & Cladding (Substrate) | NIPON/DONGBU/ BHP/ BLUESCOPE/ SHREE PRECOATED /JSW/ ISPAT |
| 61 | Roof /Cladding System Manufacturer | SHREE PRECOATED / CRIL / BLUESCOPE/LLOYD |
| 62 | Glass Wool And Related Products/ Mineral Wool & Insulation | UP-TWIGA/ OWENS CORNING/ LLOYDS / TASMAN/ POLYNUM |

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| S. No. | Item | Make |
|--------|---------------------------|--|
| 63 | Polycarbonate Sheets | GE PLASTICS / FLEXITUFF/ JAIN |
| 64 | Self Drilling Screws | HILTI/ BUILTEX |
| 65 | Logo/ Signs/ Name Plates | SIGNAGE SYSTEMS INDIA |
| 66 | Pre - Engineered Building | KIRBY BUILDING / VARCO PRUDEN/ LLOYD STEEL |
| 67 | Ms Sliding Motorized Door | HEIDZ INDIA LTD./GANDHI AUTOMATION |
| 68 | G.I. Fitting And Valves | UNION/ R Brand |
| 69 | Stainless Steel Sink | NIRALI/ KINGSTONE/ NEELKANTH |

Notes:

- a. The contractor must quote the rate considering the above make of materials.
- b. Before procurement of the all materials contractor shall submit the sample and shall have the same approved by Consultants/Employer.
- c. Alternative makes if any shall be assessed by the Engineer & his decision shall binding

STANDARD FIELD QUALITY PLAN

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| A | 13.05.21 | ISSUE FOR TENDER | ISH | MKR | KNS |
| Rev. | Date | Subject of revision | Author | Checked | Approved |

Section : CONSTRUCTION MATERIAL

| S.No | Component Operation & Description of Test | Sampling Plan with basis | Ref. Document & acceptance norms | Testing Agency | Remarks | Check |
|------|---|--|---|--|--|-------|
| 1. | CHECKING OF FOUNDATION MATERIALS | | | | | |
| A. | CEMENT | | | | | |
| i | Fineness | One sample per lot of 100 MT or part thereof from each source for MTCs and one sample per lot of 200 MT or part thereof from each source for site testing. | IS:456, IS:269, IS:8112, IS:12269, IS:4489 & TEPL Specification | Manufacturer approved lab | Review of manufacturers test certificates (MTCS) and laboratory test results by TEPL | B |
| ii | Compressive Strength | | | | | |
| iii | Initial & final setting time | | | | | |
| iv | Soundness | | | | | |
| v | Heat of Hydration for low heat cement (Not Applicable for OPC & PCC) | | | | | |
| vi | Chemical Composition of Cement | One sample per lot of 100 MT or part thereof from each source from MTCs. | IS:456, IS:269, IS:8112, IS:12269, IS:4489 & TEPL Specification | Manufacturer | Review of manufacturers test certificates by TEPL | B |
| B. | COARSE AGGREGATES | | | | | |
| i. | Determination of Particle size (Sieve Analysis) | One sample per lot of 100 cubic meter or part thereof from each source for each source for each size | IS: 383, IS: 2386 and TEPL specification | TEPL approved lab. However, Moisture content test for design mix concrete shall be done on all days of concreting at site. | Each source to be approved by TEPL. Review and acceptance of test result by TEPL | B |
| ii | Flakiness Index | | | | | |
| iii | Crushing Value | | | | | |
| iv | Specific Gravity | | | | | |
| v | Bulk Density | | | | | |
| vi | Absorption Value | | | | | |
| vii | Moisture Content | | | | | |
| viii | Soundness of Aggregate | | | | | |
| ix | Presence of deleterious materials | | | | | |

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| C | FINE AGGREGATE | | | | | |
| i | Gradation/Determination of Particle size(Sieve Analysis) | One sample per lot of 100 cubic meter of part thereof from each source | IS:383, IS:2386, IS:456 and TEPL specification | TEPL approved lab. However, Moisture content test for design mix concrete shall be done on all days of concreting at site. | Each source to be approved by TEPL. Review and acceptance of test result by TEPL | B |
| ii | Specific Gravity and density. | | | | | |
| iii | Moisture content* | | | | | |
| iv | Absorption Value* | | | | | |
| v | Bulking | | | | | |
| vi | Silt Content Test | | | | | |
| vii | Presence of deleterious materials | | | | | |
| D | BRICKS | | | | | |
| i. | Dimensional tolerance | As per enclosed Annexure-II | CPWD & TEPL specification | TEPL approved Lab. | Approved by TEPL | B |
| ii | Compressible Strength | | | | | |
| iii | Water Absorption | | | | | |
| iv | Efflorescence | | | | | |
| E | WATER | | | | | |
| i | Cleanliness (Visual Check) | Random | IS: 456, IS: 3025 and TEPL specification. The water used for mixing concrete shall be fresh, clean and free from oil, acids and alkalis, organic materials, or other deleterious materials. | Contractor | Each source to be approved by TEPL | B |
| ii | Chemical and physical properties of water for checking its suitability for construction purposes | One sample per source | IS:456, IS:3025 and TEPL specification | Contractor/ TEPL approved lab. | Approved by TEPL | B |

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|    | GTS - STANDARD FIELD QUALITY PLAN | Z/02 0064 |
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| 2. i. | REINFORCEMENT STEEL Identification & size | Random | IS:432, IS:1139, IS:1786 & TEPL specification | Contractor | Approved by TEPL | B |
| ii. | Chemical Analysis Test | One sample per heat | IS:432, IS:1139, IS:1786 & TEPL specification | Manufacturer | Review of manufactu rers test certificate s by TEPL | B |
| iii iv v | Tensile Test Yield stress/ proof stress Percentage Elongation | One sample per lot of 40 MT or part thereof for each size of steel conforming to IS:1139 and 5 MT or part thereof for HDS wire for each size of steel as per IS:432. For steel as per IS:1786 under 10mm 1 sample for each 35 MT or part thereof. Over 16m , 1 sample for each 45 MT or part thereof. | IS:432, IS:1139, IS:1786 & TEPL specification | Manufacturer s / TEPL approved Lab | Review of manufactu rers test certificate s as well as lab test result by TEPL | B |
| vi | Bend/Rebend Test | One sample per lot of 20 MT or part thereof for each size of steel as per IS:432, IS:1139. For steel as per IS:1786 under 10mm- 16mm, 1 sample for each 25 MT or part thereof 10mm-16mm 1 sample for each 45 MT or part thereof. | IS:432, IS:1139, IS:1786 & TEPL specification | Manufacturer s / TEPL approved Lab | Review of manufactu rers test certificate s as well as lab test result by TEPL | |

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| vii | Reverse Bend Test for HDS wire. | One sample per lot of 5 MT or part thereof for each size | IS:432, TEPL specification | Manufacturer/ TEPL approved lab. | Review of manufacturers test certificates as well as lab test result by TEPL | |
| 3. | STRUCTURAL STEEL USED IN CABLE TRENCHES & FOUNDATIONS | | | | | |
| i. | Dimensional Check | Random | TEPL specification & approved drawing | Contractor | Checklist to be prepared and signed jointly. | B |
| ii. | Visual Check for damages, resting, pitting etc. | 100% | TEPL specification & approved drawing | Contractor | Checklist to be prepared and signed jointly. | C |
| iii | Visual Check for welding, defects, primer coating and painting/ galvanizing as applicable | Sample per lot of 40 MT or part thereof for tensile tests and 1 sample per lot of 20 MT or part thereof for bend test for each size. | IS:2062, TEPL Specification & approved drawings | Manufacturer/ TEPL approved lab | Review of Mtgs test certificates as well as lab test results by TEPL | C |
| iv | Physical properties of structural steel | One sample per lot of 40 T or part thereof for tensile tests and 1 sample per lot of 20 T | IS 2062 ,TEPL Specifications and approved drawings | Manufacturer/ TEPL approved lab | Review of Mtgs test certificates as well as lab test results by | B |

| | | or part thereof for bend test. | | | TEPL | |
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| 4. | EQUIPMENT FOUNDATION/ CABLE TRENCH | | | | | |
| A | BEFORE EXCAVATION | | | | | |
| i | Checking of pegs condition as per line and alignment | 100% on each location | IS:4091, IS:3764 & TEPL approved drawing/ specification | Contractor | Approved by TEPL | C |
| ii. | Checking of pit making as per drawing & RL. | 100% on each location | IS:4091, IS:3764 & TEPL approved drawing/ specification. | Contractor | Approved by TEPL | C |
| B | EXCAVATION | | | | | |
| i. | Dimensional conformity | Each location | IS:4091, IS:3764 & TEPL approved drawing/ specification. | Contractor | Approved by TEPL | B |
| ii | Verticality/slopes & Square ness of each pit | Each location | IS:4091, IS:3764 & TEPL approved drawing/ specification. | Contractor | Approved by TEPL | B |
| iii | Verification & classification of foundation wherever application. | Each location | IS:4091, IS:3764 & TEPL approved drawing/ specification. | Contractor | Approved by TEPL | B |
| C | FOUNDATION BOLTS/ MATALLIC INSERTS | | | | | |

| | | | | | | |
|------|--|-------------------|--|--|--|---|
| i. | Check for proper identification foundation bolts w.r.t. type of foundation | 100% | TEPL specification & approved drawings | Contractor | Checklist to be prepared & signed jointly. | C |
| ii. | Visual check for mechanical damage and galvanizing/ painting it applicable for metallic insert | 100% | TEPL specification & approved drawings | Contractor | Checklist to be prepared & signed jointly. | C |
| iii. | Alignment & Level | 100% | TEPL specification & approved drawings | Contractor | Checklist to be prepared & signed jointly. | B |
| iv | Grouting/ Underpinning of foundation base plate. | 100% | TEPL specification & approved drawings. | Contractor | Checklist to be prepared & signed jointly. | C |
| D. | P.C.C. PADDING | For all locations | IS:456 and TEPL approved foundation drawings & Specification | Joint Inspection by TEPL and Contractor. | Approval by TEPL | B |
| E. | SHUTTERING (Formwork) | | | | | |
| i. | Check for materials, breakage or damage. | 100% | IS: 456, TEPL specification / approved drawings. | Joint Inspection by TEPL and contractor | Approval by TEPL | C |
| ii. | Check for plumb, alignment parallelism, squareness and equidistance from | 100% casting | IS:456, TEPL Specification/ approved drawings. | Joint Inspection by TEPL and | Approval by TEPL | B |

| | | | | | | |
|------|--|---------------------|--|---|------------------|---|
| | stub. | | | contractor. | | |
| iii. | Dimensional check | 100% before casting | TEPL Specification/ approved drawings | Joint Inspection by TEPL and contractor | Approval by TEPL | B |
| iv | Check for level & height. | 100% before casting | TEPL Specification/ approved drawings | Joint Inspection by TEPL and contractor | Approval by TEPL | B |
| v. | Check for rigidity of frame/ tightness | 100% | TEPL Specification/ approved drawings | Joint Inspection by TEPL and contractor | Approval by TEPL | B |
| vi | Cleaning and oiling | 100% | TEPL Specification/ approved drawings | Joint Inspection by TEPL and contractor | Approval by TEPL | B |
| vii | Diagonal bracing if required as per drawings/ site conditions | 100% | TEPL Specification/ approved drawings | Joint Inspection by TEPL and contractor | Approval by TEPL | C |
| viii | Checking of joints to avoid undue loss of cement slurry. | 100% | TEPL Specification/ approved drawings | Joint Inspection by TEPL and contractor | Approval by TEPL | C |
| F. | PLACEMENT OF REINFORCEMENT STEEL | | | | | |
| i. | Check the steel bars for rust, cracks, surface flaws, laminate etc. (Visual check) | 100% | IS:456 and TEPL Specification/ approved drawings | Joint Inspection by TEPL and contractor | Approval by TEPL | C |
| ii. | Check as per the bar bending schedule before placement of concrete. | For all locations | IS:456 IS:2502 and TEPL Specification/ approved drawings | Joint Inspection by TEPL and contractor | Approval by TEPL | C |

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|------|---|------------------------|--|--|--|---|
| iii | <p>Checking cutting tolerance for bars as per check list/ drawings. Check whether all the bent bars and lap lengths are as per approved bar bending schedule.</p> | For all locations | IS:456 , IS:2502 and TEPL Specification/ approved drawings | Joint Inspection by TEPL and contractor | Approval by TEPL | B |
| iv | <p>Check whether all joints & crossing of bars are tied properly with right guage & annealed wire as per specification</p> | 100% | IS:456 , and TEPL Specification/ approved drawings | Joint Inspection by TEPL and contractor | Approval by TEPL | C |
| v. | <p>Check for proper cover distance spacing of bars, spacers & chairs after the reinforcement cage has been put inside the formwork.</p> | 100% | IS:456 , and TEPL Specification/ approved drawings | Joint Inspection by TEPL and contractor | Approval by TEPL | C |
| vi. | <p>Check whether tapping of bars are tied properly with right guage and annealed wire as per specification.</p> | 100% | IS:456 , and TEPL Specification/ approved drawings | Joint Inspection by TEPL and contractor. | Approval by TEPL | B |
| viii | <p>Anchor bolts if applicable</p> | | | | | |
| a) | <p>Level, center-to-center distance of bolts.</p> | 100% on each location | TEPL approved pile foundation drawings/ specification. | Joint Inspection by TEPL and contractor. | Checklist to be prepared and signed jointly. | B |
| b) | <p>Visual check for galvanizing.</p> | 100% on each location. | TEPL approved pile foundation | Joint Inspection by | Checklist to be | B |

| | | | | | | |
|----|---|---|--|---|---|---|
| 5. | CONCRETING | | drawings/ specification. | TEPL and contractor. | prepared and signed jointly. | |
| a) | APPROVAL OF MIX DESIGN | Each Mix. | IS:456 & TEPL drawings/ specification. | TEPL approved by Lab | Approved by TEPL | A |
| B) | BATCHING, MIXING & PLACING OF CONCRETE AND COMPACTING. | 100% | IS:456 & TEPL approved pile foundation drawings/ specification | Joint Inspection by TEPL and contractor. | Approved by TEPL | B |
| C) | PLACING CONCRETE AND COMPACTING. | 100% | IS:456 & TEPL approved pile foundation drawings/ specification | Joint Inspection by TEPL and contractor. | Min gap between boxes and reinforce ment bars should be maintaine d. Approved by TEPL. | B |
| D) | CONCRETE TESTING | | | | | |
| i. | Slump Test | One sample per casting | IS:456, IS 516, IS: 1199 and TEPL specification. | Contractor | Approved by TEPL | B |
| ii | Check for quantities for cement, fine aggregate, coarse aggregate and water while batching | 100% on all locations | IS:456, IS 516, IS: 1199 and TEPL specification. | Contractor | Checklist to be prepared and signed jointly. | B |
| E. | CONCRETE CUBE TESTING | | | | | |
| i. | Compressive Strength | One sample for every 20 Cum of concreting or part thereof for each days | IS:456, IS 516, IS: 1199 and TEPL specification. | TEPL approved lab | Approval by TEPL Cubes must be tested | A |

| | | | | | | |
|------|---|---|--|-------------------|---|---|
| | | concreting (one sample consists of min. 3 test cubes for 28 days strength) | | | within a week after 28 days curing period and test results should be approved. Approval by TEPL | |
| F. | CHECK FINISHING, DIMENSIONAL CONFORMITY AND WORKMANSHIP BEFORE & AFTER BOX REMOVAL. | 100% | IS:456, IS 516, IA: 1199 and TEPL specification. | Contractor | | B |
| 6. | BACKFILLING | | | | | |
| i. | Check for thickness of layer & watering | 100% | TEPL specification and approved drawings. | Contractor | Approved by TEPL | C |
| ii. | Visual check for correction/ ramming. | 100% | TEPL specification and approved drawings. | Contractor | Approved by TEPL | C |
| iii. | Compaction test (percentage of max. dry density) | Samples for each pit. Equipment & other foundation 20% at random | TEPL Specification | TEPL approved lab | Review of lab test results by TEPL. Elevation for testing to be decided by TEPL. | B |

| | | | | | | |
|-----|--------------------------------------|--------|--|------------|--|---|
| 6. | BRICK-WORK & TILING WORK | | | | | |
| i. | Mortar mix/ proportion | Random | IS:2250, TEPL specification & CPWD specification. | Contractor | Approval by TEPL | B |
| ii. | Plumb & Alignment | Random | TEPL specification & CPWD Specification | Contractor | Approval by TEPL | B |
| iii | Joints | Random | TEPL specification & CPWD Specification | Contractor | Approval by TEPL | B |
| iv | Water absorption Test | Random | TEPL specification & CPWD Specification | Contractor | Approval by TEPL | B |
| 7. | PLASTERING | | | | | |
| i. | Plastering thickness and evenness | Random | TEPL specification & CPWD Specification | Contractor | Approval by TEPL | B |
| ii. | Mortar mix./ proportion | Random | TEPL specification & CPWD Specification | Contractor | Approval by TEPL | B |
| 8. | SITE SURFACING | | | | | |
| i. | Levelling | 100% | TEPL specification & CPWD Specification | Contractor | Checklist to be prepared and signed jointly | B |

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Section: GENERAL GUIDELINES FOR IMPLEMENTATION

1. Details of categories of check codes A,B &C including accepting and deviation dispositioning authorities are indicated at Annexure-1.
2. TEPL specification shall mean TEPL technical specification, approved drawings/ data sheets and LOA provisions applicable for the specific contract.
3. Accepting criteria and permissible limits for certain tests are indicated at Annexure-II. For balance tests, site to verify the same with respect to TECPL specification, relevant Indian Standards and/or prevalent code of practice.
4. It is clarified that the tests indicated at column 2 of this F.Q.P. i.e. against column “Component Operation & Description of Test,” are only generally required to be conducted. However, TEPL reserves the right to carryout any additional tests at any stage if the situation so warrants.
5. TEPL site representative shall witness all the tests conducted by the contractor as mentioned in this F.Q.P. However, in case of tests conducted in the TEPL approved lab, it is preferred to witness the tests in the lab itself, if possible.
6. TEPL shall approve testing laboratory before accepting the test results from the lab.
7. TEPL shall approve the sources for cement, coarse aggregate, fine aggregate & water before actual utilization.
8. All the testing & measuring equipment used by the contractor for testing are required to be calibrated. A copy of valid calibration report shall be retained by TEPL as records.
9. Classification of foundations shall be approved by TEPL based on the Joint Inspection Report & Soil investigation reports.
10. Curing of concrete work should be continued for a minimum period of 10 days.
11. ZONE-IV FINE AGGREGATE.
 - a. Zone-IV line aggregate shall be used for nominal mix. Reinforced cement concreting work.
 - b. Zone-IV line aggregate shall be avoided for design mix. Reinforced cement concreting work unless tests have been done to ascertain the suitability of proposed mix proportion with the prior approval TEPL site.
12. Bricks shall be free from cracks, flaws and modules of free lime. They should have smooth rectangular faces with sharp corners and should be uniform in colour.

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13. CEMENT

- a. In case supply of cement is in the scope of the contractor, the same shall be procured from sources approved by TEPL site and got tested at site on sample basis for specified acceptance tests as specified in the F.Q.P. at a reputed Third Party Lab approved by TEPL site.
- b. The samples of cement for site testing shall be taken within three weeks of the delivery and all the tests shall be commenced within one week of sampling, if the cement remains in store for a period of more than six month. All the site tests are required to be repeated before usage.

14. REINFORCEMENT STEEL & STRUCTURAL STEEL USED IN CABLE TRENCHES AND FOUNDATIONS.

- a. In case supply of steel is in the scope of the contractor, the same shall be procured from the main producers i.e. SAIL, TISCO, IISCO or Rashitriya Ispat Nigam or the rerollers approved by main producers. The steel shall be got tested at site on sample basis of specified acceptance tests as specified in this F.Q.P. at a reputed Third Party Lab approved by TEPL site.
- b. The results of the testing of cement and reinforcement steel referred to in 13.a and 14.a above shall be got approved from TEPL site before cement and reinforcement steel are put to use. However, in exceptional cases due to exigencies of work. TEPL site may authorize the contractor to use Cement and Reinforcement Steel even before the test results are received. However, in all such cases, if the test results subsequently received are found to be not complying with the specified acceptance criteria, the contractor shall have to dismantle and recast all such foundations cast with such non-conforming materials at his own cost. Confirmation to this effect shall be obtained from the contractor by the Project authorities beforehand in all such cases.

15. The contractor shall submit welding procedure specification (WPS) including the type of electrode used for approval of TEPL site before starting the welding work.

16. Approval/ acceptance of individual test results by TEPL in the course of execution of contract will not relieve the contractor of his contractual obligations and responsibilities, nor does it limit the Owner's right under the contract.

17. In case, requirement of special items like Super Sulphated Cement, Corrosive Resistant Reinforcement Steel (CRRS) etc arise due to site conditions, the specific approved of TEPL may be obtained before using the same and all the tests as per relevant standards shall be carried out.

18. All the materials shall be stored by the contractor in a manner affording convenient access for identification and inspection at all times. Storage of material shall be in accordance with IS:4032 (Latest Edition).

ANNEXURE -1

ACCEPTING AND DEVIATION DISPOSITION AUTHORITIES FOR DIFFERENT CATEGORIES OF CHECKS AS ENVISAGED IN FIELD QUALITY PLAN

| Category | Type of Check | 100% Checking/ Witnessing by | Counter Check/ Surveillance check by | Accepting Authority, it Test Results are within permissible limits | Deviation Dispositoning Authority. |
|----------|---------------|---|--------------------------------------|--|------------------------------------|
| 'A' | Critical | Executing Deptt. Plus F.Q.A. Representative | F.Q.A Representative | TEPL site office Head | TEPL Site Head required. |
| 'B' | Major | Executing Deptt. | F.Q.A. Representative | TEPL site office Head | TEPL Site Head required. |
| 'C' | Minor | Contractors Representative | Executing Deptt. | TEPL site office Head | TEPL Site Head required. |

ANNEXURE-2

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FOUNDATION MATERIALS & CONCRETE.

A. CEMENT

| Description of the Test | 33 Grade OPC as per IS:269 | 43 Grade cement as per IS:8112 | PPC as per IS:1489 | Low Heat Cement |
|--|---|--------------------------------|----------------------------|---|
| i) Fineness (min) | 225 m ² /Kg | 225 m ² /Kg | 300 m ² /Kg | 225 m ² /Kg |
| ii) Compressive Strength (min) 72 ± 1 hours 168 ± 2 hours 672 ± 4 hours | 160 kgf/cm ² 220 kgf/cm ² - | 23 MPa 33 MPa 43 MPa | 16 Mpa 22 Mpa 33 Mpa | 100 kgf/cm ² 160 kgf/cm ² 350 kgf/cm ² |
| iii) Initial Setting Time (Min) | 30 Minutes | 30 Minutes | 30 Minutes | 30 Minutes |
| iv) Final Setting Time (Max.) | 600 Minutes | 600 Minutes | 600 Minutes | 600 Minutes |
| v) Soundness (Le chatelier Method) | Max 10 mm expansion | Max 10 mm expansion | Max 10 mm expansion | Max 10 mm expansion |
| vi) Heat of hydration (Max.) | - | - | - | Max. 65 cal/gm for 7 days cal/gm for 28 days |
| vii) Chemical Composition | As per IS | As per IS | As per IS | As per IS |

B. COARSE AGGREGATE

(i) Sieve Analysis

| IS SIEVE Designation | Percentage passing for Graded aggregate of nominal size | | Percentage passing for single sized aggregate of nominal size | |
|----------------------|---|-----------|---|--------|
| | 40 mm | 20 mm | 40 mm | 20 mm |
| 63 mm | - | - | 100 | - |
| 40 mm | 95 to 100 | 100 | 85-100 | 100 |
| 20 mm | 30 to 70 | 95 to 100 | 0-20 | 85-100 |
| 10 mm | 10 to 35 | 25 to 55 | 0-5 | 0-20 |
| 4.75 mm | 0 to 5 | 0 to 10 | - | 0-5 |

- (ii) Flakiness Index Not to exceed 25%
- (iii) Crushing Value Not exceed 45%
- (vi) Soundness of aggregate applicable for concrete works subject to frost action Loss of weight after 5 cycle to exceed 12% when tested with Sodium sulphate and 18% when tested with magnesium sulphate.
- (v) Deleterious material Not to exceed 5% of the weight of aggregate when tested as per IS:2386 Part-II (1963)

C. FINE AGGREGATE

- (i) Sieve Analysis Shall confirm to Zone II or Zone III.

| IS Sieve designation | Percentage Passing for | | | |
|----------------------|------------------------|-----------------|------------------|-----------------|
| | Grading zone-I | Grading zone-II | Grading zone-III | Grading zone-IV |
| 10 mm | 100 | 100 | 100 | 100 |
| 4.75 mm | 90-100 | 90-100 | 90-100 | 95-100 |
| 2.35 mm | 60-95 | 75-100 | 85-100 | 95-100 |
| 1.18 mm | 30-70 | 55 – 90 | 75 – 100 | 90- 100 |
| 600 Micron | 15-34 | 35-59 | 60-79 | 60-100 |
| 300 Micron | 15-20 | 8-30 | 12-40 | 15-50 |
| 150 Micron | 0-10 | 0-10 | 0-10 | 0-15 |

- (ii) For guidance of adjusting sand in mix of concrete, the following table may be used.

| Moisture Content % | Building % by volume |
|--------------------|----------------------|
| 2 | 15 |
| 3 | 20 |
| 4 | 25 |
| 5 | 30 |

- (iii) Silt Content Test: Shall not exceed 4% when tested for building work and shall not exceed 10% as per procedure specified CPWD specification when tested.

(iv) Deleterious Materials: Total deleterious material shall not be more than 5% by weight.

(D) REINFORCEMENT STEEL: As per relevant Indian Standards.

(E) CONCRETE CUBE TEST

For nominal (volumetric) concrete mixes, compressive strength for M20 (1:1½:3 (cement: sand:Coarse aggregate) concrete shall be 265 kg/ cm² for 28 days.

(F) ACCEPTANCE CRITERIA BASED ON 28 DAYS COMPRESSIVE STRENGTH FOR NOMINAL MIX CONCRETE.

(a) The average of the strength of three specimen be accepted as the compressive strength of the concrete, provided the strength of any individual cube shall neither be less than 70%, nor higher than 130% of the specified strength.

(b) If the actual average strength of accepted sample exceeds specified strength by more than 30%, the Engineer-in-Charge, if he so desires, may further investigate the matter. However, if the strength of any individual cube exceeds more than 30% of specified strength, it will be restricted to 30% only for computation of strength.

(c) If the actual average strength of accepted sample is equal to or higher than specified strength upto 30%, than strength of the concrete shall be considered in order and the concrete shall be accepted at full rates.

(d) If the actual average strength of accepted sample is less than specified strength but not less than 70% of the specified strength, the concrete may be accepted at reduced rate at the discretion of Engineer-in Charge.

(e) If the actual average strength of accepted sample is less than 70% of specified strength, the Engineer-in-Charge shall reject the defective portion of work represented by sample and nothing shall be paid for the rejected work. Remedial measures necessary to retain the structure shall be taken at the risk and cost of contractor. If, however, the Engineer-in-Charge so desires, he may order addition to tests to be carried out to ascertain if the structure can be retained. All the charges in connection with these additional tests shall be borne by the Contractor.

(G) ACCEPTANCE CRITERIA FOR DESIGN MIX CONCRETE SHALL BE AS PER IS:456.

(H) SAMPLING PLAN FOR BRICK- WORK

Scale of sampling and permissible number of defectives for visual and dimensional characteristics.

| No of bricks in the lot | For Characteristics specified for individual bricks | | For dimensional characteristics for group of 20 bricks. No. of bricks to be selected. |
|-------------------------|---|---|---|
| 2001-10000 | 20 | 1 | 40 |
| 1001-35000 | 32 | 2 | 60 |
| 35001-50000 | 50 | 3 | 60 |

Note : In case the lot contains 2000 or less bricks the sampling shall be as per decision of the Engineer-in-Charge.

ii) Scale of sampling for physical characteristics

| Lot size | Sampling size for compressive strength water absorption and efflorescence | Permissible No. of defectives for efflorescence |
|-------------|---|---|
| 2001-10000 | 5 | 0 |
| 10001-35000 | 10 | 0 |
| 35001-50000 | 15 | 1 |

Note : In case the lot contains 2000 or less bricks, the sampling shall be as per decision of Engineer-in-Charge.

iii) Water absorption Test.
Water absorption after 24 hours immersion shall not exceed more than 22 percent by weight.

SOIL INVESTIGATION

| | | | | | |
|------|----------|---------------------|--------|---------|----------|
| A | 13.05.21 | ISSUE FOR TENDER | ISH | MKR | KNS |
| Rev. | Date | Subject of revision | Author | Checked | Approved |

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|    | GTS – SOIL INVESTIGATION AT STATIONS | Z/02 0022 |
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1. INTRODUCTION

The specification covers the procedure for soil investigation for foundation work involves carrying out boreholes upto minimum 15 m depth or upto refusal (when N values reaches 100), collecting (disturbed/undisturbed) soil samples, and carrying out different In-Situ and lab tests as per specifications.

2. IN- SITU GEOTECHNICAL WORK EXECUTION TECHNIQUE

2.1. Work Schedule

The program of the works must comply with the site availability.

2.2. Setting Up of The In-Situ Tests

2.2.1. The contractor shall be provided with the location of the in-situ tests. He must set up the tests at site, after locating the position of the boreholes accurately.

2.2.2. If the location, azimuth or inclination of any drill holes or in- situ tests does not conform to the given indication, such holes shall be executed anew at the contractor's expenses.

2.2.3. After completion of the work, the Contractor shall provide a map with the location of in -situ tests "as built".

2.2.4. Contractor should check for the presence of underground services prior to commencing of drilling or trial excavations and will validate and confirm that no underground services are at risk of being damaged or disturbed in any way.

2.2.5. In case specifications given under are insufficient, the test and works shall comply with relevant Indian Standard Specifications, wherever applicable.

2.2.6. Contractor is responsible for supplying the work site in due time with all material required for smooth and timely execution of work.

2.3. Execution of The Bore-Holes

2.3.1. General marks

- a) Boreholes of 100 mm to 150 mm internal diameter shall be sunk to the required depth with Shell and auger equipment through sand, silt and clay, but excluding rocks, pebbles or grabbers.
- b) The methods and machinery must, in all cases, tend to mark the levels and confirm the nature of the crossed layers.
- c) If one of the crossed layers causes landslide or soil instability, the drilling hole is to be protected by any efficient means, provided the subjacent soil is not contaminated. Bentonite slurry can be used in case of cohesionless soils.
- d) The drilling machine is to be steered by a chief drilling operator with the help of at least one experienced workman.
- e) The method of drilling is the responsibility of the Contractor. This method must permit to collect samples for identification and description of the crossed layers. The Contractor shall propose his method before starting the works.
- f) The drilling is to be vertical.
- g) During the drilling operation, all incidents are to be recorded, and in particular the losses of water, with estimates of flow and volume, possible caverns, rising of water level, alteration in type and colors of mud, etc.
- h) The boreholes shall be cased throughout the depth of boring.

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- i) Boreholes shall be cleaned properly before conducting any in-situ test or taking out undisturbed samples.
- j) After the tests are conducted, the boreholes shall be filled with sand.

2.3.2. Description of the bore log

a) Levels survey

During the drilling, the levels of separation of the different layers and the upper and lower levels of the possible caverns are to be recorded in relation to the level of topsoil.

The location of the water table is to be determined. The dates and hours corresponding, to the end of the perforation and to the recording of levels as well as the losses of water observed during the drilling are to be noted.

b) Soil Identification

As drilling progresses, the extracted soil shall be carefully preserved to enable its identification.

However the following information must be noted immediately:

- Sampling level,
- Temporary name given to the soil by the driller,
- Colour and odour,
- Soil consistency,
- Recuperation.

2.3.3. Undisturbed Soil Samples from Boreholes

The samples shall be minimum 100 mm dia and 450 mm long. Both the area ratio of the cutting edge as well as all recovery ratio of the cutting edge and the recovery ratio of the sample shall be measured and reported.

In order to reduce wall friction, suitable precautions such as oiling inside and outside the sampling tubes shall be observed. The sampling tube shall have smooth finish.

For highly sensitive soils, piston samples shall be employed. The undisturbed samples shall be tested within a period of two weeks of taking them from the boreholes or trial pit.

After recovery of sample, all exposed faces shall be sealed with wax to prevent moisture loss and the sample shall be properly labeled and transferred to the laboratory immediately.

The undisturbed samples shall be taken at an interval of 2 m or change of stratum whichever occurs earlier.

2.3.4. Disturbed Soil Samples from Boreholes

Disturbed soil samples shall be collected at every half a metre and at every change of strata. Identification labels indicating depth, borehole number and visual soil classification shall be affixed on the container.

2.3.5. Documents to be supplied by the Contractor

At each time, the contractor shall fill in a report giving details on the work executed, describing difficulties and methods used, the description of machinery, the precise depth of each operation, etc.

In addition, two weeks after the completion of boring which is covered by the contract, the Contractor hands over a provisional report in two copies including a drilling log, and in particular:

- The reference number of the bore-hole
- The location marked on a map to a convenient scale together with the X, Y and Z co-ordinates of the bore-hole
- The point level from which depths are measured
- The diameter of the bore-holes
- The recuperation
- All observations and incidence noted by the operator concerning the boring operation
- The equipment in use and the process for drawing samples
- The levels of water at the start and at the end of each shift
- The date at which the boring starts and ends, together with a graph showing progress and effective preparation speeds
- The depths at each operation
- The reports on special tests or sampling with the numbers of the samples extracted and their position
- The sectional drawing of the bore-hole with references and symbolic representations of the nature of the crossed soils

A global report shall collect all the results and data from the various daily reports, from the drilling logs, etc.

Five copies of this global report shall be submitted two weeks after completion of the in-situ works.

The Contractor shall also submit over a reproducible original of all the maps, drilling maps, etc., which are part of his daily report and of the global report.

3. STANDARD PENETRATION TESTS IN THE BOREHOLES

3.1. Mode of Operation

Standard Penetration Tests shall be carried out during the boring in accordance with IS 2131 (latest). The depth of each test shall be correctly determined. In the event that the penetration resistance “N”, determined in a test, is less than 5, the Engineer may require to clean out the borehole and to carry out another test immediately afterwards. Small-disturbed samples removed from the Standard Penetration Test split spoon sampler shall be taken in accordance with IS 2132 (latest). The Standard equipment with split spoon sampler in soil or solid cone in hard soil with 65 kgs hammer shall be used.

Unless otherwise instructed a Standard Penetration Test shall be carried out every 0.5m in the upper soft layers upto 2.0 m depth and at 1.0 m interval in the bottom layers.

3.2. Documents to be Supplied By The Contractor

The information on the Standard Penetration Test to be submitted by the Contractor consists of the following:

- Penetration resistance (Nblows/300 mm) or the Penetration (mm) for 50 blows. The procedure of testing and determination of N value shall be as per IS:2131 (latest).
- Depths (m) between which penetrations resistance is measured.
- Depth of casing and size at time of test.
- Before start of test depth SPT tools sunk under own weight from base of borehole.
- Number of blows for each 75 mm of Penetration including seating blows.
- Type of equipment
- Weight of hammer.
- Height of drop.
- Method of release.
- Use of drilling mud or casing.

Disturbed samples resulting from SPT shall be taken for classification purposes.

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3.3. Document And Report

At the end of the investigation and on completion of all the tests, the contractor shall submit a report consisting of the following documents and recommendations.

- 3.3.1 All computations leading to the logical conclusion of bearing capacities of soil, safe capacity of piles etc. shall be included in report. If references are drawn from standard test books, such references shall be clearly indicated.
- 3.3.2 The report shall contain recommendation about: -
- a) The safe net bearing capacity of soil for isolated / strip footings and proposed depth of footings, starting from bottom level.
 - b) Estimated lengths, and capacities of piles of various diameters, if recommended.
 - c) For design of retaining walls, recommendations shall be made as to the layer of excavated Design parameters like coefficient of earth pressure at rest shall be recommended.

4. STATIC CONE PENETRATION TEST

The equipment used for this test shall conform to the requirement of IS : 4968 (Part III). The capacity of equipment to be used for test shall not be less than 10.0 tonnes capacity. The test shall not be carried out on gravely soil and soil with standard penetration value 'N' greater than 50. Location of tests shall be indicated on the drawing.

4.1. Carrying Out The Test

The procedure shall meet the requirement of IS 968 (Part III). Some of the important points of the procedure given below.

- a) CPT machine, equipped with suitable core shall carry out test down to a depth of 15 m or upto refusal whichever is earlier. Test shall be performed according to codal provision IS 968 (part III) / ASTM D 3441-98 (M2 type cone)/ ASTM D 5778-95 (E1 type cone)
- b) Each CPT shall be carried out with an anti-friction device, placed above the friction sleeve, in order to penetrate as deep as possible.
- c) Use of mechanical cone, with electrical measurement and recording of parameters, is prohibited.
- d) If a M2 type cone is used, the cone resistance and lateral skin friction shall be measured at least at each 20 cm depth.
- e) If an E1 type cone is implemented, a continuous recording of cone resistance, of the lateral skin friction and of the pore pressure versus depth is required for each test.
- f) The level of water table encountered is to be noted for each test.
- g) Results of test shall give cone resistance q_c , the total lateral friction and the f_c "Friction Ratio" versus depth.
- h) The CPT refusal is characterised by a cone-resistance (q_c) value of 60 Mpa, a local skin friction (f_c) one of 1 Mpa/ or a total resistance one of 20 tons. The E1 type cone may be equipped with an inclinometer device. The refusal criterion on minimum allowed inclination shall be done or equal to 10^0 . CPT cones with refusal values lower than those quoted above will not be accepted.
- i) The cone is pushed through a distance in accordance with the design of the equipment and the need for the sub-strata and the cone resistance noted. The cone and the friction jacket are pushed together subsequently for a distance depending upon, the design of the cone and friction jacket assembly and the combined value of cone and friction resistance noted. This procedure is repeated at predetermined intervals.
- j) Equipment shall be securely anchored to the Ground at the test point for obtaining the required reaction.
- k) The rod of the Driving mechanism shall be brought to the top most position. The cone –friction jacket assembly shall be connected to the first sounding rod and the mantle tube. The assembly shall be positioned over the test point through the mantle tube guide and held vertically. The plunger of the driving mechanism shall be brought down so as to rest against the protruding sounding rod.

- l) To obtain the cone resistance this sounding rod only shall be pushed. Switching the gear clutch to the slow position, the drive handle shall be operated at a steady rate of 1 cm per sec approximately, so as to advance the cone only to a depth, which is possible with the cone assembly available. During the pushing, the mean value of resistance as indicated by pressure gauges shall be noted ignoring erratic changes.
- m) For finding combined cone and friction resistance of the soil, the sounding rod shall be pushed to the extent. The cone has been pushed at the rate of 1 cm per sec noting mean resistance on the gauges.
- n) Above procedure shall be repeated after pushing the combined cone-friction jacket and mantle tube assembly to the next depth at the next depth at which the test is to be performed.

4.2. Reports

The CONTRACTOR fills in a daily report giving details of the tests carried out, difficulties encountered, depths achieved, resistance values measured etc.

The ENGINEER must have access to these documents at any time.

At the latest one week after the execution of each test, the CONTRACTOR submits to the ENGINEER two copies of a test report including :

- the test number,
- the execution date of the test,
- the location of tests on a map supplied by the engineer or on a sketch in comparison with known and fixed points,
- the ETM co-ordinates X, Y and Z of the test,
- the level of the point from which depths are measured,
- the level of water encountered,
- the characteristics of the equipment in use (type of cone, etc.)
- the test diagram showing the variations of the cone resistance, the local lateral friction and the “friction ratio” versus depth. The results are also supplied in the form of a table detailing the level, the depth, q_c , f_c and F_R . In addition, the contractor supplies a 3.5” compatible diskette (1.44 Mbytes or more). On this diskette, the results must be presented in three columns : depth, q_c , f_c and F_R .
- the remarks noted in the daily report;
- the calibration certificate(s) of the cone(s) used.

A global report including all the preliminary test reports shall be provided to the Engineer one week after completion of the work on site. This report must be reproducible and supplied in 5 copies.

5. DYNAMIC CONE PENETRATION TEST

The test shall be conducted by driving a standard size cone attached loosely or screwed to a string of drill rods. The driving system shall comprise of 65 Kg. weight having a free fall of 75 Cm.

5.1. Test Procedure

The method of conducting the test and details of the equipment shall conform to one of the two alternatives given below. The particular method to be followed is indicated under specific requirements.

- a) The test shall be conducted in accordance with IS : 4968 (Part I). The cone size shall be 50 mm.
- b) The test shall be conducted in accordance with IS : 4968 (Part II). A continuous flow of bentonite slurry shall be maintained through the rods and the cone so as to avoid friction between the rods and the soil. The cone size shall be 65 mm and provide with vents for flow of bentonite slurry.

The test shall be reported in a suitable tabular form giving blow counts for every 30 cm. Penetration, supplemented by a graphical plot of blow counts versus depth. The test shall be terminated when blow counts (N_c) exceeds 150 for two successive penetration of 30 cms each.

6. PLATE LOAD TEST

6.1. Plate Size And Thickness

- a) For clayey and silty soils and for loose to medium compact sandy soils ($N < 15$) normally met with, checkered plate of 60 cm x 60 cm shall be used. Alternatively, circular plate of equipment area also may be used.
- b) For dense sandy or gravelly soils ($15 < 30$) the smallest size shall be 30 cm square and largest 75cm square. Circular plates of equipment area may also be used.
- c) The minimum thickness of the chequered plate shall be 25mm.

6.2. Test Pit

- a) Test pit shall be atleast five times as wide as the test plate and the depth of the pit shall be the same as the depth of actual foundations.
- b) If the test is to be done on strata water table, the water level shall be maintained at the plate level, if necessary, throughout the test by dewatering, especially in sandy soils.
- c) The test shall be conducted immediately after examination of soil.

6.3. Placing Of Test Plate

Plate shall be added to the soil by spreading fine sand in a layer not exceeding 5mm carefully levelled and set horizontally at the bottom of the pit. The ground shall be protected from rain and a minimum sealing pressure of 70g/cm² shall be applied and removed before starting the load test.

6.4. Method Of Loading

The reaction method of loading shall be employed. In this method loading is done by a jack against suitable reaction, such as, a well designed truss anchored to the ground at the two ends by soil anchors, loaded platform or any other suitable device.

6.5. Application Of Load

- a) Loading shall be carried out in increments of 1/5 design load or about 0.3 kg/cm² whichever is lower.
- b) Loading shall be carried out till one of the following conditions occur:
 - 1) Soil under the plate fails.
 - 2) Total settlement of the plate exceeds 40mm.
 - 3) A load intensity equal to thrice the design load is reached.
 - 4) Load intensity 6.5 kg/cm² is reached.

6.6. Settlement And Observation

- a) Settlement shall be recorded with four dial gauges.
- b) Settlement shall be observed for each increment of load after an interval of 1, 4, 9, 16, 25, 36 and 64 minutes and thereafter every one hour.
- c) The next load increment shall be applied when the rate of settlement is less than 0.05 mm/hour with a minimum period of two hours. For computing the rate of settlement its extrapolation for periods less than one hour shall not be permitted.

6.7. Unloading

- a) Unloading shall be done in stages in the same manner as was done during the application of load. Rebound observations during the unloading also shall be noted.
- b) Rebound shall be noted during unloading stages till the readings become reasonably constant.

6.8. Record

- a) Record shall consist of the following:
 - 1) Load-settlement reading in tabular form.
 - 2) Time-Settlement curve for each load stage.
 - 3) Load- Settlement curve for each load stage.
 - 4) Load- settlement curve in natural and log-log scale.
 - 5) Modules of sub-grade reaction evaluated from test.
- b) In addition to above the record shall also contain the following:
 - 1) Date
 - 2) List of personnel
 - 3) Weather conditions
 - 4) Irregularity in routine procedure, if any.

6.9. Post Test Requirements

- a) Back filling of the pit be carried out in an approved manner and as per the directions of Engineer-in-charge on completion of test.
- b) An auger bore shall be made from the depth of test extending to depth of 6.0m below test depth so as to ascertain the nature of sub-soil test depth. If required, undisturbed samples shall be obtained at suitable depths from bore hole.

7. DYNAMIC SOIL TESTS**7.1. General**

The following tests shall be conducted for the determination of Elastic Modulus and Dynamic Shear modulus of the soil and their variation with confining pressure for use in the design of foundation subject to vibratory loads.

- 7.1.1. Wave velocity measurements
- 7.1.2. Resonance tests
- 7.1.3. Cyclic plate load test
- 7.1.4. Repeated triaxial shear test.

7.2. Wave Velocity Measurements

The test set up and method of conducting the tests shall conform to IS: 5249 (latest edition). Concrete block shall be cast at a minimum depth of 0.5 m in a virgin soil. Back filling of the pit shall be carried out in an approved manner and as per the directions of the Engineer-in-Charge after removing the concrete block on completion of the test.

7.3. Resonance Test

The block size and test depth be the same as laid out in 3.4.2 above. The equipment set up and method of conducting the tests shall conform to IS : 5249 (latest edition).

7.4. Cyclic Plate Load Test

The test set up and plate size shall conform to that for plate load tests. After stabilization of settlements for each load increment, load shall be removed and elastic rebound & residual settlements recorded. Where necessary, more than one cycle of loading and unloading shall be applied until a steady state of settlements is reached.

7.5. Repeated Triaxial Shear Test

The test shall be carried out for confining pressure ranging from 0.5 kg/cm² to 4.0 kg/cm².

The triaxial sample shall first be subjected to an initial load equal to the anticipated static working load, which shall be indicated at the time of testing. Positive and negative values of a small increment of load shall then be applied to the sample in cycles and a graph plotted of stress against strain. E-value shall be obtained from this plot after obtaining a stable state.

8. LABORATORY TEST ON SELECTED SOIL SAMPLES

8.1. Storing Of Soil Samples In Laboratory

- 8.1.1. Soil samples shall be inspected and tested shortly after their arrival at the laboratory.
- 8.1.2. Bags of canvas and bins can be used for storing large quantities of soil. The container should have a label or tag, which gives such data as soil type, project location, boring number, depth, etc.
- 8.1.3. If disturbed clay samples are taken from pit, they should be covered with a protective coating. The coating shall preferably be with wax having melting point between 120°C to 160°F. Wax coating can be applied by either dipping the soil samples in the melted wax or using a soft brush to spread the melted wax. Wax should not be heated to more than a few degrees above its melting temperature, since heating to higher temperature tend to drive off more volatile hydrocarbons, thus making the wax more permeable and more brittle upon coating.
- 8.1.4. If soil samples are to be stored for more than 15 days, then a protective coating of wax, in more than one layer, is recommended with a total thickness of 12 mm to 18 mm.
- 8.1.5. Few selected samples shall be stored in laboratory till the soil investigation report is finalized and approved by the Engineer-In-Charge.

8.2. Handling Of Undisturbed Samples In Laboratory

- 8.2.1. Undisturbed samples shall be handled in laboratory with due precautions to avoid disturbance and loss of moisture content which may adversely affect the test results.
- 8.2.2. Unprotected samples shall never be handled with bare hands because hands foster disturbance and loss of moisture. Sample shall be protected by using Aluminum cellophane or wax paper.
- 8.2.3. When transporting a specimen it should be supported over its entire length by using a mould, plate or paper sling(s).

8.3. Procedure Of Testing

- 8.3.1. All apparatus used for laboratory testing shall conform to the specifications laid down in relevant Indian Standards.
- 8.3.2. All testing procedures shall conform to relevant Indian Standards.

8.4. Tests To Be Performed

The following tests shall be performed on the selected soil samples (according to IS 2720) and water samples collected.




- Atterberg Limits: - Liquid limit + plastic limit shall be required for U.D. samples
- Natural Moisture: - shall be required for U.D. samples as per IS:2720, Part II.
- Particle size analysis: Sieve & hydrometer analysis as per IS:1498 on at least one sample from each stratum shall be required. Porosity of soil as well as uniformity coefficient shall be determined.
- Wet & Dry Density: for U.D. samples.
- SP Gravity: For one sample from each stratum.
- Unconfined compression Test: To be conducted at site on about 25% of U.D. Samples as per IS:2720, Part I.
- Triaxial Tests: unconsolidated undrained tests and consolidated drained tests shall be done on UD samples available at Laboratory.
- Consolidation Tests: on U.D. samples taken at least one from each stratum shall be conducted for a range of pressure from 2.7 t/sq.m to 8.6 t/sq.m as per IS:2720, Part XV.
- Chemical Tests: Sulphate & chloride contents of water samples.
- Sulphate, carbonate, chloride and organic matter, content of soil samples.
- Permeability Test :: Coefficient of permeability shall be determined as per IS:2720, Part XVII.
- Soil Resistivity :: Soil resistivity shall be carried out as per IS:3043.
- California Bearing Ratio Test :: This test shall be carried out as per IS:2720, Part XVI. Curve of load-penetration in arithmetic shall be plotted.

8.5. Report

- 8.5.1. The report shall state in brief the description of test procedure employed.
- 8.5.2. The report shall also include wherever required a sample calculation with reference to formula used to evaluate various parameters.
- 8.5.3. Report shall also contain the summary of various soil parameters evaluated.
- 8.5.4. Report shall indicate character and genesis of soil.
- 8.5.5. Report shall contain details of borelogs, subsoil sections, lab and field test results in tabular and graphical form and a plot plan showing locations and reduced levels of boreholes and other tests.
- 8.5.6. Results obtained and their interpretation shall be indicated in the report.
- 8.5.7. Report shall indicate type, depth, ultimate and safe bearing pressure and settlement of foundation for following structures:
- 8.5.7.1. Power Plant Equipments, which carry heavy unit load.
- 8.5.7.2. Admonish building etc. which are lightly loaded.
- 8.5.7.3. Storage tanks and other structures found at or near ground surface.
- 8.5.8. Recommendations shall also be given for allowable bearing pressure and settlements for foundations of various sizes and at different depths ranging from surface to 5 m depth.
- 8.5.9. Report shall indicate aggressiveness of soil and soil water to reinforced concrete and steel and other building materials.

- 8.5.10. Report shall indicate suitability of soil and degree of compactness of fill for the pavement and recommendation for thickness of pavement for Class AA and Class A loadings.
- 8.5.11. Modules of subgrade reaction for pressure ranging upto 3 kg/cm² shall be indicated in the report. The recommended values shall include the effect of size, shape and depth of foundation.
- 8.5.12. In case of poor soil conditions recommendations are to be made for ::
- a) Grand treatment method,
 - b) Pile foundations if considered necessary. If so, type of pile, depth of pile, safe load capacity of pile etc.
- 8.5.13. Upon completion of tests, the Contractor shall submit two (2) interim and five (5) final copies of the report.

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BARRICADES

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2. SPECIFICATION 1

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1. INTRODUCTION

- 1.1. The document covers specifications for Barricades required for barricading the work to be carried out along the roads in the city having vehicular traffic movement.

2. SPECIFICATION

- 2.1. Providing and installing the barricades of size 2.5 m x 2.0 m of the design and type as shown in the standard drawing No TECPL-STD-19-077 enclosed herewith. Installation plan of Barricades is to be approved by Owner's Representative. Barricades are to be firmly fixed to the ground and are to be maintained during the progress of work.
- 2.2. Barricades are to be painted with logo initially and repainting to be done as and when required.
- 2.3. Wet mopping of Barricades shall be done weekly.
- 2.4. Ground Space of one-meter width outside barricades shall be cleaned everyday.
- 2.5. Barricades shall have blinking red light for night getting power through generator or electric connection.
- 2.6. Dismantling of Barricades from the site and cleaning the site as per directions of Owner's Representative.

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BRICK MASONRY

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1. GENERAL

This specification establishes the materials, dressing, laying, joining, curing, workmanship etc. for brick masonry works. Brick masonry shall also comply with all the requirements of IS specification.

2. REFERENCE**2.1. BIS Codes**

IS:2212, 2250.

2.1.1. Sequence

Commencement, scheduling and sequence of works shall be planned in detail and must be specifically approved by the Owner's Representative. However, the contractor shall remain fully responsible for all normal precaution and vigilance to prevent any damage to works whatsoever till handing over.

3. MATERIALS

Cement shall be ordinary Portland Cement (Grade 43) conforming to IS 8112.

Bricks of Class I shall be table moulded / machine made of uniform size, shape and sharp edges and shall have minimum compressive strength of 75 Kg/cm².

4. GENERAL REQUIREMENTS**4.1. Mixing Mortar**

IS 2250 shall be followed as general guidance for preparation and use of mortar. Only cement – sand mortar shall be used.

Unless otherwise specified mortar for brick work having one or more brick thickness shall be 1 part cement & 6 part sand by volume and for half brick work shall be 1 part cement and 4 part sand by volume.

Mortar shall meet the compressive strength requirement as per IS 2250 and IS 1905. sand shall conform to IS 2116 and grading shall be tested as per IS 2386.

4.1.1. Proportioning

The unit of measurement for cement shall be a bag of cement weighing 50 kgs and this shall be taken as 0.035 cubic metre. Sand shall be measured in boxes of suitable size on the basis of its dry volume. In case of damp sand, its quantity shall be increased suitably to allow for bulkage.

4.2. Mixing

The mixing of mortar shall be done in a mechanical mixer operated manually or by power. The Owner's Representative may, however, permit hand-mixing as a special case, taking into account the magnitude,

nature and location of work. The Contractor shall take the prior permission of Owner's Representative, in writing, for using hand-mixing before the commencement of work.

4.2.1.1. Mixing in Mechanical Mixer

Cement and sand in specified proportions, by volume, shall be thoroughly mixed dry in a mixer. Water shall then be added gradually and wet mixing continued for at least one minute. Care shall be taken not to add more water than that which shall bring the mortar to the consistency of stiff paste. Wet mix from the mixer shall be unloaded on water-tight masonry platform, made adjacent to the mixer. Platform shall be at least 150 mm above the levelled ground to avoid contact of surrounding earth with the mix. Size of the platform shall be such that it shall extend at least 300 mm all-round the loaded wet mix area. Wet mix, so prepared, shall be utilised within initial setting time [thirty (30) minutes either for ordinary Portland cement conforming to IS:269 after addition of water. Mixer shall be cleaned with water each time before suspending the work.

4.2.1.2. Hand Mixing

The measured quantity of sand shall be levelled on a clean water-tight masonry platform and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by being turned over and over, backward and forward, several times till the mixture is of uniform colour. The quantity of dry mix which can be consumed within initial setting time of cement shall then be mixed with just sufficient quantity of water to bring the mortar to the consistency of stiff paste.

5. CONSTRUCTION PROCEDURE

5.1. Soaking of Bricks

Bricks shall be soaked in water before use for a period that is sufficient for the water to just penetrate the whole depth of bricks as well as to remove dirt, dust and sand. Proper soaking of bricks shall prevent the suction of water from the wet mortar as otherwise mortar will dry out soon and crumble before attaining any strength. The bricks shall not be too wet at the time of use as they are likely to slip on mortar bed and there will be difficulty in achieving the plumbness of wall as well as proper adhesion of bricks to mortar. The period of soaking shall be determined at site by a field test by immersing the bricks in water for different periods and then breaking the bricks to find the extent of water penetration. The least period that corresponds to complete soaking, will be the one, to be allowed for in the construction work.

The soaked bricks shall be removed from the tank, well in advance, so that at the time of laying, they are only skin dry. The soaked bricks shall be stacked over a clean place, wooden planks or masonry platforms to avoid earth, dirt being smeared on them.

5.2. Laying

5.2.1. Brick Work (one or more brick thickness)

IS:2212 shall be followed as general guidance for construction of brick masonry.

Brick work (one or more brick thickness) shall be laid in English Bond unless otherwise specified. Half or cut bricks shall not be used except when needed to complete the bond. In no case the defective bricks shall be used.

A layer of average thickness of 10 mm of cement mortar shall be spread on full width over a suitable length of lower course of the concrete surface and shall be so laid that all joints are full of mortar. In order to

check and achieve uniformity in masonry, the thickness of bed joints shall be such that four courses and three joints taken consecutively shall measure equal to four times the actual thickness of the brick plus 30 mm. Each brick with frog upward, shall be properly bedded and set in position by gently tapping with handle of trowel or wooden mallet. Its inside faces shall be buttered with mortar before the next brick is laid and pressed against it. After completion of the course, all vertical joints shall be fully filled from top with mortar.

All brick courses shall be taken up truly plumb; if battered, the batter is to be truly maintained. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. The level and verticality of work in walls shall be checked up at every one metre interval.

The masonry walls of structures shall be carried up progressively, leaving no part one metre lower than the other. If this cannot be adhered to, the brick work shall be raked back according to bond (and not left toothed) as an angle not more than 45 degrees but raking back shall not start within 60 cm of a corner. In all cases, returns, buttresses, counter forts, pillars etc. shall be built up carefully course by course, and properly bonded with the main walls. The brick work shall not be raised more than fourteen (14) courses per day.

At the junction of any two walls, the bricks shall at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work.

The courses at the top of plinth and sills, at the top of the wall just below the soffit of the roof slab or roof beam and at the top of the parapet, shall be laid with bricks on edge unless specified otherwise. Brick on edge course shall be so arranged as to tightly fit under the soffit of the roof beam or roof slab, restricting the mortar layer thickness upto 12 mm, however, any gap between the finished brick work and soffit of roof slab/beam shall be suitably sealed with the mortar. Care shall be taken that the brick forming the top courses aid ends of wells are properly radiated and keyed into position.

5.2.2. Brick Work (half brick thickness)

For brick walls of half brick thickness, all courses shall be laid in stretcher bond. Wall shall be reinforced with 2 nos. – 6 mm diameter mild steel reinforcement bars, embedded at every third course. These bars shall be securely anchored into the masonry at the ends or shall be keyed into the main brick work as the case may be. Half the mortar thickness for the bedding joint shall be laid first and mild steel reinforcement, one on each face of the wall, shall be embedded, keeping a side cover of 12 mm mortar. Subsequently, the other half of the mortar thickness shall be laid over the reinforcement covering it fully.

The reinforcement bars shall be carried at least 150 mm into the adjoining walls or RCC columns. In case the adjoining wall being of half brick thickness, the length of bars shall be achieved by bending the bars in plan. During casting of reinforced concrete columns, 6 mm dia. M.S. reinforcing bar shall be placed at every fourth course of brick masonry. At the junction of two walls, the brick shall, at each alternate course, be carried into each of the respective walls so as to thoroughly unite the work. The brick masonry work shall not be raised more than 14 courses per day.

Brick course under the soffit of beam or slab, shall be laid by restricting the mortar thickness to 12 mm. However, any gap between the finished brickwork and soffit of slab/beam, shall be suitably sealed with the mortar.

5.2.3. Cavity Walls

Brick work in cavity walls shall be included with general brickwork. It shall consist of one wall of one or more brick thickness while the other wall shall be of half brick thickness at a clear gap of 50 mm. The brick work on with side of cavity shall conform to the specifications already stated under 5.2.1 and 5.2.2. At the base of the cavity wall, the walls shall be solidly constructed upto 300 mm above the ground level. The

cavity wall shall be terminated 300 mm below the soffit of roof slab/beam and the courses over this shall be continued in solid brickwork.

Cavity should be continuous and free from obstructions. Mortar droppings shall be prevented from falling down the cavity by the use of laths or by hayhands which shall be drawn up the cavity as the work proceeds. Any mortar which may unavoidably fall on the wall-ties, shall be removed daily and temporary openings shall be provided to permit the daily removal of mortar droppings from the bottom of the cavity.

The outer and inner levels shall be tied by means of wall ties. Ties shall be of mild steel round bars of 8 mm dia 200 mm long with hooks at both the ends. These shall be placed not more than 750 mm c/c horizontally and not more than 300 mm vertically, and staggered. Additional ties shall be provided near the openings. There shall at least, be 5 ties per square metre of surface area of the wall. Ties shall be given a bituminous coat before placement, to protect them from corrosion.

In order to keep the cavity dry, air slots shall be provided in the cavity walls at bottom as well as top to the extent of 50 sq. cm area of vents to every 2.0 sq. metre area of the wall.

5.2.4. Circular Brick Work

The specification for brick work covered under 5.2.1 and 5.2.2 shall apply, in so far as these are applicable. Bricks forming skew backs, shall be dressed or cut so as to give proper radial bearing. Defects in dressing of bricks shall not be covered up by extravagant use of mortar, nor shall the use of chips etc. be permitted.

The circular brick work shall be carried up from both ends simultaneously and keyed in the centre. The bricks shall be flushed with mortar and well pressed into their positions so as to squeeze out a part of their mortar and leave the joints thin and compact. All joints shall be full of mortar and thickness of joints shall be between 5 mm and 15 mm.

5.3. Jointing

Joints shall be restricted to a width of 10 mm with brickwork of any classification. All bed joints shall be normal to the pressure upon them i.e. horizontal in vertical walls, radial in circular brick masonry and at right angles to the face in the battered retaining walls. The vertical joints in alternate courses shall come directly one over the other and shall be truly vertical. Care shall be taken that all the joints are full of mortar, well flushed up. In case no pointing is to be done, cement mortar shall be neatly struck as the work proceeds. The joints in faces which are to be plastered or pointed shall be squarely raked out to a depth of 12 mm while the mortar is still green. The rake joints shall be brushed to remove loose particles. After the day's work, the faces of the brick work shall be cleaned on the same day with wire brush and all mortar droppings removed.

5.4. Curing

Green work shall be protected from rain or any other running water or accumulated water from any source, by suitable means. Masonry work, as it progresses, shall be kept thoroughly wet by sprinkling water at regular intervals, on all faces. Curing shall be done after 24 hours of completion of day's work and shall be done for atleast 10 days after completion. Proper watering cans with spray nozzles, rubber or PVC pipes shall be used for this purpose. Brick work done during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period.

5.5. Staging/Scaffolding

- 5.5.1. Staging/scaffolding shall be properly planned and designed by the Contractor. Use of only steel tubes is permitted for staging/scaffolding. Design of staging/scaffolding shall be submitted for approval of the Owner's Representative, before commencement of work.

Single scaffolding having one set of vertical support, shall be used and other end of the horizontal scaffolding member shall rest in a hole provided in the header course. The support shall be sound and strongly clamped with the horizontal pieces over which the scaffolding planks shall be fixed. The holes left in the masonry work for supporting the scaffolding shall be filled and made good with plain cement concrete of grade 1:2:4 and shall be made good before plastering. Suitable access shall be provided to the working platform area. The scaffolding shall be strong enough to withstand all loads likely to come upon it and shall also meet the requirements specified in IS:2750.

Double scaffolding shall be provided for pillars less than one metre in width or for the first class masonry or for a building having more than two storeys.

The following measures shall also be considered during erection of the scaffolding/staging.

- a. Sufficient sills or underpinnings, in addition to base plates, shall be provided, particularly, where scaffoldings are erected on soft grounds.
- b. Adjustable bases to compensate for uneven ground shall be used.
- c. Proper anchoring of the scaffolding/staging at reasonable intervals shall be provided in each direction with the main structure wherever available.
- d. Horizontal braces shall be provided to prevent the scaffolding from rocking.
- e. Diagonal braces shall be provided continuously from bottom to top between two adjacent rows of uprights.
- f. The scaffolding/staging shall be checked at every stage for plumb line.
- g. Wherever the scaffolding/staging is found to be out of plumb line, it shall be dismantled and re-erected afresh. Efforts shall not be made to bring it in line with a physical force.
- h. All nuts and bolts shall be properly tightened and care shall be taken that all the clamps/couplings are firmly tightened to avoid slippage.
- i. Erection work of a scaffolding/staging, under no circumstance shall be left totally to semiskilled or skilled workmen and shall be carried out under the supervision of Contractor's technically qualified civil engineer.

- 5.5.2. For smaller work or work in remote areas wooden ballies may be permitted for scaffolding/staging by the Owner's Representative at his sole discretion. The Contractor must ensure the safety and suitability of such works as described under Clause 5.5.1 above.

5.6. Embedment of Fixtures

All fixtures, pipes, conduits, holdfasts of doors and windows etc. required to be built in walls, shall be embedded in plain cement concrete block of grade 1:3:6, at the required positions, as the work proceeds.

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CONTROLLED ROCK BLASTING

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1 SCOPE

- 1.1 This specification covers the minimum requirements for materials, personnel, transportation, storage and use of explosives for grading of Right of Use (ROU) and excavation of trenches for the burial of pipeline in rocky terrain.
- 1.2 This specification does not cover the construction or operation of permanent magazines.
- 1.3 This specification applies to on-shore pipeline installation.

2 REFERENCE DOCUMENTS

- 2.1 The following National and International regulations and codes shall be used:
- 2.2 BS: 5607 : Safe use of explosives in the construction industry.
- 2.3 NFPA-495 : Manufacture, Transportation, Storage & Usage of Explosive Materials.
- 2.4 National and Local Laws/ Regulations
- 2.5 Applicable Safety Rules of Chief Inspector of Explosives, Nagpur
- 2.6 IS 4081 : Safety Code for Blasting and related drilling operations.

3 GENERAL

- 3.1 The Contractor shall acquaint himself and comply with all the applicable local laws and regulations concerning storing, handling and the use of explosives. All such laws, regulations and rules etc., as enforced from time to time shall be binding upon the Contractor. National/ Local Laws and Regulation shall take precedence over this specification in the event of conflict. All conflicts shall be brought to be notice of the Owner/ Engineer Representative.
- 3.2 The requirements stated herein however in no way relieve the Contractor of his responsibility of carrying out safe blasting operations and shall be solely responsible for damages and claims thereof.
- 3.3 The use of explosives requires an approval from the Chief Inspector of Explosives and/or his authorized Inspector. It shall be the responsibility of the Contractor obtain all such permits and observe all requirements regarding the safe storage, handling and use of explosive. All expenses incurred in this regard shall be to Contractor's account.
- 3.4 Contractor shall inform the Owner/ Engineer Representative in writing at least four (4) weeks prior to planned use of explosives.
- 3.5 Contractor shall notify the Owner/ Engineer Representative prior to any blasting in the proximity of overhead power lines, roads, communication lines, pipelines, utility services or other services and structures above and below ground. Before starting blasting operations local authorities and owners of utilities shall be consulted to check on the presence of services which could be damaged and their approval obtained to undertake blasting operations. The distances to nearest structures (houses, offices, factories) or service shall also be taken into consideration when planning blasts so that ground vibration and air over pressure is kept within acceptable levels as given in the specification.
- 3.6 Contractor shall prepare an Explosives Handling and usage Procedure for the information of the Owner/ Engineer Representative which shall incorporate the following:
 - Individual procedure and calculations
 - Nature of blasting operations, including hole diameter, depth and presence of cavities.

- Rock characteristics
- Type of explosives
- Temperature likely to be encountered in use.

3.7 No blasting is allowed within 20 m of any above ground or underground structure or facilities. No blasting is allowed within 200 m of overhead power lines/ cables unless specifically approved by the Authorities having jurisdiction over it.

4 MATERIALS

4.1 All materials such as explosives, detonators, fuses, tamping materials etc. that are proposed to be used by the Contractor in blasting operations, shall be approved by Owner/ Engineer Representative.

4.2 All electric detonators used in the blast shall be of the same electrical sensitivity and be produced/ procured from the same manufacturer.

4.3 The detonators used shall be capable of giving effective blasting of the explosives. Damaged explosive materials shall be destroyed by a responsible person as per manufacturer's instructions or returned to the manufacturer.

4.4 No explosive material shall be abandoned.

4.5 All blasting materials and testing equipment shall be regularly tested for correct performance. Guidelines/ recommendations of the manufacturer shall be adhered to.

5 PERSONNEL

5.1 Excavation by blasting will be permitted only under personal supervision of competent and licensed persons and by trained workmen.

6 STORAGE OF EXPLOSIVES

6.1 The Contractor shall build a magazine for storing the explosives. The site of the magazine, its capacity and design shall be subject to approval by the Owner/ Engineer Representative and the Inspector of Explosives before the fabrication is taken up. As a rule the explosives should be stored in a clean, dry, well ventilated, bullet-proof and fireproof building, at an isolated site. Adequate security shall be provided to ensure no unauthorized entry into the magazine. A notice shall be hung next to magazine entrance prohibiting entry of unauthorized persons.

6.2 Contractor shall comply with National/ Local Regulations and specifications for truck mounted mobile explosives store. Mobile stores shall only carry ONE DAY'S Explosives requirements and shall be parked overnight inside the compound at the authorised magazine.

6.3 All safety precautions and necessary equipment for maintenance, operation of mobile stores, as required by local authorities or regulatory bodies shall also be installed/ provided on the Mobile Store.

6.4 A careful and day-to-day account of all explosives shall be kept by the Contractor in a register and in an approved manner. The register shall be produced by the Contractor, for the inspection of the Owner/ Engineer Representative / Inspector of Explosives when so required by the later.

Any loss, damage or theft shall be reported immediately to the necessary local authorities and to the Owner/ Engineer Representative.

- 6.5 The magazine shall on no account be opened during or on the approach of a thunderstorm and no person shall remain in the vicinity of the magazine during such period.
- 6.6 Magazine shoes without nails shall, at all times, be kept in the magazine, and a wood-tub or cement trough, filled with water shall be fixed near the door of the magazine.
- 6.7 Persons entering the magazine must put on the magazine shoes. They should also following instructions:
- i. Not to put their feet on the clean floor unless they have magazine shoes on.
 - ii. Not to allow the magazine shoes to touch the ground outside the clean floor.
 - iii. Not to allow any dirt or grit to fall on the clean floor.
- 6.8 No matches or inflammable material shall be allowed in the magazine. Light shall be obtained from an electric storage battery lamps
- 6.9 No person having articles of steel or iron on him shall be allowed to enter the magazine. No tools or implements other than those of copper, brass, brass, gun metal or wood shall be allowed inside the magazine.
- Only cotton, rags, waste and articles liable to spontaneous ignition shall not be allowed inside the magazine.
- 6.10 Boxes of explosives shall not be thrown down or dragged along the floor and shall be stacked on wooden trestles. Open boxes of explosives shall never be exposed to the direct rays of the sun. Empty boxes or loose packing materials shall not be kept inside the magazine.
- 6.11 The magazine shall have a lighting conductor, which shall be got tested at least periodically, by an officer authorized by the Owner/ Engineer Representative, the testing fee shall be to the Contractor's account.
- 6.12 The magazine shall be inspected periodically by an officer representing the Owner/ Engineer Representative, who will see that all the rules are strictly complied with. He will notify all omission etc to the Contractor who will rectify the defects within a period of 3 days from the date of receipt of the notice, failing which the Owner/ Engineer Representative may take whatever actions it consider suitable.

7 PREPARATION OF EXPLOSIVES

- 7.1 Contractor shall submit the following procedure for information of the Owner/ Engineer Representative as a minimum.
- Loading of explosives
 - Drilling of new holes and extending existing holes
 - Handling of explosives at site
 - Tamping explosives into holes
 - Machines: tools and cables required
 - Initiation of blasting
 - Safety of personnel
 - Vibration control
 - Blast pattern and shot size establishment

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- Misfires
- Emergency procedures.

- 7.2 Trial blasts in conjunction with vibration recording shall be carried out for each rock and trench type, in order to assess rock breakability and vibration levels. These trial blast shall be carried out prior to actual trench blasting of the pipeline route. Contractor shall conduct trial digs as directed by Owner/ Engineer Representative in order to check suitability of the blasting pattern and to measure vibration levels to ensure vibration levels are below the allowable maximum.
- 7.3 “Weight per Distance Tables” shall be drawn up from these trials.
- 7.4 The detonators shall never be forced into the primer cartridge. It shall be inserted in a hole made by a wooden, copper, brass or aluminium pricker. The detonator shall be firmly embedded in the primer so that it is not pulled out of place during loading.
- 7.5 Detonators shall be activated electrically. In proximity of electric over head power lines, Contractor may use non-electric system with the approval of Owner/ Engineer Representative. Fly rock shall be minimized by the use of approved blast mats and by careful selection of sot size and drill hole configuration.
- 7.6 Use of explosives is prohibited in areas exposed to flammable gasses or dust.
- 7.7 Explosives shall be stored and used chronologically to ensure that the ones received earlier are being used first.
- 7.8 A make-up house shall be provided at each working place in which cartridges shall be made up by experienced men as required. The make-up house shall be separated from other buildings. Only electric storage battery lamps shall be used in this house.
- 7.9 No smoking shall be allowed in the make-up house.

8 PREPARATION OF PRIMERS

- 8.1 The primers shall not be prepared near open flames or fires. The work of preparation of primers shall always be entrusted to the qualified and approved personnel. Primers shall be used as soon as possible after they are ready.

9 CHARGING OF HOLES

- 9.1 The work of charging shall not commence before all the drilling work at the site is completed and the Owner/ Engineer Representative has satisfied itself to that effect by actual inspection.
- 9.2 The lead wires shall be kept away from conductors or sources of stray current, open lamp/flames shall be kept away.
- 9.3 Only wooden tamping rods without any kind of metal on them shall be used.
- 9.4 Only one cartridge shall be inserted at a time and gently inserted to the required depth with the tamping rod. The sand, clay or other tamping material used for filling the hole completely shall not be tamped too hard.
- 9.5 Blasting shall not take place after sunset or before sunrise unless specific approval is first obtained by Contractor from local authorities and the Owner/ Engineer Representative.
- 9.6 The site of blasting operations shall be prominently demarcated by red danger flags. The order of fire shall be given only by the supervisor-in-charge of the work and this order shall be given only after giving the

warning three times. So as to enable all the labour, watchmen etc. to reach safe shelter and after having ascertained that nobody is within the danger zone.

9.7 A buegle with a distinctive note shall be used to give the warning signals. The buegle shall not be used for any other purpose. All the labour shall be made acquainted with the sound of the buegle and shall be strictly warned to leave their work immediately at the first warning signal and to take safe shelters, and not to leave the shelters until the all clear signal have been given.

9.8 All the roads and footpaths leading to the blasting area shall be watched.

10 ELECTRICAL FIRING

10.1 Only the Supervisor-in-charge shall keep the key of the firing apparatus and shall keep it always with himself.

10.2 Special apparatus shall be used as source of current for the firing operations. Power lines shall not be tapped for the purpose.

10.3 The firing cable shall have a proper insulating cover so as to avoid short-circuiting due to contact with water, metallic parts or rock.

10.4 The use of earth as a return line shall not be permitted.

10.5 The firing cable shall be connected to the source of current only after ascertaining that nobody is in the area of blasting.

10.6 Before firing, the circuit shall be checked by a suitable apparatus.

10.7 After firing, whether with or without an actual blast, the contact between the firing cable and the source of current shall be cut off before any person is allowed to leave the shelter.

10.8 During storms, charging with electrical detonators shall be suspended. The charges already placed into the holes shall be blasted as quickly as possible after taking all the safety precautions and giving necessary warning signals. If this is not possible, the site shall be abandoned till the storm has passed.

11 VIBRATION RECORDING

11.1 Contractor shall use Company approved vibration recording system capable of measurement in three axes (tri-axial). The device shall have an accuracy of 0.0025 mm and a resonance of 2 Hz.

The device shall measure both frequency and amplitude of vibration.

11.2 All the measurement devices shall be calibrated by an APPROVED certification body.

11.3 Particle velocity shall not exceed the following:

11.4 Areas not with 500 m of existing facilities.

- 50 mm/sec at a surface measured distance of 15 m from trench centreline.

11.5 Areas with existing buried or above ground facilities within 500 m

- 20 mm/sec. At a surface measured distance from the trench center line towards the nearest existing facilities.

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11.6 The particle velocity levels are provided for the guidance only, Contractor shall be responsible and liable for any injury to life or damage to property/ facilities.

11.7 Air over pressure/ sound levels shall be limited to 100 db in inhabited areas.

12 MISFIRES

12.1 If it is suspected that part of the blast has failed to fire, or is delayed, sufficient time shall be allowed to lapse before entering the danger zone. When fuse and blasting caps are used, a safe time should be allowed and then the Supervisor alone shall leave the shelter to see the misfire.

12.2 Drilling near the hole that has misfired shall not be permitted until one of the two following operations have been carried out by the Supervisor:

- i) The Supervisor should very carefully (when the tamping is of damp clay) extract the tamping with a wooden scraper or jet of water or compressed air (using a pipe of soft material) and withdraw the fuse with the primer and detonator attached. A fresh primer and detonator with fuse shall then be placed in this hole and fired.
- ii) The Supervisor shall get one foot of the tamping cleaned off and indicate the direction by placing a stick in the hole. Another hole may then be drilled at least 9” away and parallel to it, this hole should then be charged and fired. The balance of the cartridges and detonators found in the muck shall be removed.

12.3 The Supervisor shall at once report to the office all cases of misfire, the cause of the misfire and the steps taken in connection therewith.

12.4 If a misfire has been found to be due to defective detonator, or explosive, the whole quantity from the box from which the defective articles were taken must be returned to the manufacturer for inspection to ascertain whether the whole box contains defective materials.

12.5 Re-drilling the holes that have misfired either wholly or partly shall not be permitted.

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DEMOLITION AND DISMANTLING

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* * *

1. SCOPE

This specification covers the procedure and safety requirements for demolition and dismantling of masonry (Brick & Stone), concrete (Plain/Reinforced), structural steel (sheeted / unsheeted) works.

2. GENERAL

- 2.1. Apart from this specification, the demolition and dismantling of structures (part or whole) shall be in compliance with all statutory safety regulations and any other special requirement as shown/noted on the drawings. Prior consent and approval of the Owner's Representative shall be obtained in writing before starting any dismantling works. Any restrictions imposed regarding working hours shall also be strictly followed by the Contractor.
- 2.2. All materials obtained from dismantling/demolition operations shall be the property of the Owner unless otherwise specified and shall be kept in safe custody until handed over to the Owner's Representative.
- 2.3. Where it becomes necessary to disconnect any existing service line(s) (such as electrical, piping etc.) during dismantling/demolishing operation and where so required by the Owner's Representative, suitable alternate arrangement shall be made by the Contractor to maintain the continuity and proper functioning of the affected service line(s) with the approval of Owner's Representative at no extra cost to the Owner.

3. SAFETY PRECAUTIONS

- 3.1. The Contractor shall adhere to safe demolishing/dismantling practices at all stages of work to guard against accidents, hazardous and unsafe working procedures.
- 3.2. Necessary propping, shoring, strutting and/or underpinning shall be done for the safety of all surrounding structures (whose safety is likely to be endangered) before taking up the demolishing and dismantling work.
- 3.3. Temporary enclosures made out of GI sheets, fencings, danger lights etc. shall be provided by the Contractor and got approved by the Owner's Representative before start of work to prevent accidents.
- 3.4. Contractor must ensure the availability of adequate fire fighting equipment / arrangements before starting actual demolishing/dismantling works. These facilities shall be made available throughout the entire operation of demolition and dismantling of structures.
- 3.5. All equipments, pipes, fittings and instruments, underground utilities etc. located in the vicinity shall be protected by suitable means, as decided by the Owner's Representative, during demolishing, dismantling operations.
- 3.6. Roads and working spaces shall be kept free of any debris/dismantled materials at the end of day's work.
- 3.7. Necessary measures shall be taken to keep the dust and noise nuisance to minimum levels.

- 3.8. Dismantled elements/components shall not be dropped from a height or thrown from a distance. Dismantling of elements fixed by screws/bolts/hooks etc. shall be done by taking out the fixtures with proper tools only. Such fixtures may be allowed to be cut by sawing or flame cutting, in the event of their being struckup due to corrosion etc. however the decision of Owner's Representative in this regard shall be final and binding. Welds shall be removed by flame cutting. Tearing or ripping of elements shall not be resorted to under any condition.

4. PROCEDURE

- 4.1. Entire work of demolishing and dismantling shall be meticulously planned. Prior to start of work, the Contractor shall thoroughly understand the scope and nature of the work, and then prepare and submit the proposed work execution plan of demolishing and dismantling to the Owner's Representative for his review. Comments, if any, shall be taken care by the Contractor and execution of the work shall be done based on the revised execution plan.
- 4.2. Demolition and dismantling shall be restricted to the extent shown on drawings and as directed by the Owner's Representative.
- 4.3. Demolition of any structure shall be carried out in the sequence reverse to that followed at the time of its construction.
- 4.4. Dismantling shall be done in a systematic manner. All elements shall be carefully removed without causing any damage.
- 4.5. Blasting in any form shall not be permitted.
- 4.6. Chipping of concrete/grout shall be done with precision by chiselling. The finished surfaces shall be made true to the requisite size and shape.
- 4.7. Pockets/holes of specified size shall be made/cut by drilling/chiselling.

5. CLEANING AND STACKING

- 5.1. All demolished/dismantled serviceable materials such as bricks, stones, reinforcement bars, structural steel, sheeting etc. shall be separated out, cleaned and stacked in separate lots within the plant boundary as directed by the Owner's Representative.

6. DISPOSAL

All unserviceable materials shall be disposed off in spoil heaps within or outside the plant boundary as per the directions of the owner's Representative. Areas required outside the plant boundary for dumping of disposed material shall be arranged by the Contractor and got approved by the Owner's Representative.

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7. PAYMENT

7.1. General

Measurement of all works shall be taken prior to start of demolishing / chipping / dismantling works.

7.2. Masonry/Concrete works (Demolition)

7.2.1. Payment shall be made on the basis of actual volume in cubic metres (cu.m.) of masonry/concrete works demolished. The thickness of plaster/bitumen felt shall be included in measurements.

The rate for demolishing shall include supply of labour, tools & tackles, necessary safety measures, propping, underpinning, scaffolding, handling, cutting, straightening, scraping and cleaning of reinforcement bars and other embedments (in case of reinforced concrete works), sorting out and stacking of all serviceable materials, disposal of all unserviceable material, clearing the site, etc. all complete as specified and directed by the Owner’s Representative.

7.3. Excavation & Backfilling

7.3.1. Excavation and backfilling shall be paid separately as per relevant clauses of specification of Earthworks.

7.4. Chipping of Concrete Works

Payment shall be made on the basis of admissible area in square metres (sq.m.) of concrete surfaces chipped, pertaining to the different categories of thicknesses specified in the schedule of items.

The rate for chipping shall include supply of labour, tools and tackles, necessary safety measures, scaffolding, chiselling, handling exposing, cutting, straightening, scraping, clearing the reinforcement bars (in case of reinforced concrete works), wire brushing and washing the exposed surfaces, disposal of all unserviceable material etc. all complete as directed.

7.5. Making Pockets/Holes in Concrete Works

Payment shall be made on the basis of number (Each) of pockets/holes of sizes upto and inclusive of 200x200x500 mm, made or cut in the concrete works.

The rate for making pockets/holes shall include supply of labour, tools & tackles, necessary safety measures, scaffolding, chiselling, drilling, handling, cutting or relocating reinforcement bars, cleaning, disposal of all unserviceable material etc. all complete as directed.

7.6. Dismantling of Structural Steel Works

Payment shall be made on the basis of weight (MT) of the structure/components being dismantled. Assessment of weight shall be done as per the specifications or as per the direction of Owner’s Representative.

The rate for dismantling shall include supply of labour, tools and tackles, equipment, consumables, necessary safety measures, scaffolding, propping, handling, unbolting, cutting (by sawing or flame cutting) of gussets/plates/bolts/hooks/welds, cleaning, sorting out and stacking of all serviceable materials, disposal of all unserviceable material, etc. all complete as specified and directed.

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7.7. Dismantling of Roof & Wall Sheeting

Payment shall be made on the basis of dismantled sheeted area in square metres (sq.m.) of plan area in case of roof sheeting and area in elevation in case of side and louver sheeting.

The rate for dismantling shall include supply of labour, tools and tackles, equipments, consumables, necessary safety measures, handling, scaffolding, unbolting, cutting (by saw or flame cutting) of hook bolts, removal of ridges, gutters, flashings, transporting, stacking of all serviceable materials, disposal of all unserviceable material, etc. all complete as directed.

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|    | <p style="text-align: center;">GTS-DIVERSION BERMS GABIONS AND SACK BREAKER</p> | <p style="text-align: center;">Z/02 0056</p> |
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DIVERSION BERMS, GABIONS AND SACK BREAKER

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1. DRAINAGE AND EROSION CONTROL

The control of surface and sub-surface drainage within a pipeline right-of-way is an important aspect of pipeline design. Severe right-of-way erosion, pipeline exposure and slope instability can, in many cases, be avoided with the incorporation of suitable drainage and erosion-control measures. Diversion berms, gabions, ditch plugs/subdrains are generally installed for this purpose.

2. DIVERSION BERMS

2.1. DEFINITION

Diversion berms consist of shallow earth-filled dikes, which are placed at intervals on a slope to collect and direct surface flow-off the right-of-way and away from the pipeline.

The use of diversion berms to control surface water within a pipeline right-of-way has been standard practice in the pipeline industry.

2.2. TYPES OF DIVERSION BERMS

Diversion berms may be constructed in a herringbone or diagonal pattern (refer attached drawing).

Diagonal diversion berms are used in situations where the existing topography and slope drainage suggests a preferred direction of runoff.

Berms constructed in a *herringbone pattern* are used in situations where there is no preferred direction of runoff, or where the berms are located across the slope with side cuts on both ends of the right-of-way. This pattern is preferred since it diverts the water away from the ditch and does not concentrate on just one side of the right-of-way.

2.3. DIVERSION BERM SPACING

| Slope ↓ | Soil Erosion Potential | | |
|-----------------|---------------------------|--------------------------------|--------------------------------|
| | High (Fine sands & silts) | Moderate(Clays & coarse sands) | Low (Gravel & exposed bedrock) |
| Gentle(<5%) | 45 mtr. | 50mtr. | Not necessary |
| Moderate(5-10%) | 30 mtr. | 45mtr. | 50mtr. |
| Steep(>10%) | 305 / %grade (mtr.) | 305x1.5%(mtr.) | 305x2%(mtr.) |

2.4. GENERAL CONSTRUCTION GUIDELINE FOR DIVERSION BERMS

Some general construction guidelines that would help in improving the long-term performance of diversion berms are mentioned below –

- Berms should be constructed with mineral soils, with every effort made to minimise organics being mixed in.

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- The top width and height of berms should be approximately 0.8 mtr.
- Nominal compaction of berm material in lifts will increase its resistance to erosion.
- The downslope gradient of berm should be approximately 5% to limit erosion from surface runoffs.
- The berms should extend across the full width of the right-of-way to prevent the flow of water back onto the right-of-way.
- To a large extent, the spacing of the berms depends on the local topography and drainage. Berm spacing should be reduced as the slope increases.

3. GABIONS

Areas subjected to severe erosion by stream flow or concentrated surface drainage may require a more robust type of erosion protection. If the sloping side of the water crossing & embankments is equal to 45° or more, Gabion wall will be constructed. Procedure for constructing Gabions will be as follows:-

- Fabricate hexagonal mesh of opening size 60 mm x 80 mm made of 3.0 mm dia galvanised steel wires with selvages finished with 4.0 mm dia galvanised wire.
- Gabion unit of 2.0 m x 1.0 m x 1.0 m size to be fabricated packed inside with solid hard rock boulders graded from 75 mm to 150 mm voids to be overfilled excess upto 40 mm to allow for settlement.
- Mesh must have a overlapping of 150 mm allround.
- Lacing, bracing, lying at corners and placement at site shall be as per detailed approved drawing.
- Staking of Gabions shall be done by using 1.8 m, 32 mm galvanised round bars @ 500 c/c to be driven into the embankment.

If the sloping side of the water crossing embankment is between 10° and 45°, gabions mattresses will be constructed. Procedure for constructing Gabions mattresses will be as follows:

- Fabricate hexagonal mesh of opening of size 60 mm x 80 mm made of 3.0 mm dia galvanised steel wires with all selvages finished with 4.0 mm dia galvanised wires.
- Gabions mattresses unit i.e. diaphragms of size 2 m x 25 cm thick with length varying from 4.0 m to 6.0 m as per site requirements. In any case, mattresses length will not be more than 60 m. Mattresses shall be filled using solid hard rock boulders (grade from 75 mm to 150 mm) overfilling upto 40 mm will have to be done to allow for settlement.
- Gabions mattresses diaphragms shall be laced, laid and placed at required locations as per detailed approved drawing.

Gabions are used along banks of streams and rivers to prevent toe erosion. Generally gabions are used to adequately protect the bank or diversion berm when available stones are too small for use as riprap. A gravel blanket or filter cloth is typically laid under the gabions to create a flat surface for tying the baskets together and as a filter medium to prevent loss underlying fines.

4. GEOLOG SACK BREAKER

When designing a pipeline in sloping terrain, the potential of surface and sub surface seepage to collect and flow within the loose pipe backfill must be recognised. If the seepage is not controlled, it can lead to

backfill erosion and pipe exposure. The installation of impervious seepage barriers at intervals along the pipe ditch will effectively block subsurface seepage within the pipe backfill and force it to the surface, where it can be diverted off the right-of-way by a diversion berm.

It has been a common practice in the industry to use sack breakers to control seepage within the pipe ditch. These are of sand-filled jute sacks keyed into the pipe ditch walls and hand-placed in the form of a pyramid.

To ensure that the sack breaker effectively impedes the flow of water down the ditchline, it is essential that the sacks be carefully keyed into the ditch walls and ditch bottom, with the bags placed to interlock with one another. This is necessary to ensure that there are no short-circuit seepage paths through the sack breaker.

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EXCAVATION, BACKFILLING, COMPACTION

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1. GENERAL

1.1. Scope

This SPECIFICATION covers the excavation and backfilling of pits and trenches for the foundations of structures and the compacting of the backfill material.

It also covers the excavating and backfilling of trenches for drainage pipes, utilities pipes, ducts and cables and the excavating and backfilling of pits for manholes and alike.



The following definitions shall apply :

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| AGREEMENT | Designates the agreement concluded between the OWNER and the CONTRACTOR, under which the latter undertakes to the former the GOODS and/or SERVICES according to the stipulations which are agreed and specified in the form of an order. |
| OWNER | Designates the purchaser of the GOODS and/or SERVICES which are the subject of the AGREEMENT. |
| CODE | Designates a set of systems and Indian rules or international standardization documents for design, materials, tests, etc. |
| CONTRACTOR | Designates the individual or legal entity with whom the order has been concluded by the OWNER. The term "CONTRACTOR" may be used indifferently for a supplier, a manufacturer, an erection CONTRACTOR, etc. |
| DAYS - WEEKS - MONTHS | Specify the number of calendar days, weeks or months and not of working days, weeks or months. |
| OWNER'S REPRESENTATIVE | Designates the individual or legal entity to which the OWNER has entrusted various tasks in relation with the carrying out of his PROJECT. |
| GOODS and/or SERVICES | Designate, depending on the case, all or part of the drawings or documents, substances, materials, materiel, equipment, structures, plant, tools, machinery,... to be studied, designed, manufactured, supplied, erected, built, assembled, adapted, arranged or put into service by the CONTRACTOR under the AGREEMENT, including all the studies, tasks, works and services specified by the order. The terms GOODS or SERVICES may be indifferently used one for the other as required by the context. |
| PROJECT | Designates the aggregate of GOODS and/or SERVICES to be provided by one or more CONTRACTORS. |
| STANDARD | Designates a set of models or references, corresponding to common practice and generally used by the OWNER'S REPRESENTATIVE. This can be : typical standard drawings or documents. |
| SPECIFICATION | Designates a document describing in some details general or particular requirements for specific type of works. |

1.2. References

The standards referred to in this section are as follows :

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| [As per Indian Labour Laws] |
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1.3. Submittals

1.3.1. Construction and method drawings

The CONTRACTOR shall submit the following drawings and details :

- a) the results of the survey specified in paragraph 3.1.
- b) construction drawings, method diagrams and plant details for each major excavation in close proximity to an existing structure showing in full detail, with appropriate supporting calculations, the CONTRACTOR'S proposals for carrying out the excavation, for shoring the sides of the excavation, for shoring and underpinning the existing structure if necessary, for controlling and recording all movements which could affect the structure, for compacting the backfill material and, if necessary, for dewatering the excavation or lowering the level of the groundwater in the vicinity of the excavation to enable the whole of the work to be executed in the dry and the stability and condition of the adjoining structure to be preserved.

1.4. Site Conditions

1.4.1. Existing conditions

The attention of the CONTRACTOR is drawn to the fact that, at certain locations, excavation for the foundations of structures will have to be carried out in close proximity to existing structures and to the requirements of this SPECIFICATION in this respect.

2. MATERIALS

2.1. Backfill Material

Only suitable material as defined below and approved by the OWNER'S REPRESENTATIVE shall be used for backfilling.

Suitable material shall comprise all materials which are acceptable in accordance with the Contract for use in the Works and which are capable of being compacted in the manner and to the specified density.

Unsuitable material shall mean other than suitable material and, unless instructed otherwise by the OWNER'S REPRESENTATIVE, it shall include :

- i. material from swamps, marshes or bogs and soil containing more than 10% organic matter;
- ii. peat, logs, stumps and perishable material;
- iii. clay of liquid limit exceeding 70 and/or plasticity index exceeding 45;
- iv. soils containing soluble salts other than calcium sulphate in quantities exceeding the relevant percentages by weight given in the following table :

| pH value of soil | Total soluble salts excluding Ca SO ₄ | Sulphates Na SO ₄ + Mg SO ₄ | Chlorides |
|---------------------|--|---|-----------|
|---------------------|--|---|-----------|

| | | | |
|---------|-------|--------|--------|
| over 6 | as e) | - | - |
| 5 - 6 | 0,5 % | - | - |
| under 5 | 0,5 % | 0,05 % | 0,45 % |

v. salty of gypsiferous soils containing more than 10 % soluble salts.

3. EXECUTION

3.1. Preparation




Before any major excavation work is undertaken, the CONTRACTOR shall carry out an adequate survey of all existing structures in close proximity which could be affected by the intended work. The survey shall include the establishment of the following data regarding each structure:

- a) type of construction, structural condition and any defects;
- b) limits and levels of foundations;
- c) type and quality of foundation;
- d) extent of vaults, tunnels and similar underground structures;
- e) locations of utilities in the vicinity.

The CONTRACTOR shall provide all shoring and underpinning of existing structures, required to ensure their stability and safety during the excavation work. Shoring and underpinning shall comply with the requirements of :

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| [As per Indian Labour Laws] |
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Before starting the excavation of trenches etc. and if the presence of existing underground utilities is known or suspected, the CONTRACTOR shall establish the exact location of these by means of carefully excavated trial pits, using hand methods in the immediate vicinity of the pipe, duct or cable, and shall carry out such diversion or protection of these as is shown on the drawings or directed by the OWNER'S REPRESENTATIVE.

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3.2. Excavation, Backfilling And Compacting Of Foundation Pits And Trenches

3.2.1. Excavation of foundation Pits and Trenches

Depth and dimensions of footings

Pits and trenches for foundations of structures and buildings shall be excavated to the levels and dimensions shown on the drawings or to such other levels and dimensions as directed by the OWNER’S REPRESENTATIVE. The OWNER’S REPRESENTATIVE may require from the CONTRACTOR to excavate below the foundation levels shown on the drawings or he may order him to stop when suitable foundation material is encountered.

Bottom of the excavation

The bottom of all excavation shall be carefully graded and if required by the OWNER’S REPRESENTATIVE stepped or benched horizontally.

All excavations shall be taken out as nearly as possible to the exact dimensions of the foundations to minimise backfilling.

In excavations for foundations of structures and buildings a bottom layer of soil shall be left in place temporarily and subsequently removed only when the concrete is about to be placed, in order to avoid, as far as possible, softening or deterioration of the surface of the bottom of the excavations by exposure.

The thickness of the layer will depend on the type of soil and will be determined by the OWNER’S REPRESENTATIVE. Any pockets of soft material in the bottom of pits and trenches shall be removed as directed and the cavities so formed filled with concrete Grade M15. Where, after grading of the bottom, any volumes of material become puddled, softened or loosened, the disturbed or damaged material shall be removed as directed and the cavities so formed filled with concrete Grade M15, at the CONTRACTOR’S expense.

After the completion of placing of any blinding concrete required by the Contract, no trimming of the side faces shall be carried out for 24 hours.

When any excavation has been taken out and trimmed to the levels and dimensions shown on the drawings or directed by the OWNER’S REPRESENTATIVE, the OWNER’S REPRESENTATIVE shall be informed accordingly so that he may inspect the completed pit or trench.

Excavated materials

Excavated materials from excavations which are suitable and required for backfilling shall be stockpiled clear of the excavation works. The stockpiles shall be shaped and graded to permit proper drainage.

Excavated materials from excavations which are suitable but superfluous to the needs for backfilling shall be utilised by the CONTRACTOR where suitable filling material is required elsewhere in the Works or, if superfluous to all the requirements for backfilling or filling, it shall be removed from the site by the CONTRACTOR.

If the CONTRACTOR allows material which, on excavation is suitable for re-use, to become unsuitable and it is in this condition when required for backfilling or filling, he shall make good by running in to spoil and replacing with other suitable material, or when directed by the OWNER’S REPRESENTATIVE, the moisture content of the material shall be adjusted before deposition, to facilitate the compaction in a way as specified by this SPECIFICATION.

Excavated materials from excavations which are unsuitable for use as backfilling shall be run to spoil off the Project Site, selected by and at the CONTRACTOR expense or to a dumping place as directed by the OWNER (as defined by the agreement constituent documents).

Excavation greater than necessary

Excavation to a depth greater than specified shall be corrected by the CONTRACTOR at his own expense by concrete Grade M15.

Excavation to a width greater than specified shall be corrected by the CONTRACTOR at his own expense and to the satisfaction of the OWNER'S REPRESENTATIVE by completely filling the excess volume of excavation against the completed foundation either with concrete Grade M12/15 or if agreed by the OWNER'S REPRESENTATIVE with approved material compacted in a way as specified in paragraph 3.2.5 of this SPECIFICATION.

Shoring to excavations

The sides of all excavations shall be shored adequately at all times to the satisfaction of the OWNER'S REPRESENTATIVE.

The submission by the CONTRACTOR of the details of his proposals for such work and the OWNER'S REPRESENTATIVE'S agreement thereto, shall not relieve the CONTRACTOR of any responsibility for the safety of the work.

Timber or other shoring materials shall be removed as the work proceeds unless otherwise directed or permitted by the OWNER'S REPRESENTATIVE. The OWNER'S REPRESENTATIVE may direct shoring materials other than timber to be left behind in trenches or other excavations.

In placing, altering or removing shoring to the sides of excavations, care shall be taken to avoid pressure being brought to bear on the permanent work before it is capable of withstanding such pressure.

3.2.2. Excavation of Trenches

Excavation of trenches

Excavation for pipes, ducts and cables shall be carried out in trenches and shall conform to the lines and levels shown on the drawings or to any specified gentle curve in plan. Except where any greater width is shown on the drawings all trenches shall be excavated to such a width as will give adequate room in the trench for the proper support of the trench, and shall be excavated to a sufficient depth and width to enable the pipe, duct or cable and any specified or agreed joint, bedding, haunching and surround to be accommodated.

Trenches for sub-soil drains and land drains shall be of the minimum width capable of accommodating the pipes in order to ensure good alignment of the pipes as laid and shall be excavated to uniform gradients in straight lines or specified gentle curves.

Trenches for French drains having pipes up to 150 mm in diameter shall be excavated to a width of at least four times the nominal diameter of the pipes; for pipes over 150 mm in diameter the width shall be the diameter plus 450 mm.

The excavation of trenches at or near the toes of cutting or embankment slopes shall be carried out in such a manner that there is no excavation into the slope for working space.

Where a trench is adjacent to an existing or a new structure or building, and the bottom of the trench is lower than the foundation of the structure or building, the pipe or duct shall be bedded and surrounded in

concrete Grade C12/15 and the trench shall be filled in with concrete up to the level of the top of the foundation.

When constructing new structures and buildings and laying adjacent pipes or ducts the item, requiring the deepest excavation, shall be executed first.

Bottom of the trench

Before any pipes, ducts or cables are laid or concrete or other bed placed in the trench, the base of the excavation shall be trimmed true in cross-section and gradient and rammed by hand solid to afford a firm and uniform bearing throughout the entire length of the trench. Where, after trimming of the base of the excavation, any volumes of material become puddled, softened or loosened, the disturbed or damaged material shall be excavated to such additional depth as may be required by the OWNER'S REPRESENTATIVE, to the full width of the trench, and be replaced up to the proper level with sand, gravel or pipe bedding material properly compacted or with concrete of the same grade as the bed, as the OWNER'S REPRESENTATIVE may direct, at the CONTRACTOR'S expense.

Where a firm foundation is not encountered, due to soft, spongy or other unsuitable material, all such unsuitable material under the pipe, duct or cable shall be removed over the full width of the trench and the space shall be backfilled with sand, gravel or pipe bedding material properly compacted or with concrete of the same grade as the bed, to provide adequate support for the pipe, duct or cable.

Excavated materials

Excavated materials from trench excavations which are suitable for the purpose shall be set aside for use as backfill.

Excavated materials from excavations which are unsuitable for use as backfilling shall be run to spoil off the Project Site, selected by and at the CONTRACTOR expense or to a dumping place as directed by the OWNER (as defined by the agreement constituent documents).

Excavation greater than specified

Excavations taken out to a greater depth than specified shall be filled in to the required level with compacted suitable material or with the specified pipe bedding material properly compacted.

Where pipes or ducts are to be bedded on a concrete bed, any such additional excavation shall be filled in to the required level with concrete of the same grade.




Where pipes or ducts are to be bedded on, haunched or surrounded with concrete, any additional lateral excavation beyond the specified overall dimensions of the concrete bed, haunch or surround shall, except where such additional lateral excavation is shown on the drawings, be filled in to the level of the top of the specified concrete with concrete of the same grade. No payment will be allowed for any of the filling in of additional excavation specified in this paragraph.

Supporting of sides of trenches

The sides of the trenches shall be supported adequately at all times by means of walling, struts and runners or sheet piling of sufficient numbers and dimensions to prevent the falling in, movement or slipping of the ground, injury to workmen and damage to the Works or adjacent property.

3.2.3. Excavation around existing structures

Should the results of the survey specified above, indicate that an existing structure would be affected by the intended excavation work, the CONTRACTOR shall design and employ a temporary support system for

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the excavation, of sufficient strength to preserve the stability of the structure, and of sufficient rigidity to prevent any movement of the soil which could cause significant damage to the structure. The CONTRACTOR shall include in his design calculations for temporary support systems a reliable estimate of the expected settlement of each existing structure affected.

In all cases where for any reason (e.g. due to the close proximity of the excavation to an existing structure, the conditions of the soil, changes in ground water level due to de-watering, etc.) the displacement of any part of a temporary support system of an excavation could cause movement or settlement of an existing structure, the CONTRACTOR shall provide and monitor adequate reference marks and instrumentation for controlling and recording all movements which could affect the structure.

Should the movement of any part of a temporary support system of an excavation or of any existing structure exceed the amount of movement or settlement estimated for that particular stage of the excavation work, the work shall be discontinued and the OWNER'S REPRESENTATIVE shall be notified immediately. In such cases the CONTRACTOR shall carry out to the approval of the OWNER'S REPRESENTATIVE all measures necessary to prevent further movement or settlement.

The methods used for constructing temporary support systems and for excavating in close proximity of an existing structure shall be compatible with the condition and use of the concerned structure. No equipment shall be used which could cause damage to the structure, for example due to static loading, vibration or shock waves.

Equipment used close to occupied building shall be of a type which causes the least disturbance to the occupants in respect of noise, vibration, shock waves, dust and mud.

Where necessary, walkways, building entrances and façades shall be protected adequately from damage or soiling from debris, dust or alike.

3.2.4. Excavations to be kept free from water

The CONTRACTOR shall keep all excavations quite free from water, whether affected by floods, storms or otherwise, so that the works may be constructed in dry conditions. He shall construct, as may be required by the OWNER'S REPRESENTATIVE, grips or channels or sub-drains at levels lower than the bottom of the permanent works to convey the water to sumps which he shall construct in positions convenient for the disposal of the liquid drained thereto. The grips, channels, sub-drains and sumps shall, where possible, be constructed clear of the permanent works and shall be filled as the permanent work proceeds to the satisfaction of, and as may be ordered by, the OWNER'S REPRESENTATIVE.

The sub-drains shall be formed with pipes of adequate diameter. Trenches shall be excavated to the minimum width capable of accommodating the pipes, their inverts shall be graded to outfall and approval clay tile pipes shall be laid open-jointed in the trenches which shall then be backfilled carefully with granular filter material. The grading of the filter material used in the sub-drain shall, where necessary, be such that the ground below foundation level is in no way weakened by the washing out of any of its finer particles. Where sub-drains are located directly below any part of the permanent concrete works, the trenches shall, immediately before the construction of the permanent work is started, be covered with approved waterproof sheets which shall lap both sides of such trenches by at least 150 mm.

The CONTRACTOR shall also provide, fix, maintain and work such engines, pumps, hoses, chutes and other appliances as are necessary to keep the sub-soil or accumulated water at a level 300 mm lower than the bottom of the permanent works (or at a lower level as the OWNER'S REPRESENTATIVE may direct) for such periods as the OWNER'S REPRESENTATIVE shall direct. After raising the water herein referred to, the CONTRACTOR shall immediately convey it away from the Works. When practical the water shall be discharged into the permanent outfall for the pipe drainage system.

Foundation pits and trenches shall be kept free from water during the time that excavation is being carried out and until, according to the OWNER'S REPRESENTATIVE, any concrete therein is sufficiently set and all constructional works therein can suffer no damage from flooding, hydrostatic pressure, flotation or other cause. They shall be kept free from water during the period that backfilling is being carried out.

Precautions shall be taken to prevent piping uplift of the bottom of excavations either by the use of cut-off walling or sheeting by lowering the water table or by other means and all such precautions shall, prior to adoption, be subject to the approval of the OWNER'S REPRESENTATIVE.

The CONTRACTOR shall take care to avoid undermining any part of the Works or other properties by pumping, but should the undermining or other damage occur due to prolonged or excessive pumping he shall immediately make good this at his own expense, to the satisfaction of the OWNER'S REPRESENTATIVE.

3.2.5. Backfilling and compacting of foundation pits and trenches

Backfilling of Foundation Pits and Trenches

Backfilling of foundation pits and trenches shall be carried out as soon as the foundations and structural works therein have acquired adequate strength as specified by the OWNER'S REPRESENTATIVE.

The timing and rate of placing backfill material around or upon any completed or partially completed structure shall be arranged in such a way that no part of the work is over-stressed, weakened, damaged or endangered. In particular the placing of backfill material against walls designed to be restrained by structural elements, located above or below finished ground level, shall not be started until such structural elements have been installed and, if made of concrete, have attained their full specified strength and have had their temporary supports removed.

Backfill material shall be placed in layers of uniform thickness and shall be brought up uniformly on all sides of the foundation or structure being backfilled. Each layer shall be so placed as to maintain adequate drainage and to prevent accumulation of water.

Timber sheeting and other excavation supports shall be removed carefully as the filling proceeds except as otherwise specified or ordered, but the removal of such supports will not relieve the CONTRACTOR of his responsibility for the stability of the works. No timber supporting member shall be left behind in pits or trenches. Care shall be taken to maintain the integrity of the sides of the excavation and to fill all spaces left by the withdrawn supporting members.

Compacting of Backfill Material

The backfill material shall be compacted in layers not exceeding 150 mm in depth when compacted, to a dry density not less than that obtaining in the adjacent undisturbed soil and not less than 95 % of the maximum dry density. Cohesive materials shall be compacted at a moisture content within 2 % of the optimum moisture content on the wet side.

Full compaction shall be achieved throughout every layer, up to the edges of the pits or trenches and up to the faces of the foundations or structural works therein.

- Unless other compacting equipment is required or agreed on, compaction shall be carried out by power rammers, vibrating plate compactors or lightweight vibratory rollers.
 - Power rammers are machines which are actuated by explosions in an internal combustion cylinder, each explosion being controlled manually by the operator.

- Vibrating plate compactors are machines having a base plate to which is attached a source of vibration consisting of one or two eccentrically-weighted shafts. Vibrating-plate compactors shall be operated at the frequency of vibration recommended by the manufacturer and shall normally be operated at travelling speeds of less than 15 m per minute.
- Vibratory rollers are self propelled or towed rollers having means of applying mechanical vibration to one or more rolls. Vibratory rollers shall be operated with their vibration mechanism operating only at the frequency of vibration recommended by the manufacturer.
- All such rollers shall be equipped with a device which indicates automatically the frequency at which the mechanism is operating.
- Compacting equipment or methods which transmit excessive pressure to foundations or structural works in the pits or trenches shall not be used.

3.2.6. Backfilling and compacting of trenches

Backfilling of Trenches

Backfill material shall be approved by the OWNER'S REPRESENTATIVE and shall be free from stones or lumps exceeding 40 mm in largest dimension, vegetable matter and other unsatisfactory material.

If the CONTRACTOR allows material which, on excavation is suitable for re-use, to become unsuitable and it is in this condition when required for backfilling, he shall make good by running it to spoil and replacing with other suitable material, or when directed by the OWNER'S REPRESENTATIVE, the moisture content of the material shall be adjusted before deposition in the trench, to facilitate compaction in the manner specified in this paragraph.




Backfilling shall wherever practical be undertaken immediately after the preceding specified operations have been completed, and the works have been inspected and approved by the OWNER'S REPRESENTATIVE, so as to reduce the lengths of trenches open at any one time.

When concrete beds, haunches or surrounds have been placed, compaction by mechanical means shall not be started until at least four days have elapsed from the time of placing of the last concrete.

Where no haunch or surround of concrete or surround of pipe bedding material is specified, backfill material shall be brought up equally on both sides of the pipe or duct, first to the level of the centre of the pipeline and then to a height of 300 mm above the top of the pipe barrel or duct. The backfill material shall be placed in layers, each of them not exceeding 150 mm in loose depth and each of them compacted carefully and thoroughly for the full width of the trench with hand tools not driven by an engine. During the placing of backfill material below the level of the top of the pipe barrel or duct, the backfill material shall be placed in layers on alternate sides of the pipe or duct so that at no time the difference in level between the top surfaces of the compacted material on either side of the pipe or duct shall be greater than 150 mm.

Where a surround of concrete or surround of pipe bedding material is specified, backfill material placed above the surround up to a height of 300 mm (or a greater height as may be shown on the drawings) above the top of the pipe barrel or duct shall be placed in layers, each of them not exceeding 150 mm in loose depth and each of them compacted carefully and thoroughly for the full width of the trench with hand tools not driven by an engine.

Where, in wide trenches, backfilling is necessary at the sides of a haunch or surround of concrete or a surround of pipe bedding material as well as above them, the backfill material placed at the sides of, and above, the haunch or surround up to a height of 300 mm (or a greater height as may be shown on the drawings) above the top of the pipe barrel or duct shall be placed in layers each of them not exceeding 150

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mm in loose depth and each of them compacted carefully and thoroughly for the full width of the trench with hand tools not driven by an engine. During the placing of backfill material below the level of the top of the pipe barrel or duct (where the pipe or duct is haunched) or below the level of the top of the surround the backfill material shall be placed in layers on alternate sides of the pipe, duct or surround so that at no time the difference in level between the top surfaces of the compacted material on either side of the pipe, duct or surround shall be greater than 150 mm.

In no case, the backfill material shall be thrown directly on to exposed pipes or ducts.

Care shall be taken not to disturb the pipes, ducts, haunch or surround during the placing and compacting of the backfill material.

The backfill material placed above the upper level of material compacted by hand specified in the preceding paragraphs shall be deposited in layers each of them not exceeding 150 mm in depth when compacted and each of them compacted in a way as specified in this paragraph.

Timber sheeting and other excavation supports shall be removed carefully as the filling proceeds except as otherwise specified or ordered, but the removal of such supports will not relieve the CONTRACTOR of his responsibility for the stability of the works. No timber supporting members shall be left behind in trenches. Care shall be taken to keep the sides of the trench solid and to fill all spaces left by the withdrawn supporting members.

Regardless of the method of compaction, no traffic or heavy loads shall be allowed over the backfilled surface until the four days for setting of the last concrete have elapsed.


Compacting of Backfill Material

The backfill material shall be compacted in accordance with the requirements of paragraph 3.2.5 of this SPECIFICATION.

3.3. Field Quality Control

Tests of compacted backfill material will be made as often as the OWNER’S REPRESENTATIVE shall deem necessary to ensure compliance with the requirements of this SPECIFICATION.

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FALSE CEILING, FALSE FLOORING, UNDERDECK INSULATION
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1. FALSE CEILING GRID SYSTEMS**1.1. Galvanised Steel Grid System**

Galvanised Steel grid system shall be erected for the purpose of supporting Mineral fibre false ceiling tiles.

1.1.1. Material**a. Main Runner**

Main runner shall be of hot dipped galvanised steel and 'T' shaped of 24 mm x 38 mm size and 0.33 mm thickness with double rotary stitching.

b. Cross Runner

Cross runner shall be of hot dipped galvanised steel and 'T' shaped of 24 mm x 30 mm size, 0.25 mm thickness, 1200 mm long and 24 mm x 25 mm size, 0.25 mm thickness, 600 mm long with double rotary stitching.

c. Perimeter Section

Material shall be same as runners. Sections shall be 22 mm x 22 mm size of 0.45 mm thickness. Exposed areas of all the metallic members shall be powder coated (25 micron).

1.1.2. Erection

Main Runners shall be placed at the spacing of maximum 1200 mm c/c. Cross runners shall be fixed @ maximum 600 mm c/c to obtain a grid of 600 mm x 600 mm.

The grid shall be suspended by means of 4 mm dia MS wire, 6 mm thick MS cleat of 25 mm x 25 mm section, dash fasteners and level adjusters.

The overall grid system shall be rigid by self locking joints, in accordance with false ceiling patterns, perfectly levelled and aligned at desirable height as per drawings.

1.2. Aluminium Grid System

Aluminium grid system for supporting false ceiling tiles shall be of approved make and shall be perfectly levelled, aligned at desired height and in accordance with the false ceiling pattern as per drawings.

1.2.1. Material**a) Main Runner**

Main runner shall be of extruded anodised (25 micron) aluminium Tee Sections of 25 mm x 35 mm size (approved make), 2.5 mm thick

b) Cross Runner

Cross runner shall be of extruded anodised (25 micron) aluminium Tee Sections of 25 mm x 25 mm size (approved make), 2.5 mm thick.

c) Perimeter Section

Material shall be of extruded anodised (25 micron) aluminium angle Sections of required size.

1.2.2. Erection

The grid system shall be assembled by interlocking the main and cross runners @ 600 mm maximum bothways by means of Aluminium angle cleats. The main runners shall be suspended from the ceiling by means of 3 mm thick MS flat clamp fixed to main runner @ 1200 mm maximum and fixed to 6 mm dia MS hook which again is fixed to the ceiling. 3 mm thick MS flat clamp shall be connected to main runner with 25 mm long MS clamp with levelling nut and @ 1200 mm maximum. The MS hooks shall be suspended from the ceiling by means of slotting in 25 mm x 25 mm hooks shall be suspended from the ceiling by means of slotting in 25 mm and 25 mm x 3 mm thick MS angle, fixed to the slab by 12 mm dia Dash fasteners @ 1200 mm c/c.

The overall grid system shall be rigid, in accordance with false ceiling pattern, perfectly levelled and aligned at desirable height.

1.3. GI Grid System

1.3.1. Material and Workmanship

a) Wall Channels

Wall channels shall be made of 0.5 mm thick GI of size 27 mm, one flange 20 mm and the other 30 mm. Wall channels shall be fixed to peripheral walls by rawl plugs/dash fasteners @ 450 mm c/c.

b) Intermediate Channels (main runners)

GI intermediate channels shall be 0.9 mm thick, of size 45 mm and with two flanges of 15 mm each. The intermediate channels shall be suspended from the ceiling @ 1200 mm with 25 mm x 0.5 mm GI hanger bolted to the channel and fixed to the ceiling (by means of bolting to GI cleat fixed to the ceiling with dash fasteners).

c) Ceiling Sections (Cross runners)

GI channel shaped ceiling sections shall be 0.5 mm thick having a knurled Web of 51.1 mm and two flanges of 26 mm each with lips of 10.5 mm. The ceiling sections shall be fixed to the intermediate channels in perpendicular direction at 450 mm C/C with the help of connecting clips.

GI grid system for supporting false ceiling tiles shall be perfectly levelled, aligned at desired height in accordance with false ceiling pattern.

2. FALSE CEILING TILES

The tiles shall be placed in position over the supporting grid system by means of hold down clips at four corners of each tiles and one in Centre of each side. The finished false ceiling shall be perfectly levelled and aligned, at desired height as per drawings.

Necessary Electrical and Ac and other fixtures shall be provided as per drawing and in coordination with relevant construction activities.

2.1. Mineral Fibre Tiles

Mineral fibre false ceiling tiles shall be with durable tegular edging having NRC value of minimum 0.50, Light reflectance value of minimum 80%, K value of 0.052 to 0.057 w/m deg. C and fire performance conforming to class I as per BS:476. The tiles shall be of 600 mm x 600 mm x 15 mm size. The tiles shall have fissured or granulated texture on the front side as specified. Back side shall be provided with protective coating.

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2.2. Particle Board Tiles

Particle board tiles shall be made of teakwood particle board conforming to IS:3087 (3 layer flat pressed particle board bonded with BWP type phenol formaldehyde Synthetic resin as per IS:848, categorised as Class-I for ‘Surface of very low flame spread’ as per IS:1642, treated with antifungus chemicals).

The tiles shall either be painted or laminated as specified. Lamination shall be 0.5 mm thick and of approved quality, shade and texture fixed by hot press method and shall conform to BS:476, Part-7. The tiles shall be painted at the bottom surface (facing the floor) with two coats of approved colour acrylic emulsion paint (of approved make) after sanding off the surface with 120 grit sand paper and applying particle board primer. The other surfaces shall be painted with 2 coats of linseed oil varnish.

Tile sizes shall be 600 mm x 600 mm x 12 mm and all four edges of the tiles shall be painted with a coat of approved quality primer.

2.3. Gypsum Board Tiles

Gypsum board shall conform to IS:2095. The Gypsum boards used for false ceiling shall have following properties.

- a. Thermal Conductivity - 0.16 W/mk
- b. Thermal Resistance

- For 9.5 mm thick board - 0.06 Sq. MK/W
- For 12.5 mm thick board - 0.08 Sq. MK/W
- For 15 mm thick board - 0.09 Sq. MK/W

- c. Fire Propagation

- Fire Propagation

Index of performance - Not exceeding 12 and a sub index not exceeding

- Surface spread of flame - Class 1 (both sides) as per test to BS:476, Part-7)

Gypsum boards shall be of specified thickness, and of specified finish (painted with Plastic Emulsion Paint / Laminated with 0.5 mm thick lamination). The Gypsum board shall be screw fixed to the under side of false ceiling grid system with 12.5 mm dia dry wall screw @ 230 mm C/C by drilling machine, Joints in the board shall be finished flush with fillers, finisher and primer as per manufacturer’s recommendation to give a seamless finish.

These boards shall be of make Armstrong / Nittobo / Libsom or equivalent with necessary provision for electric fixtures, A.C. Ducts, Smoke Detectors etc.

3. UNDERDECK INSULATION

3.1. Material

Underdeck insulation shall be of phenolic foam rigid slab of 25 mm thickness and approximately 1000 mm x 500 mm size as specified and shall conform to IS:13204. It shall have density of 32 kg / M³ and K Value 0.016 Kcal/hr M²C as per BS:4370, Part-2. The insulation shall be classified as ‘Non Combustible’ as per BS:476, Part-5 and ‘Class 1’ for surface spread of flame as per BS:476, Part-7. It shall be prelaminated on both sides with kraft paper.

3.2. Workmanship

The entire soffit of slab and beams shall be thoroughly cleaned. Bituminous primer or zinc chromate primer shall be applied evenly @ 0.5 kg/m² over the entire surface. Hot bitumen or CPRX adhesive shall then be applied on the insulation panel @ 1.5 kg/Sq.M. The panels shall be pressed in position and further secured by dash fasteners.

The under deck insulation shall be fixed only after all fixtures like hooks, clamps, cleats etc. for light fixtures, ducts etc. have been fixed in the ceiling.

4. CAVITY (FALSE FLOORING (WITH METAL TRAY))**4.1. Material****4.1.1. Pedestal Base Plate**

Pedestal base plate shall be made of galvanised Mild steel and shall be of 100 mm x 100 mm size and 3 mm thick. It shall have stiffening folds as per drawing.

4.1.2. Pedestal Stud

Pedestal stud of 19 mm I.D. and 3 mm thickness shall be made of galvanised mild steel seamless pipe.

4.1.3. Top-Head Attachments

Top head attachments shall be made of pressure die cast aluminium alloy disc of 2.5 mm thickness, having channel shaped projects in al 4 directions and 4 pin heads on top as per drawing to receive panels. A fully threaded bright rod of 19 mm I.D. shall be fitted to underside of top head and inserted into base pipe stud.

4.1.4. Channel Stringers

Channel stringers shall be galvanised, machine cut, cold rolled mild steel channels of size 18.5 mm x 18.5 mm and 2.5 mm thickness.

4.1.5. MDF Board Floor Panels

Floor panels shall be of dense, homogeneous, medium density fibre boards manufactured from agro based lignocellulosic fibres conforming to IS:848, BWP type and categorised as Class-1 for 'Surfaces of very low flame spread' as per IS:1642. It shall be of 18 mm thickness and of size 610 mm x 610p mm in general.

The floor panels shall be fixed with screws onto MS bottom tray of 1.2 mm thickness die formed to shape as per drawing.

The floor panels shall be finished on top with antistatic type PVC tiles or laminate as specified and along four sides with hard PVC lipping as per drawing.

4.2. Workmanship

False flooring pattern shall be as per approved drawing. Pedestal base plates shall be fixed to the base floor by dash fasteners as per the grid.

The pedestal stud locations shall ensure the grid work as per flooring pattern which in general shall be of 610 mm x 610 mm dimension. The length of the pedestal studs shall be such that clear cavity between false flooring and base flooring is of desired depth.

The threaded bright rod with the top head attachments shall be inserted into the studs and shall be adjusted to obtain proper level of the finished floor panels by means of the adjustment nuts.

Stringer channels then shall be fitted onto the top heads in position to form the supporting grid work for the floor panels checking the level once again by adjusting the nut position if necessary. Now the check nut shall be finally tightened to secure the final level. Floor panels as specified shall be placed over the stringer channels and top head disc in such a manner that the holes in MS tray fit into the pin heads on discs.

Each floor panel shall be marked with positional numbering on the underneath. The finished floor panels shall be perfectly levelled, aligned without any gaps in between the panels.

Each individual panel shall be removable for the purpose of maintenance of the cavity.

Necessary cut-outs shall be made in the panels for cable routing, control panel fixation etc. as per drawing. Necessary ramps, slopes, steps etc. shall be also provided for as per drawing.

Around a control panel/rack, the residual space left out shall be filled up with cut panels of uniform size as required to fully close the gap between the adjacent full panel and the control panel base channel. In this case the part floor panel shall extend upto the full width of the base channel and the cut size shall be determined accordingly. An additional row of jack pedestals shall be provided along the cut out on which the edge of the floor panel shall rest and over which the base channel of control panel shall be placed. It shall not directly rest on the jack head pedestal or grid channels.

The cavity between false flooring and base floor shall be properly cleaned and made dust free. The floor shall be finally coated with polyurethane based coating. The finished false flooring shall be able to serve for a distributed load of 1250 kg/Sq.M.

5. CAVITY (FALSE FLOORING (WITH PARTICLE BOARD))

5.1. Material

5.1.1. Pedestal Base Plate

Pedestal base plate shall be made of galvanised Mild steel and shall be of 100 mm x 100 mm size and 8 mm thick.

5.1.2. Pedestal Stud

Pedestal stud of 30 mm dia shall be made of galvanised mild steel seamless pipe. The stud shall have threadings at top and bottom for attaching the top head attachment and fixing to base plate.

5.1.3. Top-Head Attachments

Top head attachments shall be made of pressure die cast aluminium alloy of shape and thickness as per drawing. The top head attachment shall be provided with check nuts at bottom portion for attaching the top head threadings in the stud allowing for adjustment upto 25 mm up and down.

5.1.4. Channel Stringers

Channel stringers shall be galvanised, machine cut, cold rolled mild steel channels of size 40 mm x 40 mm and 3.15 mm thickness.

5.1.5. Particle Board Floor Panels

Floor panels shall be of unveneered, 3 layer flat pressed, teakwood particle board conforming to IS:3087 bonded with BWP type phenol formaldehyde synthetic resin conforming to IS:848 and categorised as Class-1 for 'Surfaces of very low flame spread' as per IS:1642. It shall be of 35 mm thickness and of size 610 mm x 610 mm in general.

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The floor panels shall be finished on the underneath side with 0.05 mm thick Aluminium foil turned up and extended by minimum 12 mm along the perimeter.

The floor panels shall be finished on top with antistatic type PVC tiles or high pressure laminate as specified and along four sides with hard PVC lipping as per drawing.

12 mm x 12 mm x 75 mm long, 2 mm thick Aluminium channel cleats shall be provided on middle of four sides of the panels for lateral stability.

5.2. Workmanship

False flooring pattern shall be as per approved drawing. Pedestal base plates shall be fixed to the base floor by 6 mm dia, 40 mm long dash fasteners as per the grid.

The pedestal stud locations shall ensure the grid work as per flooring pattern which in general shall be of 610 mm x 610 mm dimension. The length of the pedestal studs shall be such that clear cavity between false flooring and base flooring is of desired depth.

The top head attachments shall be inserted into the studs and shall be adjusted to obtain proper level of the finished floor panels by means of the adjustment nuts.

Stringer channels then shall be fitted onto the top heads in position to form the supporting grid work for the floor panels checking the level once again by adjusting the nut position if necessary. Now the check nut shall be finally tightened to secure the final level. Floor panels as specified shall be placed over the stringer channels.

Each floor panel shall be marked with positional numbering on the underneath. The finished floor panels shall be perfectly levelled, aligned without any gaps in between the panels.

Each individual panel shall be removable for the purpose of maintenance of the cavity.

Necessary cut-outs shall be made in the panels for cable routing, control panel fixation etc. as per drawing.

Necessary ramps, slopes, steps etc. shall be also provided for as per drawing. Around a control panel/rack, the residual space left out shall be filled up with cut panels of uniform size channel. In this case the part floor panel shall extend upto the full width of the base channel and the cut size shall be determined accordingly. An additional row of jack pedestals shall be provided along the cut out on which the edge of the floor panel shall rest and over which the base channel of control panel shall be placed. It shall not directly rest on the jack head pedestal or grid channels.

The cavity between false flooring and base floor shall be properly cleaned and made dust free. The floor shall be finally coated with polyurethane based coating. The finished false flooring shall be able to serve for a distributed load of 1250 kg/Sq.M.

6. PARTITIONING AND PANELLING

6.1. MS Frame

MS frame for Partitioning and Panelling shall consist of horizontal and vertical members of 18 SWG 52 mm x 38 mm MS sections. The members shall be welded to each other at maximum 600 mm c/c both ways. The frame shall be fixed to the floor/ceiling/wall with GI roullete plug, screw and washers and 300 mm maximum c/c. The members shall be provided with one coat of red oxide zinc chromate primer.

The frame-work arrangement shall be in accordance with the pattern for partition including doors/windows etc.

6.2. Gypsum Board for Partitioning and Panelling

Gypsum boards for partitioning and panelling shall be 12.5 mm thick and same as specified in clause no. 2.3.

Number of Gypsum board layers (single skin or double skin) shall be as specified and with finishing (painting or lamination) as specified.

Frame work along the edges shall be concealed with partition/panel boards. Necessary cutouts for electrical, AC, return air etc. and other fixtures shall be provided in the boards. Glazing if any shall be fixed with putty and wooden beadings.

6.3. Laminated Particle Board for Partitioning and Panelling

Particle board for partitioning/panelling shall be 12 mm thick and shall be same as in clause no. 2.2.

Number of Particle board layers (single sin or double skin) shall be as specified and with finishing (painting or lamination) as specified.

Frame work along the edges shall be concealed with partition/panel boards. Necessary cutouts for electrical, Ac, return air etc. and other fixtures shall be provided in the boards. Glazing if any shall be fixed with putty and wooden beadings.

7. MEASUREMENT AND RATES

For item rate tenders, False ceiling/flooring, Insulation, Partition, Panelling shall be measured in Sq.M. correct upto two places of decimal. Dimensions shall be measured correct upto 0.01M.

No deduction shall be done for cut outs for fixtures, cables, etc. upto 0.18 Sq. M. in area. No extra shall be paid for providing such cutouts.

Rate for item rate tenders shall include all materials, labour, transport, conveyance, erection, storage, other incidental expenditures involved in carrying out the items.

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FLOOR FINISHING

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1.0 GENERAL

Reference shall be made to the following Indian Standards for any further information etc. not covered in the specification. In case of any conflict/contradiction, provision of this specification shall override.

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| IS:4971 | Recommendations for selection of Industrial floor finishes. |
| IS:2114 | Code of practice for laying in situ terrazzo floor finish. |
| IS:1237 | Specification for Cement concrete flooring tiles. |
| IS:777 | Specification for glazed earthenware wall tiles. |
| IS:2571 | Code of practice for laying in situ cement concrete flooring. |
| IS:4631 | Code of practice for laying of epoxy resin floor toppings. |
| IS:3462 | Code of practice for unbaked flexible PVC flooring. |
| IS:5318 | Code of practice for laying of flexible PVC sheet and tile flooring. |
| IS:3461 | Specification for PVC asbestos floor tiles. |
| IS:1443 | Code of practice for laying in situ granolithic concrete floor topping. |
| IS:5491 | Code of practice for laying in situ granolithic concrete floor topping. |
| IS:4441 | Code of practice for use of silicate type Chemical resistance mortars. |
| IS:4443 | Code of practice for use of resin type chemical resistant mortar. |
| IS:1196 | Code of practice for laying Bitumen Mastic flooring. |

2.0 CEMENT CONCRETE FLOORING

2.1. Workmanship

2.1.1. Sub-base

The sub-base which shall be laid on the prepared bed shall be of specified thickness and as per structural drawings and specifications.

The sub-base shall be of boulders/gravel/broken bricks/sand/cement concrete as per drawings. In case of upper floors, the structural RCC slab shall be treated as sub-base.

2.1.2. Base Course

Base course shall be 25 mm thick M-15 grade concrete and shall generally conform to Civil structural specification.

The floor space on which base course is to be laid shall be divided into square/rectangular or as per designed panels to prevent cracks in the floor finish. No dimensions of the panels shall exceed 2M and length of the panel shall not exceed 1.5 times its breadth. Base course shall be laid on alternate panels. The borders of the panels shall have mitred joints at the corners of the room and intermediate joints shall be in straight line with panel joints.

The panels shall be bound by glass/PVC/stainless steel strips etc. as specified. These shall be fixed in position with their top at proper level, giving slope wherever required.

The flooring shall butt against masonry of wall which shall not be plastered. When the base course is to be laid on hardened base, the sub-base shall be roughened by steel wire brushing and cleaned. Before laying the base course, neat cement slurry @ 2.75 kg of cement per Sq. M. of area shall be brushed into the prepared sub base surface.

Cement concrete shall be placed in position and beaten with trowel and finished smooth. Beating shall cease as soon as surface is found covered with cream of mortar. Necessary slope shall be provided.

2.1.3. Floor Finishing

Finishing of the surface shall follow immediately after the completion of base course. The base course shall be free of excessive moisture before starting the floor finishing. Use of dry cement, cement sand mixture sprinkled on the surface to stiffen the concrete or absorb excessive moisture shall not be permitted.

While the concrete is still green, cement @ 2.75 kg per Sq.M. of floor area shall be mixed with water to form a thick slurry and spread over the surface. It shall be pressed twice by means of iron floats, once when the slurry is applied and second time when the cement starts setting.

The junction of floor with wall plaster, cladding, skirting shall be rounded off uniformly upto a radius of 25 mm unless otherwise mentioned.

2.1.4. Curing

Each finished portion of floor, on completion shall be kept wet with ponding for a minimum period of 7 days.

3.0 CEMENT CONCRETE GRANOLITHIC FLOORING

3.1. General

Cement concrete granolithic flooring shall consist of a sub-base, a base course and finishing layer of floor finish. Workmanship shall in general be same as for cement concrete flooring, unless otherwise mentioned.

3.2. Workmanship

Workmanship shall in general conform to IS:5491.

3.2.1. Sub-base

The sub-base which shall be laid on the prepared bed shall be of specified thickness and as per structural drawings and specifications.

The sub-base shall be of boulders/gravel/broken bricks/sand/cement concrete as per drawings. In case of upper floors, the structural RCC slab shall be treated as sub-base.

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3.2.2. Base Course (Under Layer)

Base course shall be M-15 grade concrete and shall generally conform to Civil Structural Specification.

The floor space on which base course is to be laid shall be divided into square/ rectangular or as per designed panels to prevent cracks in the floor finish. No dimension of the panels shall exceed 2M and length of the panel shall not exceed 1.5 times its breadth. Base course shall be laid on alternate panels. The borders of the panels shall have mitred joints at the corners of the room and intermediate joints shall be in straight line with panel joints.

The panels shall be bound by glass/PVC/stainless steel strips etc. as specified. These shall be fixed in position with their top at proper level, giving slope wherever required.

The flooring shall butt against masonry of wall which shall not be plastered.

When the base course is to be laid on hardened base, the sub-base shall be roughened by steel wire brushing and cleaned. Before laying the base course, neat cement slurry @ 2.75 kg of cement per Sq.M. of area shall be brushed into the prepared sub base surface.

Cement concrete shall be placed in position and beaten with trowel and finished smooth. Beating shall cease as soon as surface is found covered with cream of mortar. Necessary slope shall be provided.

Thickness of base course shall be as follows for different thickness of floorings:

- 40 mm thick flooring = 25 mm thick
- 50 mm thick flooring = 35 mm thick

3.2.3. Wearing Top Layer

The top layer shall be laid over first layer within 15 minutes of laying the first layer. The cement and aggregates for the top layer shall be mixed dry. After mixing, sufficient quantity of washed sand and water shall be added to make the mix plastic but not flowing. The top and bottom layer shall firmly grip together.

3.2.4. Floor Finishing

Finishing of the surface shall follow immediately after the completion of base course. The base course shall be free of excessive moisture before starting the floor finishing. Use of dry cement, cement sand mixture sprinkled on the surface to stiffen the concrete or absorb excessive moisture shall not be permitted.

While the concrete is still green, cement @ 2.75 kg per Sq.M. of floor area shall be mixed with water to form a thick slurry and spread over the surface. It shall be pressed twice by means of iron floats, once when the slurry is applied and second time when the cement starts settings.

The junction of floor with wall plaster, cladding, skirting shall be rounded off uniformly upto a radius of 25 mm unless otherwise mentioned.

3.2.5. Curing

Each finished portion of floor, on completion shall be kept wet with ponding for a minimum period of 7 days.

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4.0 HEAVY DUTY FLOORING

4.1. General

Heavy duty flooring shall consist of a sub-base, a base course and a finishing layer of floor finish.

4.2. Workmanship

4.2.1. Sub-base

The sub-base which shall be laid on the prepared bed shall be of specified thickness and as per structural drawings and specifications.

The sub-base shall be of boulders/gravel/broken bricks/sand/cement concrete as per drawings. In case of upper floors, the structural RCC slab shall be treated as sub-base.

4.2.2. Base Course

Base course shall consist of one layer of 35 mm thick cement concrete (1 cement : 1.5 Coarse sand : 3.5 stone aggregates of 10 mm to 6 mm size by volume) laid on sub-base in panels in accordance with clause no. 2.2.2.

4.2.3. Floor Finish

Finishing layer shall be of cement, hardener and stone aggregate mix of 15 mm thickness laid over the base course. Unless otherwise mentioned, one part of approved quality hardener and four parts of cement by weight shall be mixed dry. They dry mixture shall be mixed with stone grit of 6 mm and down size in the ratio of 1 hardener and cement mixture : 2 stone grit by volume. Just enough water shall then be added to the mix.

The mixture so obtained shall then be laid on the base course within 2 to 4 hours of latter's laying. It shall be firmly pressed into bottom concrete so as to have a good bond with it. After the starting of initial setting, the surface shall be finished smooth and true with steel floats.

5.0 PRECAST HYDRAULICALLY PRESSED CEMENT TILES

5.1. Materials

5.1.1. Cement Concrete Tiles

Cement concrete tiles shall conform to IS:1237 and shall be of approved shade, with 10 mm down size stone aggregates and using a 1:6 or as directed mixture of white and ordinary cement and shall be of 20 mm thickness and approved shade.

5.1.2. Pigments

Pigments to be admixed with mortar or for grouting the joints shall conform to Table-1 of IS:2114.

5.1.3. Cement Mortar

Cement mortar shall be in accordance with civil structural specification and following schedule.

- For flooring : 20 mm thick, cement mortar (1 cement : 4 coarse sand by volume)
- For skirting/dado/riser : 12 mm thick, cement mortar (1 cement : 3 coarse sand by volume).

5.2. Workmanship

Workmanship shall in general conform to IS:1443. The base on which tiles are to be laid shall be cleaned of all dust, dirt and properly wetted by applying neat cement slurry @ 2.75 kg. Of cement per Sq.M. of area without allowing water pools. Cement mortar of specified thickness shall then be spread over the base for two rows of tiles and 3-5 metres in length. The mortar shall be laid in slope as per requirements and thickness of mortar shall not be less than 10 mm at any place. The top of the mortar shall be kept rough so that cement slurry can be absorbed. Laying shall be from centre and proceed outwards in two directions at 90°. Cut tiles of uniform sizes shall be laid along periphery, if necessary. Neat cement slurry @ 2.75 kg. Of cement per Sq.M. shall be spread over the mortar bed for laying 20 tiles at a time. The tile shall then be fixed in this grout one after the other, each tile being gently tapped and properly bedded in line and level. The Joints shall not exceed 1.5 mm in width. After the day's work, the excess cement slurry on top and the joints shall be cleaned with broom stick and washed before the slurry sets hard. Next day, the joints shall be filled with the cement grout to match the shade of the tile.

Tiles along the periphery shall be continued by average 12 mm under the wall plaster, skirting or dado.

For skirting/dado/risers on the brick masonry wall, the joints shall be raked out to a depth of at least 15 mm while the masonry is being laid. In case of concrete work, the surface shall be hauled and roughened with wire brushes. The wall surface shall be uniformly and evenly covered with backing of cement mortar 1:3 (1 cement : 3 coarse sand by volume) of specified thickness. Before hardening of the cushioning mortar, back of each tile shall be covered with a neat layer of cement slurry @ 4.4 kg of cement per Sq.M. and edges with white cement with or without pigment to match the shade of tiles and the tiles then shall be pressed on the backing and tapped.

The tiles shall be corrected to proper planes with joints truly vertical in required pattern and butt jointed. The fixing shall be done from bottom upward. The top of skirting and dado shall be truly horizontal.

5.3. Curing

The flooring shall be cured for 7 days by keeping it wet with ponding. Heavy traffic on the flooring shall be permitted only after 14 days.

5.4. Grinding and Polishing

Grinding shall be commenced after 14 days when the tiles and the joints are properly set. Grinding shall be done by machines except for skirting and small areas. First grinding shall be done with carborundum stones of 48 to 60 grade grit fitted in the machine. Water shall be properly used during grinding. When the chips show up and the floor has been uniformly rubbed, it shall be cleaned with water baring all pin holes. It shall then be covered with a thin coat of grey/white cement mixed with pigments to match with colour of the flooring. This grout shall be kept moist for a week. Thereafter the second grinding shall be started with carborundum stone of 120 grit. Grinding and curing shall follow again. Final grinding shall be with carborundum of grade 220 to 350 grit using water in abundance. The floor shall be washed clean with water, oxalic acid powder shall then be dusted at 35 gms./sq.m. on the surface rubbed with machine fitted hessian bobs or rubbed hard with woollen rags. The floor shall then be washed clean and dried with a soft cloth or linen. If any tile is disturbed or damaged, it shall be refitted or replaced and properly jointed and polished.

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6.0 CEMENT PLASTER SKIRTING

6.1. Material

Cement plaster skirting shall be laid with cement mortar (1 cement : 3 coarse sand by volume) as per clause no. 5.1.3 and shall be of specified thickness (6 mm / 12 mm / 18 mm) as per item description.

6.2. Workmanship

The surface on which the skirting is to be applied shall be prepared and skirting of specified thickness shall be laid. The junction between flooring and wall shall be rounded off to a radius of 25 mm if not otherwise mentioned.

While the mortar is still green, cement @ 2.75 kg per square metre shall be mixed with water to form a thick slurry and applied over the mortar. It shall be pressed twice by means of iron floats, once when the slurry is applied and second time when the cement starts setting.

7.0 CAST IN-SITU TERRAZZO FINISH

7.1. Materials

7.1.1. Base Course (Under Layer)

Base Course for Cast-in-Situ terrazzo flooring shall be 25 mm thick cement concrete (1 cement : 2 coarse sand : 4 stone aggregate, 10 mm nominal size by volume).

In case of vertical surfaces, the base course shall be 13 mm thick cement mortar (1 cement : 3 coarse sand by volume).

7.1.2. Aggregates for terrazzo topping

The aggregate to be used in topping shall be marble chips of plain White/Pink Makrana/ Baroda green etc. all grade-1 as specified which shall be of 10 mm nominal size. Marble powder to be used to terrazzo topping shall pass through IS Sieve Terrazzo. Marble chips shall be hard, sound, dense and homogenous in texture with crystalline and coarse grains. It shall be uniform in colour and free from stains, cracks, decay and weathering. All proportions of materials used should be as directed by the Owner's Representative / as specified.

7.1.3. Pigments

Pigments to be used in terrazzo shall be permanent colour and shall conform to IS:2114, Table-1.

7.2. Workmanship

Workmanship shall in general conform to IS:2114. Terrazzo flooring shall be of specified thickness and shall be laid in two layers and in panels. Under layer or base course shall be of cement concrete laid over sub base and top layer shall be of terrazzo floor finish. Details of panels shall as per drawing. The thickness of Terrazzo finish shall be 15 mm.

Top layer shall consist of mix of white cement, marble powder, marble chips, water and pigments. Cement and marble powder mix proportion shall be 3:1 by weight. Cement, marble powder mix shall be mixed with marble chips in the proportion of 4:7 by volume. Quality and shade of chips and powder shall be as specified with a view to avoid variation in colour. Sufficient quantity of white cement shall be added in the cement mix to obtain the desired shade. Mixing shall be done in a trough or tub and complete quantities of white cement and pigment for a particular unit of job shall be dry mixed with aggregates. Water shall be added in small quantities to this dry mix to get a proper consistency. The mix shall be plastic but not so wet as to flow. The mix shall be used within 30 minutes of its preparation.

The base course/under layer shall be divided in panels with dividing strips (glass/PVC/ stainless steel strips) upto the finished surface levels in accordance with clause no. 2.2.2. The sub-base shall be cleaned of all dust, dirt or any loose material. It shall then be wetted with water, mopped and smeared with neat cement slurry.

Terrazzo topping shall be laid while the under layer is still plastic but has hardened enough which is normally achieved between 18-24 hours after laying the under layer. A cement slurry @ 2.75 kg of cement per Sq.M. of area pigmented with the same colour as the topping be brushed on the surface immediately before laying the topping. The terrazzo mix shall be laid to a uniform thickness and be compacted thoroughly by tamping or rolling and trowelled and brought true to required level by a straight edge and steel floats so that the maximum amount of marble chips come up and spreaded uniformly over the surface and no part of the surface is left without the chips.

7.3. Curing

The surface shall be left dry for air curing for a period of 12-18 hours. Thereafter water shall be allowed to stand overnight in pools for a period of minimum four days.

7.4. Grinding and Finishing

Grinding and polishing shall be done with machines and shall start after 7 days of laying. First grinding shall be done with carborundum stone of 60 grit size. The surface shall then be washed clean and grouted with a grout of cement and/or colouring matter in same mix and proportion as the topping in order to fill any pin holes that appear. It shall then be allowed to dry for 24 hours and wet cured in the same manner as in clause no. 5.3. The second grinding shall be done with carborundum stone of 80 grit size. The surface shall then be prepared as after first grinding.

The third grinding shall be done with carborundum stone of 120 to 150 grit size. The surface shall then be prepared again as after first grinding.

The fourth grinding shall be done with carborundum stone of 320 to 400 grit size. The surface shall then be washed clean and rubbed hard with felt and slightly moistened oxalic acid powder @ 35 gms. Per square metre of floor surface. After the finishing works are over, the surface shall be washed with dilute oxalic acid solution and dried. Floor polishing machine fitted with felt on hessian bobs shall then be run over it until the floor shines.

In case of polishing, wax polish shall be applied on the surface with the help of soft linen over a clean and dry surface. Then the polishing machine fitted with bobs shall be run over it. Clean saw dust shall be spread over the floor surface and polishing machine again operated to remove excess wax.

Cast-in-Site Terrazzo in skirting, dado and risers shall be of specified thickness and of same shade as that of the flooring.

Underlayer for terrazzo on vertical surfaces shall be of stiff cement mortar 1:3 (1 cement : 3 coarse sand by volume) finished rough so as to give a good bond to the topping. Terrazzo topping shall be average 12 mm thick and under layer shall be 13 mm thick. Terrazzo topping shall be laid on the under layer in accordance with clause no. 7.2. Other details shall be same as for flooring excepting grinding which shall be manual and panels dividers are required.

8.0 PRECAST HYDRAULICALLY PRESSED TERRAZZO TILES

8.1. Materials

8.1.1. Terrazzo Tiles

Terrazzo tiles shall be of specified thickness and shade and shall generally conform in all respects to IS:1237. The tiles shall be made with 10 mm down size stone aggregates, white and ordinary cement mix (1 white cement : 6 ordinary cement by volume) and pigments conforming to IS:2114, Table-1.

8.1.2. Pigments

Pigments to be admixed with mortar or for grouting the joints shall conform to Table-1 of IS:2114.

8.1.3. Cement Mortar

Cement mortar shall be in accordance with civil structural specification and following schedule.

- For flooring - 20 mm thick cement mortar (1 cement : 4 coarse sand by volume)
- For skirting/dado/riser - 12 mm thick cement mortar (1 cement : 3 coarse sand by volume).

8.2. Workmanship

Workmanship shall in general conform to IS:1443. The base on which tiles are to be laid shall be cleaned of all dust, dirt and properly wetted by applying neat cement slurry @ 2.75 kg. Of cement per Sq.M. of area without allowing water pools. Cement mortar of specified thickness shall then be spread over the base for two rows of tiles and 3-5 metres in length. The mortar shall be laid in slope as per requirements and thickness of mortar shall not be less than 10 mm at any place. The top of the mortar shall be kept rough so that cement slurry can be absorbed. Laying shall be from centre and proceed outwards in two directions at 90°. Cut tiles of uniform sizes shall be laid along periphery, if necessary. Neat cement slurry @ 4.4 kg. Of cement per Sq.M. shall be spread over the mortar bed for laying 20 tiles at a time. The tiles shall then be fixed in this grout one after the other, each tile being gently tapped and properly bedded in line and level. The Joints shall not exceed 1.5 mm in width. After the day's work, the excess cement slurry on top and the joints shall be cleaned with broom stick and washed before the slurry sets hard. Next day, the joints shall be filled with the cement grout to match the shade of the tile.

Tiles along the periphery shall be continued by average 12 mm under the wall plaster, skirting or dado.

For skirting/dado/risers on the brick masonry wall, the joints shall be raked out to a depth of at least 15 mm while the masonry is being laid. In case of concrete work, the surface shall be hauled and roughened with wire brushes. The wall surface shall be uniformly and evenly covered with backing of cement mortar 1:3 (1 cement : 3 coarse sand by volume) of specified thickness. Before hardening of the cushioning mortar, back of each tile shall be covered with a neat layer of cement slurry @ 4.4 kg of cement per Sq.M. and edges with white cement with or without pigment to match the shade of tiles and the tiles then shall be pressed on the backing and tapped.

The tiles shall be corrected to proper planes with joints truly vertical in required pattern and butt jointed. The fixing shall be done from bottom upward. The top of skirting and dado shall be truly horizontal.

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8.3. Curing

The flooring shall be cured for 7 days by keeping it wet with ponding. Heavy traffic on the flooring shall be permitted only after 14 days.

8.4. Grinding and Polishing

Grinding shall be commenced after 14 days when the tiles and the joints are properly set. Grinding shall be done by machines except for skirting and small areas. First grinding shall be done with carborundum stones of 48 to 60 grade grit fitted in the machine. Water shall be properly used during grinding. When the chips show up and the floor has been uniformly rubbed, it shall be cleaned with water baring all pin holes. It shall then be covered with a thin coat of grey/white cement mixed with pigments to match with colour of the flooring. This grout shall be kept moist for a week. Thereafter the second grinding shall be started with carborundum stone of 120 grit. Grinding and curing shall follow again. Final grinding shall be with carborundum of grade 220 to 350 grit using water in abundance. The floor shall be washed clean with water, oxalic acid powder shall then be dusted at 35 gms/sq.m. on the surface rubbed with machine fitted hessian bobs or rubbed hard with woollen rags. The floor shall then be washed clean and dried with a soft cloth or linen. If any tile is disturbed or damaged, it shall be refited or replaced and properly jointed and polished.

9.0 TILE WORK

9.1. Materials

9.1.1. Tiles

Glazed (vitreous and ceramic tiles shall conform to IS:777 and shall be of specified shade, size and of approved manufacturer. Ceramic tiles shall be matt finished and non slip type.

The size shall be as per following:

White/coloured glazed vitreous tiles

- 200 mm x 100 mm x 6 mm
- 200 mm x 150 mm x 6 mm
- 200 mm x 300 mm x 6 mm
- 300 mm x 300 mm x 8 mm / 5.5 mm / 7.3 mm (± 5%)
- Ceramic Tiles
- 300 mm x 300 mm x 8 mm / 5.5 mm / 7.3 mm (± 5%)
- 200 mm x 100 mm x 6 mm

9.1.2. Pigments

Pigments to be admixed with mortar or for grouting the joints shall conform to Table-1 of IS:2114.

9.1.3. Cement Mortar

Cement mortar shall be in accordance with civil structural specification and following schedule

- For flooring : 20 mm thick, cement mortar (1 cement : 4 coarse sand by volume)
- For skirting/dado/riser : 12 mm thick, cement mortar (1 cement : 3 coarse sand by volume)

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9.2. Workmanship

The tiles shall be laid over a coating of specified adhesive (as per approved manufacturer's specification) laid on base floor/wall plaster. The Joints of the tiles shall be flush pointed with cement paste (white cement and pigment conforming to IS:2114, Table-1) matching the shade of colours.

9.2.1. Curing

The flooring shall be cured for 7 days by keeping it wet with ponding. Heavy traffic on the flooring shall be permitted only after 14 days.

10.0 KOTA STONE FINISH

10.1. Materials

The Kota Stone slabs shall be of selected quality and shade, hard, sound, dense, homogenous in texture, free from cracks, decay, weathering and flakes. These shall be machine cut to the requisite size and thickness and chisel dressed. Floor flooring and skirting/dado/riser the thickness of the stone slabs shall be 25 mm and 18 mm respectively.

The slabs shall have the top (exposed) face polished before being brought to site. Before starting the work, the Contractor shall get the samples of slabs approved by Owner's Representative.

10.2. Workmanship

10.2.1. Dressing of Slabs

Each slab shall be machine cut to the required size and shape and fine chisel dressed at all edges to full depth and machine rubbed to a smooth surface finish. All angles and edges of the slabs shall be true square and free from chippings giving a plane and smooth surface.

10.2.2. Preparation of Surface

Cement mortar of specified thickness and mix and shall be laid over the base after making it rough, cleaning thoroughly and applying neat cement slurry @ 2.75 kg of cement per Sq.M. of area to receive the mortar.

The mortar shall be laid for fixing one slab at a time. Cement mortar shall be 15 mm thick (1 cement : 4 coarse sand by volume) for flooring and 12 mm thick (1 cement : 3 coarse sand by volume) for skirting/dado/riser.

10.2.3. Laying

The slab shall be washed clean before laying. It shall be laid over cement mortar bedding on top, pressed, tapped gently to bring it in level. It shall be then lifted and laid aside. Top surface of the mortar then shall be corrected by adding fresh mortar at hollows and depressions. The mortar then shall be allowed to harden and cement slurry of honey like consistency @ 4.4 kg of cement per Sq.M. shall be spread over the mortar. The edges of the slabs shall be buttered with white cement with or without pigment grout to match the shade of the slabs. The slabs shall then be gently placed in position and tapped with wooden mallets till it is properly bedded in level. The joints shall be as fine as possible. Surplus cement on the surface of the slab shall be removed. The slabs in flooring shall continue for not less than 10 mm under the plaster/skirting. The finished surface shall be true to levels and slopes as instructed by the Owner's Representative.

The slabs shall be laid in patterns as per drawings and size shall not be less than 310 mm x 310 mm which shall be uniform. Cut size may be used along periphery as required.

10.3. Curing

The floor shall be cured for a minimum period of 7 days by wetting.

10.4. Polishing and Finishing

Unevenness at the meeting edges of slabs shall be removed by fine chiselling. Polishing etc. shall be done, except that cement slurry shall not be applied on the surface before each polishing.

11.0 MARBLE STONE FLOORING / GRANITE FLOORING AND FACIA

11.1. Materials

11.1.1. Marble slabs

The marble slabs shall be 20 mm thick and grade-I Makrana White or Makrana plain Pink or Abu Green or Baroda Green as specified. The marble from which the slabs are made shall be of selected quality, hard, sound, dense, homogenous in texture, free from cracks, decay, weathering and flakes. The sample of Marble stone slabs shall be got approved from the Owner's Representative. For granite slab thickness shall be 20 mm for floors and facia and the sample shall be got approved by Owner's Representative.

Fixing of granite slab on facia should be with the help of gun metal dowels.

The slabs shall be machine cut to the requisite dimensions.

11.1.2. Pigments

Pigments to be admixed with mortar or for grouting the joints shall conform to Table-1 of IS:2114.

11.1.3. Cement Mortar

Cement mortar shall be in accordance with civil structural specification and following schedule:

- For flooring/slabs: 20 mm thick, cement mortar (1 cement : 4 coarse sand by volume)
- For skirting/dado/riser : 12 mm thick, cement mortar (1 cement : 3 coarse sand by volume).

11.2. Workmanship

Same as clause no. 10.2 except that cement mortar shall be 20 mm thick (1 cement : 6 coarse sand by volume) for flooring.

11.3. Curing

The floor shall be cured for a minimum period of 7 days by wetting.

11.4. Polishing and Finishing

Unevenness at the meeting edges of slabs shall be removed by fine chiselling. Polishing etc. shall be done in accordance with clause no. 5.4, except that cement slurry shall not be applied on the surface before each polishing.

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12.0 P.V.C. FINISH

12.1. Materials

12.1.1. PVC Roll/Tiles

PVC roll/Tile shall be 2 mm thick homogenous, unbacked, flexible type of approved texture, colour and pattern, conforming to IS:3462/3461.

12.1.2. Antistatic PVC Roll/Tile

Antistatic PVC roll/tile shall conform to BS:2050, Table-2 in addition to IS:3462.

12.1.3. Adhesive

Adhesive shall be neoprene based rubber adhesive of approved make.

12.2. Workmanship

The base course shall be Cement Concrete flooring/Cement Concrete granolithic flooring for flooring and Cement plaster for skirting thoroughly dried and cleaned well before the laying of PVC rolls/tiles.

PVC rolls/tiles shall be brought to the temperature of the area in which it is to be laid and staked suitably near the site for a period of about 24 hours.

The layout of PVC flooring shall first be marked with guidelines on the base course to required pattern without adhesive. The adhesive then shall be applied by spatula to the base floor and back of the PVC roll/tile. PVC rolls shall be placed in position from one end onwards slowly without creation on any air pockets between roll and the base course. PVC rolls/tiles shall be placed only when the adhesive is set sufficiently for laying. When set sufficiently for laying, the adhesive will be sticky to the touch but shall not mark the fingers. After placing, the roll shall be pressed suitably with a wooden roller weighing about 5 kg. The joint between adjacent rolls shall be thin hairline type. For PVC tiles laying shall start from centre and proceed outwards in two right angle direction till the periphery of the room/area is reached. Fractional tiles of uniform cut sizes may be laid only along the peripheral border is so required owing to size of the room area.

PVC rolls in flooring shall be continued for 100 mm high skirting without any joints and with 50 mm radius rounded corner at the junction of skirting and flooring. Any excess adhesive squeezing out of the surface shall be wiped off immediately with a wet cloth. In case of such excess adhesive becoming hard, it shall be removed with a solution of one part of commercial Butyle Acetate and three parts of turpentine oil or any other solution as advised by the manufacturer of the roll.

After a minimum period of 24 hours after laying the rolls/tiles, the finished floor shall be cleaned with a wet cloth soaked in warm soap solution of 2 spoons of soft soap powder in 5 litres of warm water or detergent as per approved manufacturers specifications.

13.0 ACID RESISTANT TILES

13.1. Material

The tiles shall be vitrified ceramic tiles of approved size as per approved manufacturer's specification and shall be homogeneous. They shall have the following properties.

| S.No. | Property | Values | Norms |
|-------|---------------------|------------------|------------|
| | Water Absorptions | $\pm 0.5\%$ | ASTM C 373 |
| | Scratch Resistance | ≥ 6 | ASTM C 373 |
| | Chemical Resistance | Unaffected | ASTM C 650 |
| | Abrasion Resistance | ≥ 100 | ASTM C 510 |
| | Breaking Strength | 1400 kg/sq.cm. | ASTM C 648 |
| | Density | ≥ 2.0 Gm/CC | |

13.2. Workmanship

The base course shall be Cement Concrete flooring/Cement Concrete granolithic flooring for flooring and Cement plaster for skirting/dado and background surface shall be prepared.

Tiles shall be fixed on the prepared surface over a bitumen priming layer, bitumen mastic layer and resign type chemical resistant mortar. The bitumen shall conform to IS:702 and laying of bitumen mastic shall conform to IS:1196.

Joints shall be allowed to set for 24 hours. The floor shall then be washed as per manufacturer's specifications to totally remove all marks from tile surface.

14.0 EPOXY COATING

14.1. General

Epoxy floor coating shall be pigmented (approved shade) and consist of a solvent based, two pack system with epoxy resins and amine curing agents, chosen to withstand high degrees of chemical and abrasive action as per approved manufacturer's specification.

14.2. Materials

14.2.1. Screed

The screed shall be provided in flooring and shall consist of a solvent free combination of epoxy resin, modified amine hardeners filled with specially graded and selected chemically inert aggregates of high strength. The system shall include an epoxy resign primer and screed which are both supplied in pre-weighed units ready for on-site mixing and application. The thickness of screed shall be minimum 3 mm thick.

14.2.2. Finishing Coat

An epoxy resin sealing coat in two coats @ 125 gms/sq.m. (minimum) per coat shall form the topping coat over the screed in case of flooring and over plastering in case of vertical surfaces.

14.3. Workmanship

14.3.1. Preparation of Surface

The surface shall be sound, clean and dry in order to achieve maximum adhesion with the primer coating of epoxy resin as per approved manufacturer's specification.

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14.3.2. Laying

The primer shall be applied by brush and shall be allowed to become tacky. The screed shall be prepared as per manufacturers specification and laid in specified thickness evenly over the base floor by trowel. In case of flooring, the finished, cured screed shall have a slightly granular texture.

The epoxy resin topping shall be applied at least 24 hours after the laying of the screed. This topping shall be applied by brush or sprayed to a specified thickness in two coats with 3-5 hours interval between them. Care shall be taken to finish the topping perfectly smooth and devoid of any bubbles and unevenness. The newly laid floor shall be protected from dust or moisture and allowed to be used only after a minimum lapse of 48 hours.

15.0 MEASUREMENT AND RATE

Measurement and rate for flooring for item rate tenders shall be in Sq.M. in general unless otherwise mentioned.

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|    | <p style="text-align: center;">GTS – MISC. WORKS FOR UNDERGROUND PIPING AND OTHER CIVIL WORKS</p> | <p style="text-align: center;">Z/02 0015</p> |
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MISC. CIVIL AND STRUCTURAL WORKS FOR UNDERGROUND PIPING AND
OTHER CIVIL WORKS

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* * *

1. SCOPE

This specification covers the material and construction details for various civil works as given below:

- a) All Earthwork except for Site Grading and Underground Piping.
- b) Plain and reinforced cement concrete work in catch pits clean outs manholes, pipe supports, water monitors, hydrant pedestals, thrust block etc.
- c) Brick work for various structures such as Manholes, Catch basins, Valve Chambers, instrument tapping chambers, flushing chambers etc.
- d) Plastering for the above structures as applicable.
- e) Manhole frames, manhole covers, ladder rungs etc. for the above structures as applicable.
- f) Miscellaneous structure steel work such as ladders, platforms, chequered plate covers, gratings etc.

The work shall include supply of various materials as per relevant standards, required for the execution of work except for those items designated as Owner's scope of supply in the special conditions of contract or elsewhere in the contract documents. Contractor shall transport from Owner's stores those materials which are a part of Owner's supply.

All materials not fully specified herein and which may be used in the work shall be of quality approved by the Owner's Representative and he shall have the right to determine whether all or any of the materials offered or delivered for use in the work are suitable for the purpose. Contractor shall give the samples of material to the Owner's Representative and shall get it approved before procurement and use.

2. EARTHWORK AND BACKFILLING

- 2.1. Refer TECPL's Specification no. Z/02/0006 – 'Excavation, Backfilling, Compaction'.

3. PLAIN AND REINFORCED CEMENT CONCRETE

- 3.1. Refer TECPL's Specification no. Z/02/0004 – 'Structural Concrete'.

4. BRICK WORK

- 4.1. Refer TECPL's Specification no. Z/02/0026 – 'Brick Masonry'.

5. CEMENT PLASTERING

- 5.1. Materials

The specifications for cement, sand and water shall be given in TECPL's Specification no. Z/02/0001 - 'Materials'.

- 5.2. Cement mortar shall be of grade and thickness specified in drawing or as directed by the Owner's Representative, if not specified. The surface on which plastering is to be done shall be thoroughly cleaned from dust, dirt, oil, etc. It should be washed properly and watered for 4 hours before plastering. The joints of brick work shall be raked out to a depth of at least 12 mm when plastering has to be done. On cement concrete surface, the surface shall be scarified by lines with trowel when it is still green or hacked if concrete is hard as directed by Owner's Representative.
- 5.3. Plaster shall not in any case, be thinner than specified. It shall have uniform specified thickness. Any extra thickness of plaster done by Contractor will not be paid for. When smooth finishing is required the cement plaster shall be floated over with neat cement within 15 minutes of the application of the final coat.
- During the process of plastering all corners shall be rounded to a radius of 25 mm unless otherwise specified.
- 5.4. The plaster shall be protected from sun and rain by such means as the Owner's Representative may approve. The plaster shall be cured for 7 days.
- 5.5. Construction joint shall be kept in plastering work at places approved by Owner's Representative.
- 5.6. Payment
- 5.6.1. Payment for plastering shall be made on the basis of the area of surface plastered, measured before plastering. All measurements shall be separately made for each face of walls.
- 5.6.2. The rate of plastering shall include cost of scaffolding, swings, cleaning the surface, raking out joints, hacking concrete surfaces, etc. needed for carrying the work and shall cover the extra labour for plastering the jambs, sills, and soffits or opening except for plastering bands, cornices and skirting upto 30 cm width.

6. M.S. RUNGS / C.I. STEPS

The rungs for valve pits/manholes shall be of M.S. conforming to Indian Standard and to the shape and size as shown in drawings. C.I. steps for manholes if used shall be as per IS:5455. M.S. Rungs or CI Steps shall be coated with 2 coats approved bituminous paint.

Payment for steps/rungs shall be made per number and the rate shall include supply and fixing, finishing the wall etc. complete.

7. CHEQUERED PLATES AND STRUCTURAL STEEL WORKS

Chequered plates shall be 6 mm (7 mm moreover chequers and shall conform to IS:3502). Steel for chequered plate shall conform to IS:2062 and shall be clearly rolled and free from harmful surface defects such as crack surface flaws etc. The plate shall be cut to shape and fixed to the bearing members as shown in relevant drawings and as direction by Owner's Representative. The edges shall be made smooth, no burrs or gaged ends shall be left. The plates may be spliced with prior consent of the Owner's Representative. But in that case care should be taken so that there is continuity in the pattern of the plates between the portions. Lifting arrangements shall be provided including lifting rods.

Grating shall be fabricated out of MS flats, angles and rounds etc., as per drawings and as approved by Owner's Representative. Steel for grating plates shall conform to IS:2062 of general Weldable quality and shall be clearly rolled and shall be free from harmful surface defects.

Payment shall be made on the basis of weight of M.S. Gratings/chequered plate and supporting frame actually laid. The rate shall include supply of all necessary, steel materials cutting to size, fabricating, smoothening edge if necessary, transporting and fixing at all positions and providing lifting arrangements. Full deductions shall be made for all opening above 30 mm square and the rate shall include making of opening of all sizes and supply and painting 2 coats of anticorrosive paint over a coat of red oxide zinc chromate primer. The exposed surface of grating and frame shall be painted with two thick coats of coal tar. The rate shall include providing and laying M.S. grating and frame, breaking and making good existing concrete/brick masonry surface if necessary finishing, painting etc. complete with all labour and materials. Payment shall be on number basis.

8. C.I. MANHOLE FRAME AND COVER

C. I. Manhole frame and covers shall conform to IS:1726 with size and grade as shown in drawings.

9. VENT PIPES

These shall be M.S. Black Steel Tube conforming to IS:1239 medium grade or as specified in drawings. The pipe bends shall be embedded in 1:3:6 grade cement concrete or as shown in drawing.

All pipes shall be 25 mm clear of wall or column with M.S. holder bat clamp as per instructions of the Owner's Representative. All holes in walls and column shall be made good by 1:2:4 grade cement concrete. All pipes and clamps shall be painted with two coats of paints of approved make.

Payment shall be made on running meter basis and the rate shall include supply of all materials, cutting, edge preparation, jointing by welding, fixing in concrete block, cutting of walls or concrete and making good the same, painting with 2 coats of anticorrosive paint necessary scaffolding etc. complete.

The rate shall also include excavation and backfilling, if any.

10. FUNNELS, CLEAN OUTS, PLUGS

These shall be fabricated from M.S. Plates, pipes chequered Plates, rounds, angles etc., to be supplied by the Contractor. The fabrication shall be in accordance with the approved drawings.

Payment for these items shall be made on weight basis and rate shall include fabrication, erection, welding jointing and painting etc. all complete.

11. BRICK BAT FILL

11.1. The brick bats used for filling in valve pits shall be from common burnt clay building bricks. A sample of brickbats used shall be got approved from Owners' Representative.

11.2. The compaction of the layer of brick bats shall be proper so that brickbats are not disturbed and do not sink in the soil.

11.3. The payment for brick-bat fill shall be made on MZ basis as shown in drawing and the rate shall include supply, laying, compacting etc. complete with all materials and labour.

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|    | GTS – MISCELLANEOUS ITEMS | Z/02 0016 |
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MISCELLANEOUS ITEMS

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1. SCOPE

The scope shall be as specified separately for different items below.

2. REFERENCES

2.1. BIS Codes

IS:73, IS:383 and IS:6613

2.2. TECPL's Specifications

Z/02/0001 Materials

Z/02/0004 Structural Concrete

3. MATERIALS

The materials shall be as specified separately for different items below.

4. GENERAL REQUIREMENTS

- 4.1. The Contractor shall test the materials, where applicable, in approved laboratory as required by the Owner's Representative and furnish test certificates for materials and obtain the approval of the Owner's Representative prior to the use of such materials in the works. All tests shall be in accordance with relevant Indian Standards.

5. PRE-CONSTRUCTIONAL ANTI-TERMITE TREATMENT

5.1. Scope

This specification establishes the materials and method of accomplishing pre-constructional anti-termite treatment of soil for protection of buildings against attack by subterranean termites with the usage of chemical emulsions in accordance with the procedure laid down.

5.2. Materials

Refer TECPL's specification no. Z/02/0001.

5.3. Procedure for Treatment

- 5.3.1. The treatment shall be carried out by an approved agency specialised In the field. Apart from this specification, the work shall be carried out in compliance with IS:6313. In case of any contradiction, this specification shall govern.

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5.3.2. Site Preparation

Prior to start of chemical treatment, area(s), shall be made free from logs, stumps, timber offcuts, levelling pegs, roots of plants/trees etc. Soil treatment shall start when foundation trenches/pits are ready to take concrete masonry in foundations and plinth area ready for laying the subgrade. Treatment shall not be carried out when it is raining or the subsoil water level is at the same or higher than the level of treatment. In the event of water-logging of foundations, the water shall be pumped out and the chemical emulsion applied when the soil is absorbent.

5.3.3. Treatment of the excavated pits/trenches and backfill for Foundations

- a) The bottom surface and the lower 300 mm side surfaces of the excavated pits/trenches for foundations of masonry works and RCC plinth beams supporting such masonry works, shall be treated with specified chemical emulsion @ 5 litres/m² of the surface area. However, no such treatment shall be required in case of pits/trenches made for RCC foundations supporting RCC walls and/or columns.
- b) On completion of construction of masonry foundations, the backfill in immediate contact with the substructure shall be treated in layers of 300 mm with emulsion @ 7.5 litres/m² of the vertical surface of the substructure (i.e. $7.5 \times 0.300 = 2.25$ litres/meter of perimeter) for each side. The treatment shall be given after ramming of each layer of soil, by rodding the earth at 150 mm centres close to the wall surface and working the rod backward and forward (parallel to the wall surface) and then spraying the specified dosage of emulsion. The emulsion shall be directed towards the masonry surfaces so that the soil in contact with these surfaces is well treated with the chemical. After the treatment, the soil shall be tamped back into place. This shall be done for full depth of the fill.
- c) For RCC walls and columns, the treatment as specified in (b) shall start from a depth 500 mm below the finished ground level and shall be done upto the FGL.

5.3.4. Treatment of Plinth/Basement and Apron

- a) The top surface of the consolidated earth below the non-suspended floor slabs and the peripheral aprons of widths upto 750 mm, the bottom surface and side surfaces of the excavated pits for the basements shall be treated with chemical emulsion @ 5 litres/m² of the surface area. Holes 50 to 75 mm deep at 150 mm centres, both ways, shall be made on the surface with 12 mm diameter mild steel rod and then emulsion shall be sprayed uniformly over the area. At expansion joint locations, anti-termite treatment shall be supplemented by treating through the expansion joint @ 2.0 litres per linear metre of joint after the subgrade has been laid.
- b) Treatment of Junctions of plinth filling and wall/column faces shall be done after making a small channel 30 mm x 30 mm, by making rod holes 150 mm apart (upto the ground level) in the channel and then by moving the rod backward and forward @ 7.5 litres/m² of the vertical wall/column surface so as to soak the soil right to the bottom. The soil shall be tamped back into place after the treatment.

5.3.5. Treatment of Soil along External Perimeter of Building

After the building is complete, the earth along the external perimeter shall be rodded at intervals of 150 mm and to depth of 300 mm. The rod shall be moved backward and forward parallel to the wall to break up the earth and chemical emulsion poured along the wall @ 7.5 litres/m² of vertical surface (i.e. $7.5 \times 0.300 = 2.25$ litres/metre of perimeter). After the treatment, the earth shall be tamped back into place.

6. ANTI-CORROSIVE LAYER

6.1. Scope

This specification covers the requirement of materials, method of preparation and procedure for laying an anticorrosive layer over top surface of tank foundations for protection of bottom plates of steel tanks against corrosion attack.

6.2. Materials

6.2.1. Sand shall be clean, dry, coarse, hard, angular, free from coatings of clay, dust and mix of vegetable and organic matter and shall conform to IS:383 – Grade III.

6.2.2. Bitumen shall be of grade A 90 conforming to IS:73.

6.3. Mixing and Laying

The bitumen shall be heated to a temperature of 175°C to 190°C with 3% kerosene if required and sand (8 to 10% by volume) shall be thoroughly mixed with it in a mixing drum to give a uniform mixture and shall be laid over clean and dry surface of tank foundation to line, grade and levels as shown on the drawings and directed by the Owner's Representative. Bitumen shall not be heated beyond the specified temperature limits. The layer shall be tamped to form hard mass of specified compacted thickness.

7. DRESSING AND TRIMMING

7.1. Scope

This specification covers the procedure for dressing, trimming and paving with earth the peripheral area around the completed building/structure.

7.2. Procedure

The ground all around the completed building/structure for 3 metres width or as specified by the Owner's Representative, shall be cleaned and dressed to suitable slope. Over the prepared ground a layer of approved earth shall be spread, watered and well consolidated so as to achieve an average thickness of 75 mm.

8. HARD CORE

8.1. Scope

This specification covers the requirements of materials and procedure for laying of hard core.

8.2. Materials

Hard core shall consist of broken/crushed stones of 150 mm and down size. Stones shall be sound, angular, hard and free from flakes, dust and other impurities.

8.3. Procedure

Hard core shall be laid to the grade, level and thickness as shown on the drawing. Broken stones of required height shall be vertically placed and blinded with approved murrum/sand and consolidated with roller including watering, dressing etc. However, areas inaccessible by roller may be compacted by hand rammer.

9. SAND FILLING IN PLINTH/FOUNDATIONS

9.1. The specification of sand is to be used for filling.

9.2. Filling shall be carried out in layers not exceeding 15 cms and shall be compacted mechanically or by saturation to specified grade and level and to obtain 90% laboratory maximum dry density or as specified in schedule of rates.

9.3. Compaction by flooding may be accepted at the discretion of the Owner's Representative, provided the required compaction is achieved.

9.4. The Contractor shall not commence filling in and around any work until it has been permitted by the Owner's Representative.

10. DAMP PROOF COURSE – (DPC)

10.1. All materials used for Damp Proof Course shall comply with TECPL's relevant specification.

10.2. The 40 mm thick Damp Proof Course shall consist of plain cement concrete of grade M-20, unless otherwise specified.

10.3. The Damp Proof Course shall be laid at plinth level of masonry walls, flush with the floor surface and shall not be carried across doorways.

10.4. Before laying, the top surface of wall shall be thoroughly cleaned and watered. The DPC shall be laid in layers of 20 mm thickness retaining the edges by necessary form work and shall be well tamped and troweled to smooth finish. The layer shall be cured by keeping the surface wet for 40 hours and after it has dried, two coats of hot bitumen of grade A120/S120 conforming to IS:73 shall be applied over it at the rate of 1.7 Kg./m². Over this, the second layer of 20 mm thick concrete shall be laid and cured as described in case of the first layer and two coats of hot bitumen at the rate of 1.7 kg./m² shall be applied again in a similar manner. Over this, dry sharp sand shall be sprinkled evenly before hardening of second coat of bitumen paint.

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MISCELLANEOUS STEEL WORKS

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1. GENERAL

- 1.1. All materials supplied by the Contractor shall conform to their respective specifications.
- 1.2. The Contractor shall furnish test certificates for all materials prior to their use in the works.
- 1.3. Other requirements not covered under this specification shall be in accordance with the specification no. Z/02/0023 – Structural Steel Works.

2. REFERENCES

As mentioned in the respective clauses.

3. MATERIAL

As mentioned in the respective clauses.

4. ANCHOR BOLTS

4.1. Material

Materials for anchor bolts, nuts, locknuts, washers, pipe sleeves and anchor plates shall conform to their respective specifications.

4.2. Fabrication

Fabrication of anchor bolts and their complete assemblies shall be strictly in compliance with the specifications and drawings/standards. Anchor bolts shall have coarse type threads conforming to IS:4218.

4.3. Placement

Anchor bolt assemblies shall be placed in position strictly as per drawings and securely held during pouring and vibrating of concrete with necessary templates and other dummy structures to prevent their dislocation.

4.4. Tolerances

Tolerances allowed for anchor bolts positioning shall be:

For sleeved bolts, one tenth of the bolt nominal diameter.

For bolts without sleeves, one twentieth of the bolt nominal diameter.

4.5. Protection

The exposed surfaces of bolts shall be properly covered (after greasing of bolts and packing of sleeves) with jute cloth so as to protect them from damage till final erection of structure/equipment is over.

4.6. Payment

This clause shall apply to Item Rate tender only.

4.6.1.

Payment shall be made on the basis of actual weight in metric tons of the anchor bolt/anchor bolt assembly. The rate shall include supply (as per scope of supply conditions given in the tender) of all materials,

handling, transporting, fabrication, turning from available size MS round to required diameter, threading, welding, fixing in position, at all levels and locations, providing necessary templates, greasing, packing of sleeves, covering with jute cloth and other protective measures etc. all complete.

- 4.6.2. The rate shall cover bolt of any diameter and nomenclature.
- 4.6.3. Payment for fixing in position anchor bolt assembly (already fabricated and supplied by the Owner as free issue) shall be made on the basis of actual weight of anchor bolts/bolt assemblies in metric tons. The rate shall include handling, transporting, fixing in position, welding if required, providing necessary templates, greasing, packing of sleeves, covering with jute cloth and other protective measures etc. all complete.
- 4.6.4. No separate payment shall be made for templates, dummy structures, supports etc. and the rate quoted shall be inclusive of all cost related to such provision required for correct and accurate installation of anchor bolts/assembly.

5. METAL INSERTS

5.1. Material

Materials required for fabricating metal inserts shall conform to TECPL's Specification no. Z/02/0023 – Structural Steel Works.

5.2. Fabrication

Fabrication of inserts shall be done strictly as per drawings/standards and in compliance with the requirements of TECPL's Specification no. Z/02/0023 – Structural Steel Works.

5.3. Placement

Metal inserts shall be correctly embedded (in plain concrete/reinforced concrete) as per their location shown on the drawings. Care shall be taken that these are securely held in position and do not get disturbed during concreting. Where necessary, these may be welded to the reinforcement bars. Suitable templates, spacers, dummy structures and temporary staging shall be provided. Necessary cutting in the formwork and adjustment of reinforcement bars shall be done for the placement of metal inserts where required.

5.4. Painting

The exposed surfaces of metal inserts shall be cleaned with wire brush and given one coat of red oxide zinc chromate primer (conforming to IS:2074) or any other primer as specified in other specifications, after fabrication.

5.5. Payment

This clause shall apply to Item Rate tender only.

- 5.5.1. Payment shall be made on the basis of actual weight in metric tons of the metal inserts. The rate shall include supply (as per supply conditions given in the tender) of all materials, handling, transporting, fabrication, welding, fixing in position, at all levels and locations, providing necessary templates, spacers, dummy structures, adjusting the formwork and reinforcement, staging, preparation of surface for painting, applying one coat of red oxide zinc chromate primer or any other primer, as specified, etc. all complete.

6. CHEQUERED PLATES

6.1. Material

Chequered plates shall be of mild steel and conforming to IS:3502. Chequering shall be closed or open-ended or of any other pattern as shown on drawings.

6.2. Fabrication Drawings

Refer TECPL's Specification no. Z/02/0023 – Structural Steel Works.

6.3. Fabrication

Chequered plates shall be fabricated as per the "Approved for Construction" fabrication drawings (prepared by the Contractor based on design drawings). These shall be perfectly flat and without any dents/deformations and shall be cut to the required size and shape. Holes/notches/openings of the required size, if any, shown on drawings shall be made. Nosing for staircase treads shall be made by cold bending of chequered plates. All edges shall be made smooth and even. All chequered plate units shall be given distinct erection marks in accordance with the marking drawings. Stiffeners of any description shall be welded with the chequered plates where shown on drawings.

6.4. Erection/Fixing

Chequered plates shall be fixed to the bearing members by welding/ bolting/ screwing as shown on drawings. All bolts/screws shall be of counter-sunk type so that the heads remain flush with the top of plate. Where welding is used for fixing, stitch welds of minimum 50 mm length with a pitch of 150 mm shall be used. Continuous sealing run of weld shall be provided along the junction of two consecutive chequered plates parallel to the span. For removeable flooring, details as shown on drawings shall be followed.

6.5. Painting

Chequered plates shall be cleaned (both the surfaces) with wire brush and given one coat of red oxide zinc chromate primer (conforming to IS:2704) or any other primer as specified in specifications, on both surfaces.

6.6. Payment

This clause shall apply to Item Rate tender only

6.6.1. Payment shall be made on the basis of admissible weight in metric tons (determined as described in clause 6.6.2) of the chequered plates accepted by the Owner's Representative. Where stiffeners are used, weight of the same shall be included in arriving at admissible weight.

The rate shall include supplying (as per supply conditions given in the tender), fabricating, erecting M.S. chequered plates including transporting, handling, straightening if required, cutting to required size and shape, making holes/notches/opening of required size and nosing, smoothening the edges, fixing by welding/bolting/screwing, at all levels and locations, preparing detailed fabrication drawings, surface cleaning, removal of rust, scale, grease and applying one coat of red oxide zinc chromate primer or any other primer as specified, etc. all complete.

In any stiffening sections are provided below the chequered plates for strengthening, the same shall be separately measured and paid under Structural Steel Work (TECPL's Specification no. Z/02/0023).

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6.6.2. The weight for payment shall be determined from the fabrication drawings and respective bill of materials prepared by the Contractor. The bill of materials shall be checked and approved by the Owner's Representative before making the payment. The weight shall be calculated on the basis of BIS Handbook. No allowance in weight shall be made for rolling tolerances.

6.6.3. Welds, bolts, nuts, screws, washers, clips shall not be measured. The quoted rate shall be deemed to include the same.

7. GRATINGS

7.1. Categories

The gratings shall be of two categories:

- 1) Category 'A' - Fabricated by the Contractor as per design/drawings/standards.
- 2) Category 'B' - Ready made bought out from an approved manufacturer.

7.2. Material

Materials for fabrication and fixing of Gratings shall conform to their respective specification.

7.3. Fabrication Drawings

Refer TECPL's Specification no. Z/02/0023 – Structural Steel Works.

7.4. Fabrication

7.4.1. Category 'A' Gratings

These shall be fabricated strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on design drawings and standards. All units shall be given distinct erection marks in accordance with the marking drawing. All notchings in the flats shall be punched and not flame-cut. Continuous around welding shall be done along the contact-lines between two flats on both the surfaces. All fabrication shall be done in a shop under strict supervision. Clamps shall be fabricated as shown on drawing/standard.

7.4.2. Category 'B' Gratings

These shall be as per manufacturer's details designed to carry loads as specified on the design drawing supplied to the Contractor. The deflection shall not exceed span/200 or 6 mm whichever is minimum. The maximum clear size of voids in the grating shall be limited to 30 mm x 55 mm. Thickness of grating shall be 25 mm. The Contractor shall make necessary notches/opening in the gratings as shown in the drawings. All edges affected by such notches/openings shall be suitably stiffened by welding additional flats of the requisite size. All units shall be given distinct erection marks in accordance with the marking drawings. Before procurement the Contractor shall submit the design calculations, drawings and manufacturer's literature/catalogues and get the same reviewed by the Owner's Representative. The contractor shall submit sample gratings for inspection and approval by Owner's Representative whenever asked for.

7.5. Erection/Fixing

Gratings shall be fixed to the bearing members by welding/clamping and bolting as indicated in the drawings. Minimum length and maximum pitch of welds shall be 50 mm and 150 mm respectively where

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stitch welding is used for fixing along the lines of supports. The edges of two consecutive gratings shall be bolted with minimum two bolts on each side of the grating panel.

7.6. Galvanising

Gratings and the fixing clamps, bolts, nuts shall be cleaned with wire brush and galvanisation shall be done in accordance with IS:2629 and tested as per IS:2633 and IS:6745. Quantity of zinc coating shall be minimum 900 gms/sq.m. of surface area (0.12 mm uniform thickness).

7.7. Payment

This clause shall apply to Item Rate tender only.

7.7.1. Payment shall be made on the basis of admissible weight in metric tons of the gratings accepted by the Owner's Representative.

The rate shall include supplying, fabricating, erecting MS gratings (of the specified category) including transporting, handling, cutting to required size and shape, making holes/notches/openings, smoothening the edges, fabricating clamps, fixing by welding/clamping/bolting, at all levels and locations, preparing detailed fabrication drawings, surface cleaning, removal of rust, scale, grease and applying one coat of red oxide zinc chromate primer or any other primer as specified, or galvanising as required, all complete.

7.7.2. The weight for payment shall be determined from the fabrication drawings and respective bill of materials prepared by the Contractor. The bill of materials shall be checked and approved by the Owner's Representative before making the payment. The weight, shall be calculated on the basis of BIS Handbook as mentioned above. No allowance in weight shall be made for rolling tolerances.

7.7.3. Welds, bolts, clamps, nuts and washers shall not be measured. The quoted rate shall be deemed to include the same.

8. TUBULAR HAND RAILING

8.1. Material

Materials for fabrication and fixing of Tubular Hand Railing shall confirm to their respective specification.

8.2. Fabrication Drawings

Refer TECPL's Specification no. Z/02/0023 – Structural Steel Works.

8.3. Fabrication

Handrailing shall be fabricated strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on design drawings and standards. All tubes shall be straight and without any dents/deformations. Tubes shall be cut and ends shall be prepared to a neat and workman-like finish. All elements shall be directly welded. All welded joints shall be cleaned and filed or ground smooth, if required, to have a smooth surface and aesthetically pleasant appearance. Splicing of top rail shall not be allowed. Tubes shall be coldbent to shape and curvature in case of discontinuous ends of handrails. Ripples, kinks and/or dents at bends shall not be accepted.

Lower ends of vertical posts shall be cut and splayed (for grouting in pockets in the concrete members). For removable type of hand railing, suitable base plates (with provision for bolting) shall be welded to the lower

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end of vertical posts. All units shall be given distinct erection marks in accordance with the marking drawing.

8.4. Erection/Fixing

Hand railing, shall be fixed to the bearing members by welding/bolting/grouting as indicated on the drawings. Local notching shall be made in the floor plate/grating to accommodate vertical posts/their base plates which shall always be welded to the main supporting member. When the posts are to be fixed in concrete members, suitable pockets shall be made in concrete for grouting as shown on drawings/standards.

8.5. Painting

Tubes shall be cleaned with wire brush and given one coat of red oxide zinc chromate primer (conforming to IS:2074) or any other primer as specified, after fabrication.

8.6. Payment

This clause shall apply to Item Rate tender only.

8.6.1. Payment shall be made on the basis of measured length in meters (m) of top rail only (Horizontal and/or inclined lengths). The rate shall include preparation of fabrication drawings, supply of all materials, handling, transporting, straightening if required, cutting to required size, bending, welding, bolting, fixing in position at all levels and locations, grouting with 1:2 (cement:sand) mortar, surface cleaning, removal of rust, scale grease and applying one coat of red oxide zinc chromate primer (conforming to IS:2074) or any other primer as specified, after fabrication etc. all complete.

8.6.2. The rate shall include making suitable notches in floor plates/gratings and pockets in concrete structures for fixing the vertical posts.

9. MILD STEEL RUNGS

9.1. Material

All materials shall conform to their respective specifications.

9.2. Fabrication

Rungs shall be fabricated as specified in TECPL's standards/drawings. Mild steel bars shall be straightened if required, cut, bent to shape and given one coat of red oxide zinc chromate primer on exposed portions.

9.3. Fixing

Rungs shall be fixed in position as per detailed drawing and firmly tied/welded with reinforcement to prevent their displacement during vibrating of concrete.

9.4. Payment

This clause shall apply to Item Rate tender only.

9.4.1. Payment shall be made on the basis of actual weight in kilograms (Kgs.) of the M.S. rungs. The rate shall include supply of all materials handling, transporting, straightening if required, cutting to required size, bending to shape, tying/welding with reinforcement bars, fixing at all levels and locations, adjustment of

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formwork, applying one coat of red oxide zinc chromate primer (conforming to IS:2074) or any other primer as specified, and two coats of anti-corrosive paint or any other paint, as specified, on the exposed portion of rungs etc. all complete.

10. LIGHT GAUGE STEEL STRUCTURAL SECTIONS

10.1. Material

All materials required for fabrication and fixing in position of Light Gauge Steel Structural Sections shall conform to their respective specification.

10.2. Fabrication Drawings

Refer TECPL's Specification no. Z/02/0023 – Structural Steel Works.

10.3. Fabrication

Fabrication of members shall be done strictly as per the "Approved for Construction" fabrication drawings prepared by the Contractor based on the latest design drawings and in accordance with IS:800, IS:801 and other relevant BIS Codes.

All members shall be straight and free from any dents/deformations/twists. Members shall be cut to the required sizes and ends prepared to a neat and workman like finish. Holes (for sag rods and cleat bolts) of appropriate size shall be drilled and all members/ components shall be given distinct erection marks in accordance with the marking drawings. Holes shall not be formed by gas cutting process.

10.4. Erection

Structural members shall be erected in proper sequence and aligned properly without causing any twist. Permanent bolting/welding shall be done only after proper alignment has been achieved. Proper access, working platforms and safety arrangements shall be provided by the Contractor for working and inspection.

10.5. Painting

All structural components shall be cleaned thoroughly and given one coat of red oxide zinc chromate primer (conforming to IS:2074) or any other primer as specified, after fabrication.

10.6. Payment

This clause shall apply to Item Rate tender only.

10.6.1. Payment shall be made on the basis of admissible weight in metric tons (determined as described in clause 10.6.2) of the structure accepted by the Owner's Representative. The rate shall include supplying, fabricating, erecting, at all levels and locations, testing of bolted and/or welded Light Gauge structural steel works including cleats, crook bolts, splices/sleeves, all other fixtures and accessories, straightening if required, cutting, edge preparation, welding and bolting of joints, fixing in line and level with temporary staging and removal of the same after final alignment, handling, transporting, storage, preparation of detailed fabrication drawings and getting them reviewed by the Owner's Representative, surface cleaning, wire brushing, removal of scale, rust, oil or grease and painting as per 8.5 above etc., all complete.

10.6.2. The weight for payment shall include all structural members, cleats, splices, gussets and sag rods and shall be determined from the fabrication drawings along with respective bill of materials prepared by the Contractor. The bill of materials shall be checked and approved by the Owner's Representative before making the payment. The weight shall be calculated on the basis of BIS Handbook. Manufacturer's

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catalogues/charts shall be adopted in case relevant weights of sections used are not covered I BIS Handbook. No allowance in weight shall be made for rolling tolerances.

- 10.6.3. All welds, bolts, nuts washers, fixtures and accessories shall not be measured. The quoted rate shall be deemed to include the same.
- 10.6.4. The rate shall be applicable to all cleats, splices, sleeves and gussets. Sag rods, however, shall be separately measured and paid under structural steel item (viz. TECPL's Specification No. Z/02/0023).

11. EXPANSION FASTENERS

11.1. Material

Expansion fasteners (medium and heavy duty) shall be of mild steel / high tensile steel with rust proof coating including both mechanical and chemical fasteners.

11.2. Classification

The expansion fasteners shall be designated as medium and heavy duty depending on their usage. The broad classification is given below for general guidance.

11.2.1. Medium Duty (Mild Steel/ High Tensile Steel)

- Ladders and stairs supports.
- Cables and cable trays supports.
- Electrical panels and fixtures.
- Hangers for pipes and cable trays.
- Pipe supports.

11.2.2. heavy Duty (Mild Steel / High Tensile Steel)

- Platform support (beam and columns)
- Knee brackets for pipes/multi tiers cable trays/walkways etc.

Note:- Expansion fasteners shall not be used for:

- 1) Members supporting equipment and pipes subjected to vibrations.
- 2) Cantilever connections designed to cater for effective cantilever spans greater than 1000 mm and 1000 Kgs. Of concentrated load at the free end.

11.3. Selection

The Contractor shall submit to the Owner's Representative manufacturer's catalogues along with the specimens of expansion fasteners (proposed to be used for the job) for his selection and approval. Selected fasteners shall be capable to carry the specified loads.

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11.4. Testing

If so desired by the owner’s Representative, the Contractor shall carry out all the requisite tests (pullout test, torque test etc.) of specimen expansion fasteners (representative of those to be used) from approved laboratory/test house and submit the report to him for approval. The decision of the Owner’s Representative regarding the adequacy of strength and load carrying capacity of the expansion fastener shall be final and binding to all. The cost of all such tests shall be borne by the Contractor.

11.5. Installation

The Contractor shall install the expansion fasteners at their correct location (to suit the requirement of fixtures as shown in drawings) as per the procedure laid down by the manufacturer. Location of all holes shall be premarked on the concrete surfaces and then holes drilled carefully with an electric drill to the correct recommended size and depth. Holes shall be exactly round and true perpendicular to the concrete surface. Edge distance and pitch of fasteners shall be as recommended by the manufacturer. The Contractor shall suitably shift the hole with the approval of the Owner’s Representative in case any reinforcement bar is met with while drilling the hole in RCC structure. Necessary staging shall be provided for working and the Contractor shall take requisite safety precautions so as not to cause any damage to the existing structure/equipment. Any damage done while executing the job shall be made good by the Contractor at his cost.

11.6. Protection

The exposed surfaces of expansion fasteners shall be properly greased and covered with jute cloth so as to protect them from damage.

11.7. Payment

This clause shall apply to Item Rate tender only.

11.7.1.

Payment for installing rust proof expansion fasteners shall be made on number basis (each). The rate shall include supply of complete assembly, handling transporting, providing necessary temporary staging, installing (as per manufacturer’s specifications) in PCC/RCC structures, at all levels and locations, testing, drilling, cleaning, covering with jute cloth, relocating and redrilling in case of any obstruction, making good any damage done to the structure, grouting the abandoned holes and any gap left between the contact surfaces of PCC/RCC and fixtures to be added, etc. all complete.

12. BITUMEN/BITUMINOUS MATERIALS

Bitumen to be used for various types of work shall meet all the requirements of relevant BIS Codes as given below:

Specification of Paving Bitumen. IS:73

Specification of bitumen mastic for flooring. IS:1195

Specification for Bitumen felts for water proofing and IS:1322
and damp proofing.

Specification for Bituminous compounds for water proofing IS:1834
and caulking purposes.

Specification for preformed fillers for expansion joint IS:1838
in concrete pavements and structures.

Specification for bitumen mastic for use in water proofing of roofs IS:3037

Specification for bitumen primer for use in water proofing and IS:3384
damp proofing.

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Specification for Bitumen Mastic for Tanking and Damp proofing. IS:5871

Specification for Glass fibre base coal tar pitch and bitumen felts. IS:7193

Code of practise of damp proofing using bitumen mastic. IS:7198

Specification for bitumen Mastic, Anti Static and electrically conducting grade., IS:8374

The type and grade shall be as shown on the drawings or as indicated in schedule of quantities or as directed by Owner's Representative. Tests and acceptable criteria shall be as per relevant BIS Codes.

13. PVC PIPES

PVC Pipes shall conform to the requirements of IS:4985.

14. WOOD/TIMBER

14.1. Wood recommended for platforms of cold vessels or below cold vessels/exchangers shall be hard and shall be of Group A, Grade I and shall have safe permissible stress of 7N/mm in compression, perpendicular to grains on outside location as per IS:883. General characteristics like durability, treatability etc. shall conform to IS:883 and IS:3629.

14.2. Timber required to be used for form work shall be fairly dry before use. It should maintain its shape during the use and even when it comes into contact with moisture from the concrete. Storage of Wood/Timber shall be as per the requirements of IS:4082.

For proper identification and selection of suitable timber for form work, following codes shall be referred.

Classification of commercial timbers and their zonal distribution IS:399

Specification for ballies for general purposes. IS:3337

Specification for Ply wood for concrete shuttering work. IS:4990

15. EPOXY COMPOUNDS

Refer TECPL's relevant General Technical Specification (GTS).

16. PAINT

Refer TECPL's relevant General Technical Specification (GTS).

17. ANTITERMITE COMPOUNDS

17.1. Chloropyrifos emulsifiable concentrates (1%) conforming to IS:8944 shall be used for treatment of soil for protection of buildings against attack by subterranean termites.

18. POLYSULPHIDE SEALANTS

18.1. Polysulphide Sealants shall conform to IS:12118 and be of approved make. Test conditions and requirements shall be as given in the above referred BIS Code.

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PILING

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1. GENERAL

1.1. Scope

This General Technical SPECIFICATION covers the materials, fabrication and installation of the following types of piles :

- precast concrete piles;
- driven cast-in-place piles;
- bored cast-in-place piles.

1.2. References

CODES & STANDARDS and regulations applicable and referred to in this SPECIFICATION are:

BIS Standards

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|--------------|---|--|
| IS:800-1984 | : | Code of practice for general construction in steel |
| IS:383-1999 | : | Specification for coarse and fine aggregates from natural sources for concrete |
| IS:269-1989 | : | Specification for 33 grade ordinary Portland cement |
| IS:8112-1989 | : | Specification for 43 grade ordinary Portland cement |
| IS:456-2000 | : | Plain and reinforced concrete |
| IS:2116-1980 | : | Specification for sand for masonry mortars |
| IS:4926-1976 | : | Specification for ready mixed concrete |

Regulations

As per Indian Labour Laws. : General Regulation for the protection of Work

1.3. Quality Assurance

The materials such as cement, steel reinforcement, aggregates and water shall be tested in accordance with the requirements of GTS - Structural Concrete.

Manufacturers of precast reinforced concrete piles shall have previous experience of manufacturing similar items.

All materials shall be tested at the place of manufacture (or elsewhere if convenient and appropriate) by an approved testing agency to ensure that they comply with the requirements of this section.

The Owner's Representative may agree that routine tests carried out by the Manufacturers cover all or part of the requirements of paragraph 3 below, provided that he is satisfied with the Manufacturer's testing procedures.

The construction of installation of all piles shall be undertaken using techniques and equipment which have a well proven record of success and be implemented by specialised personnel who have extensive experience in carrying out such work.

1.4. Submittals

1.4.1. Geotechnical Soil Characteristics

Unless specified otherwise the results of the soil investigation and type & the capacity of pile shall be made available to the contractors.

If the CONTRACTOR judges that the available soil data are incomplete or not reliable he shall to submit a complementary investigation program to the approval of the Owner's Representative.

The Owner's Representative will decide whether or not complementary investigation is really required and has to be executed.

1.4.2. Design Documents

1.4.2.1. Studies and documents prepared by the Owner's Representative

Unless otherwise specified, these studies are limited to :

- the calculation of the service loads i.e. the loads (compression, traction, horizontal forces, bending moments) transmitted by the superstructure to the piles at the pile head level;
- the preparation of the piling drawing comprising all or part of the following information:
 - number and location of piles;
 - the cut-off level for each pile;
 - eventually a minimum pile length;
 - minimum reinforcement requirements.

1.4.2.2. Studies and documents to be performed by the CONTRACTOR

Unless specified otherwise, the CONTRACTOR shall perform following design studies :

- selection of the most adequate type of pile;
- calculation of the maximum allowable pile loads or load combinations;
- detailed characteristics of the piles (section, reinforcement);
- expected settlements and horizontal displacements due to the effective pile loads;
- detailed piling sequence and time schedule.

At least 15 days before the commencement of piling job, the design calculations shall be submitted to the Owner Representative for approval and approval shall be taken for the same before the commencement of the job.

1.4.3. Products Data

The type of pile and design of the driving methodology etc shall be finalised after validating the geo technical data available.

Sources and manufacturers SPECIFICATION for:

- precast concrete piles.
- under reamed piles.

1.4.4. Test Reports

The CONTRACTOR shall submit as soon as possible reports on the tests specified in clauses 1.3 and 6.2 of this SPECIFICATION.

1.4.5. Certificates

The CONTRACTOR shall submit certificates of compliance with the specified CODES, or other recognised and equivalent STANDARDS in respect of materials specified in clause 2.1 of this SPECIFICATION.

This clause does not apply in case of use of an approved ready mix concrete.

Should the Owner's Representative decide not to carry out tests, the CONTRACTOR shall, whenever required, obtain from the Manufacturer and submit to the Owner's Representative certificates showing that tests of materials have been carried out in accordance with the requirements of this SPECIFICATION and results are tabulated in the prescribed format.

1.4.6. Samples

The CONTRACTOR shall, if so instructed by the Owner's Representative, deliver to the Owner's Representative or to a nominated testing agency such samples as would be required for the independent performance of the tests, and confirmation of conformity with the STANDARDS, as referred to in clause 2.0 of this SPECIFICATION.

1.4.7. Drawings and Other Details

The CONTRACTOR shall submit to the Owner's Representative for his approval full details of all his proposed arrangements for casting, handling and placing of precast concrete units, for the installation of steel piles and for the construction of cast in place piles as specified in the following paragraphs.

The CONTRACTOR shall submit to the Owner's Representative for his approval shop drawings of all precast concrete piles including methods of checking and testing in with specified tolerances.

The CONTRACTOR shall submit to the Owner's Representative and obtain his approval of fully detailed drawings showing the proposed layouts of pile casting yards, the methods of assembling and dismantling moulds, provision for vibrating immediately after casting, for curing and protection from the sun.

All materials used in the fabrication of precast piles and all methods adopted in the manufacturing shall be to the satisfaction of the Owner's Representative.

The CONTRACTOR shall submit to the Owner's Representative for approval detailed descriptions of the plant, equipment, materials and procedures that he proposes to use for every type of piling operation that is to be undertaken. The descriptions shall include plant and equipment specifications, pile construction sequence, protective systems, detailed construction or installation procedures, test procedures, etc.

1.5. Delivery Storage And Handling

The CONTRACTOR shall be responsible for all the necessary arrangements that may be required in connection with the transport of long piles.

The delivery, storage and handling of all piles shall be carried out in an approved manner.

1.6. Site Conditions

1.6.1. Existing Conditions

If at certain locations, pile driving or pile construction will have to be carried out in close proximity to existing structures, the CONTRACTOR shall take all adequate means to avoid damage to existing structures by for instance :

- vibrations,
- decompression of the soil due to boring;
- other phenomena that could occur during execution.

When during execution the CONTRACTOR encounters underground pipes, sewers, cables or any other obstructions he shall immediately seek instruction from the Owner's Representative.

Drawings are not guaranteed either as to accuracy or completeness for the position of underground obstacles.

The CONTRACTOR shall verify the location of any underground obstacles before starting any work.

1.6.2. Environmental Requirements

The contractor shall abide by the rules and regulations of the Noise & Pollution Control Board of the area.

1.7. Alternatives

If the CONTRACTOR is of the opinion that the piling design, undertaken by the Owner's Representative, is inadequate for execution purposes, the same has to be informed to the Owner's Representative by writing and an alternative proposal including drawings and design calculations shall be submitted for approval.

The Owner's Representative is free to consider or not alternative proposals.

2. PRODUCTS

2.1. Materials For Concrete Works

For specification of Cement, Aggregates, Water, Ad-mixtures, Concrete and Reinforcement Steel, refer GTS Z/02/0004.

2.1.1. Steel Pipes for Pile Permanent Casings

Pipes diameters of less than 20 cm shall not be used.

Pipes wall thickness shall not be less than :

| | | |
|-------|--|---------------|
| 8 mm | for diameters between | 20 and 25 cm; |
| 9 mm | for diameters between | 30 and 35 cm; |
| 11 mm | for diameters between | 40 and 45 cm; |
| 13 mm | for diameters greater than or equal to | 50 cm. |

A corrosion allowance of 2 mm shall be included in the wall thickness design.

2.2. Fabrication And Storage Of Precast Concrete Piles

2.2.1. General

All precast concrete piles shall be manufactured by approved suppliers as per the approved design by the Owner Representative.

The piles shall be truly straight. The maximum allowance for deviation of the longitudinal axis from a straight line drawn from the centre of the tip to the centre of the head shall not exceed 10 mm per 10 metre of length of the pile.

The length of each pile shall be determined by the CONTRACTOR according to the required bearing capacity.

The piles shall be designed, cast and cured to develop the strength necessary to withstand the stresses imposed while handling, transporting and driving without suffering any damage.

Square piles up to 400 mm x 400 mm shall have chamfered corners. Piles larger than 400 mm x 400 mm shall be octagonal in cross section (Nominal size measured across the flats).

Where precast piles are to be used in the permanent works in aggressive ground conditions, they shall be protected from sulphate attack by the use of a protective coating : this coating shall be a coal tar epoxy paint system to the approval of the Owner's Representative and consisting of :

- a primer coat;
- a top coating with a high build two-pack coal-tar epoxy capable of providing a dry film thickness of up to 200 microns.

2.2.2. Fabrication

2.2.2.1. Casting Yard

The casting yard for all concrete piles shall be so arranged that the piles can be lifted from their beds and transported to the piling frames with a minimum of handling. The casting yard shall have a well-drained surface to prevent excessive or uneven settlement due to softening during manufacture and curing.

2.2.2.2. Concrete Casting

The piles shall be cast in a continuous operation from end to end of each pile. The concrete shall be thoroughly compacted against the forms and around the reinforcement by means of immersion and / or shutter vibrators. The faces of the pile including those exposed at the top of the pile shall be dense as far as possible. Immediately on completion of the casting, the top surface shall be finished without excessive trowelling. Care should be taken to ensure that vibrations from adjoining work does not affect the previously placed concrete for piles during the settling period.

2.2.2.3. Curing

After casting, freshly cast piles shall be protected from sudden changes of temperature and humidity by shading and covering from hot sun and by watering to ensure that the concrete remains humid during the curing period.

The method and time of curing shall be subjected to the approval of the Owner's Representative.

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2.2.2.4. Reinforcement

The reinforcement shall extend along the whole length of the piles.

A minimum concrete cover of 40 mm shall be maintained.

The main longitudinal reinforcement shall not be less than 0.8 % of the cross pile section, with a minimum of 6 bars diameter 12 mm. Longitudinal bars shall be of one stretch, by means of butt-welded standard lengths. They shall be fit tightly into the pile shoe.

The lateral reinforcement shall be at least 8 mm diameter at a 200 mm pitch and shall be carefully welded to the main reinforcement. It shall be in the form of hoops, links or spirals and shall resist the driving stresses.

The CONTRACTOR may deviate from these requirements in case of prestressed piles types.

2.2.2.5. Marking of piles

Each pile shall be marked indelibly with a reference number, length and the date of casting.

2.2.2.6. Inspection

Each pile shall be inspected as soon as possible after removal from formwork for any defects such as honeycombing, voids or movement of forms or reinforcement.

The Contractor shall be advised to made good of any such defects to the satisfaction of the Owner's Representative. If, in the opinion of the Owner's Representative, a pile has major defects, it will be rejected.

2.2.3. Handling, Stacking and Storing of Precast Concrete Piles

Piles shall not be handled or moved until the concrete has attained the specified 28 days characteristic strength determined by field control test cubes.

Care shall be taken at all stages of transporting, lifting and handling to ensure that the piles are not damaged or cracked. Any piles damaged during such operations will be rejected by the Owner's Representative and shall be replaced at the CONTRACTOR'S own expense.

Piles shall be lifted and handled, using lifting rings designed for this purpose. Cast-in lifting eyes will not be permitted. The rings shall be installed only at the indicated lifting points. Steel wire rope slings or other tackle that might cause damage shall be padded.

If the piles are put down temporarily after being lifted, they shall be placed on trestles or blocks located at the lifting points.

Piles shall be stored on firm ground not liable to unequal settlement under the weight of the stack of piles. The piles shall be placed on timber / steel supports which are truly level and spaced so as to avoid undue bending in the piles.

The supports shall be placed vertically above one another.

Spaces shall be left round the piles to enable them to be lifted without difficulty. The order of stacking shall be such that the older piles can be withdrawn for driving without disturbing new piles.

Separate stacks shall be provided for different lengths of piles.

Arrangements shall be provided to enable the piles to be sprayed with water if necessary, to meet weather conditions or to provide further curing during storage; in hot weather the piles shall be shaded from direct sunshine.

3. EXECUTION OF PILES

3.1. Preparatory Works

3.1.1. Site Preparation

Before commencing the piling work, and if the presence of existing underground utilities is known or suspected, the CONTRACTOR shall establish the exact location of these by means of carefully excavated trial pits, using hand methods in the immediate vicinity of the pipe, duct or cable, and shall carry out such diversion or protection of these as is shown on the Drawings or as directed by the Owner's Representative.

The areas where piling operations are to be carried out shall be levelled and kept clear of water to provide a dry stable working platform for the plant and equipment to operate on.

3.1.2. Setting out

By means of bench marks the Owner's Representative shall provide two reference lines and one level point.

The setting out of the piles shall be done by the CONTRACTOR starting from these reference lines.

3.2. General Prescriptions For All Types Of Piles

3.2.1. Program

The CONTRACTOR shall submit to the Owner's Representative a weekly piling program. He shall inform the Owner's Representative each day of the piling to be carried out on the following day and give adequate notice of his intention to work outside normal hours and at weekends.

3.2.2. Piling Method

The CONTRACTOR shall supply for approval detailed method statement and procedures for each piling operation in the form of instructions to his Foremen on how to execute the Piling.

3.2.3. Piling Records

The CONTRACTOR shall keep detailed records of each pile.

For this purpose a record book shall be drawn up and updated by the CONTRACTOR; it shall be submitted at regular intervals to the approval of the Owner's Representative.

This record book shall include for each pile details on :

- Location, reference number (corresponding to the number fixed on the implantation drawing), type and size of the pile;
- Length of the tube in case of temporary casing;

- Date and hour of start and end of each operation :
- Drilling or driving, reinforcement placing, concreting;
- Level from which the pile is bored or driven (working platform level);
- Level of the pile base;
- Top level of the concrete pile before the cut-off operation;
- Useful length;
- Used materials (drilling or driving tools, concreting equipments);
- Curing results of the bottom hole before putting down the reinforcement cage and before concreting (including mainly the slurry characteristics);
- Nature and description of the bored soils;
- Poured concrete volume and theoretical volume (measured concrete curves);
- For driven cast in place piles, used concrete volumes during base concreting and shaft concreting will be distinguished;
- Behaviour, workability, fluidity of concrete, results of the compression tests;
- Water level within the hole before concreting;
- Slurry characteristics before and during drilling;
- For driven piles, the refusals corresponding to the three last sets of blows (10 hammer blows) will be noticed for each pile; for one pile by each 20 piles, a driving diagram will be drawn up according to the prescription of the IS:2911-Part-I,II,III

The CONTRACTOR will submit to the approval of the Owner's Representative a proposal of piling record sheet including all the details mentioned here above.

3.2.4. Tolerances

The maximum permitted deviation of the pile centre from the centre point shown on the setting out drawing shall be 25 mm in any direction.

The maximum permitted deviation of the completed pile from the vertical is 25 mm per meter.

For raked piles the maximum permitted deviation of the finished pile from the specified rake is 40 mm.

3.3. Execution of Driven Cast-In-Situ Piles

3.3.1. General

Driven cast-in-place piles can be of two types, the first having a permanent steel or concrete casing and the second being with only a temporary casing during construction to maintain the stability of the pile hole.

All plant materials and operations employed in the formation of a pile shall be such as to ensure that the completed pile is of the full cross section.

3.3.2. Equipment

The CONTRACTOR provides to the Owner's Representative all data proving the suitability, efficiency and energy of the driving equipment.

The weight of the falling mass must always be adequate to take down the piles at the depth defined by the design.

3.3.3. Driving

Pile driving will not be allowed to commence before the approval by the Owner's Representative of the CONTRACTOR'S proposals and calculations which shall include the following:

- a) calculation for refusal;
- b) proposed minimum depths the piles are to be driven through the ground;
- c) details of hammers proposed to be used.

The first pile to be installed with a particular rig shall be one located at or close to one of the soundings shown on the piling drawings. For this pile the tube shall at least be driven to the required tip elevation. A blow count shall be made over the entire pile length.

The number of blows required to drive the tube over the last 25 cm to the required tip elevation shall be used as a guidance for the adjacent piles to be installed with the same rig in the area covered by the same sounding.

The final set of each pile shall be recorded either as the penetration in millimetres per 10 blows or as the number of blows required to produce a penetration of 25 mm (see piling records 3.2.3.).

When a final set is being measured, the following requirements shall be met :

- a) The exposed part of the tube shall be in good condition without damage or distortion.
- b) The dolly and packing, if any, shall be in sound condition.
- c) The hammer blow shall be in line with the pile axis and the impact surfaces shall be flat and at tight angles to the pile and hammer axis.
- d) The hammer shall be in good condition and operating correctly.
- e) The temporary compression of the pile shall be recorded if required.

In case of any variation or change in the driving conditions, such as another type of hammer or a different stroke, a new blow count shall be made at or close to a sounding.

The calculation for refusal shall be performed with the help of the Danish driving formula :

$$Q_c = \frac{e_h E_n}{s + \left(\frac{e_h E_n L}{2AE} \right)^{1/2}}$$

$$Q_a = \frac{Q_c}{5}$$

Where : e_h = Efficiency of the hammer (dimensionless ratio).

s = Average penetration of the pile per hammer blow for the final ten (10) blows (m/blow).

A = Cross sectional area of the pile (m²).

- E = YOUNG'S modules of the pile (kN/m²).
 E_n = Nominal energy of the pile hammer (kNm/blow).
 L = Pile length (m).
 Q_c = Calculated pile capacity (kN).
 Q_a = Allowable pile capacity (kN).

The CONTRACTOR shall submit for approval a detailed description of the material and devices being used and also the application of the above formula for the selected material (3 weeks before site installation).

The CONTRACTOR shall inform immediately the Owner's Representative when any unexpected change in driving characteristics occurs and propose methods to solve the problem. A detailed record of the driving resistance over the full length of the nearest available pile shall be taken if required by the Owner's Representative.

The pile driving is carried out following a sequence in order to avoid, as much as possible, an increasing of the driving resistance for the last piles.

Damage to neighbouring piles during driving

In case of damage to the adjacent piles, for example observation of concrete raising in the neighbouring piles, the CONTRACTOR shall review the driving sequence.

Particular dispositions may be needed and decided with the agreement of the Owner's Representative.

3.3.4. Mixing of Concrete

Approved power driven - revolving drum type mixers shall be used equipped with suitable mechanisms for accurately measuring water. The volume of materials per batch shall not exceed the manufacturer's rated capacity for the mixer.

Mixers with worn or badly bent blades shall not be used.

The time allowed for mixing, after all ingredients have been placed in the mixer shall not be less than 2 minutes for drums of one cubic metre capacity or less. For drums in excess of one cubic metre the mixing time shall be increased by 30 seconds for each cubic metre or fraction thereof in excess of one cubic metre.

All concrete must be thoroughly mixed to an even colour and consistency throughout.

The entire contents of the drum shall be discharged before the materials for the succeeding batch are fed into the drum. No re-mixed, re-tempered, excessively wet or partially set concrete shall be permitted in the work.

The drum of the mixer shall be thoroughly cleaned of all adhering concrete at frequent intervals during continuous operation. Mixers which have been out of use for more than 30 minutes shall be cleaned before any fresh concrete is mixed.

3.3.5. Placing of Concrete

Before starting concreting, the CONTRACTOR has to check the implantation of the driven tube and verify that no water or soil is present within the tube. A special procedure must permit to execute this control at any moment.

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Concrete shall be placed in the work within 30 minutes after mixing or discharge from a ready-mix truck.

In depositing concrete through a cage of reinforcement care shall be taken to prevent segregation of concrete mortar from the aggregate.

At all stages of the works every precaution shall be taken to prevent wasting and the formation of voids in the concrete. These defects can be due to faulty consolidation, insufficient head of concrete during placing, concrete of inadequate workability, flow of groundwater past green concrete or extracting the casing too late or too quickly.

The volume of the concrete shall be checked at frequent intervals and steps taken to maintain a sufficient head of concrete above the bottom of the casing to prevent inflow of soil or water.

The poured concrete volume needed by the concreting of each pile has to be measured and noted in the piling record.

In case of successive pourings of dry concrete with tamping, a minimum thickness of concrete must be maintained within the tube to avoid any insertion of soil or water at the base of the tube. In any case, this thickness must be larger than the half-diameter of the tube.

In case of continuous pouring of concrete, the concrete has to fill the tube in order that the pile is continuous up to the top level when the tube is removed. If the tube is not long enough to contain a sufficient concrete volume, the complement of concrete is added after raising of the tube over the needed length. The basis of the tube is always 1 m below the concrete level except at the cut-off level.

The concreting curve is usually drawn up by the CONTRACTOR for one pile by each 50 piles. If the concrete consumption is not normal (under-volume or more than 30 % of over-volume), special procedures will be taken by the CONTRACTOR in agreement with the Owner's Representative.

In case of successive pourings with tamping, the concreting curve is drawn up by measuring the quantities of each pouring of concrete (max. 0.5 m³) versus the top level of concrete into the tube.

In case of continuous pouring over the full length of the tube, the concreting curve is drawn up by measuring the concrete top level every time the tube is raised over 2 m.

During extraction of the casing observation shall be kept on the surface of the concrete to detect any tendency towards lifting of the concrete.

3.3.6. Finishing Pile Heads

The concrete of the pile shall be brought up sufficiently far above the required finished level to allow for slumping on withdrawal of the casing and to ensure that all laitance and weak concrete rises above cut-off level. The concrete shall be cast to a minimum of 0.5 m above the cut-off level, and to a minimum of 0.3m above groundwater level.

3.3.7. Reinforcement

Except otherwise specified, the reinforcement shall extend along the whole length of the piles. It shall be adequately assured in position.

A minimum concrete cover of 40 mm shall be assured.

The main longitudinal reinforcement shall not be less than 0.8 % of the cross pile section with a minimum of 6 bars diameter 12 mm. Longitudinal bars shall be executed in full accordance with IS:1786-1985.

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The spiral reinforcement shall be at least 8 mm diameter at a 200 mm pitch and shall be carefully welded to the main reinforcement.

3.4. Execution of Bored Cast-In-Situ Piles

3.4.1. General

Bored cast-in-place piles can be of two types, the first having a permanent steel or concrete casing and the second being with only a temporary casing during construction to maintain the stability of the pile hole.

Bored cast-in-place piles are formed by boring or grabbing and subsequently filling the hole with concrete.

Piles, 600 mm or less in diameter are commonly known as small diameter bored piles.

All plant, materials and operations employed in the formation of a pile shall be such as to ensure that the completed pile is of the full cross section.

3.4.2. Boring

3.4.2.1. Boring with permanent casing

The piles are bored into the depth required by the particular SPECIFICATION, by the drawings or by the CONTRACTOR'S calculation notes.

For each pile, the CONTRACTOR draws up the geotechnical profile of the boring with description of the strata and samples taken for each stratum as mentioned in the piling record item of these SPECIFICATIONS.

If required by the Owner's Representative, a representative sample - even disturbed - from each stratum will be kept in tight packing until the end of the works.

The bottom of the casing shall be kept sufficiently far below the boring to prevent the inflow of soil and the formation of cavities in the surrounding ground.

This is particularly important for pile borings carried out in close proximity to the foundations of adjacent buildings when loss of ground from beneath the foundations can occur.

When the casing cannot practicably be advanced below the bottom of the borehole (for example in compact sand and gravel) inflow of soil and groundwater shall be prevented by drilling mud such as bentonite suspension maintained within the boring (see 3.4.2.3).

If any block of hard material or any part of old foundations or piles is encountered by the boring, the surrounding soil will be disintegrated as far as possible during drilling through the block.

The boring of a hole located closer than 3 diameters centre to centre of a pile may not start before placing of the concrete into that pile.

The bottom of the hole is regularly checked during boring to detect any hazard (e.g. unexpected change in soil condition, presence of erratic blocks ...), to produce the geotechnical cross-section and control the stability of the bottom of the hole.

Care shall be taken to avoid over rapid withdrawal of the boring tools causing suction leading to excessive removal of the casing.

3.4.2.2. Boring with temporary casing

The temporary tube used to maintain the stability of the pile excavation will be free from distortion and will be of uniform cross section throughout its length.

The base of the tube is always located below the bottom of the boring. During drilling, the thickness of water and soil within the tube must be large enough to create an overpressure at the base of the drilling-tool.

Boring using a hollow twist drill.

A hollow twist drill is screwed in the soil by means of a hydraulic turntable.

The central hollow pipe of the twist drill is closed at the bottom in order to avoid water and soil penetration during screwing.

The hollow twist drill is by preference made of one piece, the use of more than 3 twist drill elements is prohibited.

Once the requested depth has been reached, the twist drill will be pulled out while simultaneously concrete is pumped in the central hollow pipe of the twist drill.

The pulling out of the twist drill will be done without rotation.

Concrete pumping is done with a pressure of approximately 2.5 N/mm² and without interruption.

Pouring concrete has to follow scrupulously the putting out of the twist drill in order to avoid empty spaces in the bored pile. The pulling out of the twist drill has to be stopped if the supply of concrete is interrupted.

The concrete pressure has to be maintained as long as the bottom of the twist drill hasn't reached the theoretical cut-off level.

A reinforcement cage is placed in the wet concrete using a vibrator fixed on top of the cage.

3.4.2.3. Boring with drilling mud

When drilling slurry is used for the boring, the removal of the slurry shall be made by the CONTRACTOR permanently and with efficiency in order to avoid the pollution of the working platform. Then cleaning of the site includes the evacuation of all the drilling slurry.

The level of the drilling slurry and accordingly the level of the working platform from which the piles are executed is always located at one meter minimum above the highest static levels of the ground water.

The drilling slurry consist of water, bentonite and eventually clay, cement and other additives. The drilling slurry must be able to maintain the stability of the pile excavation during the boring and until the end of concreting to ensure a perfect concreting.

Bentonite characteristics are given hereunder. The CONTRACTOR has the possibility to use other equivalent slurry mixture as per local practice. In that case, the CONTRACTOR has to demonstrate the equivalent quality of the slurry used.

Bentonite

Bentonite is a clay containing mainly montmorillonite having special swelling and thixotropic properties.

The source and properties of the bentonite to be used for the bored piles shall be provided in the form of certificates from the supplier. The certificates shall be submitted prior to the beginning of the works to the Owner's Representative's approval.

Bentonite suspension

The bentonite suspension shall agree to the criteria shown in the following table at stages "fresh", "ready to re-use" and "before concreting".

| TABLE FOR BENTONITE SUSPENSIONS | STAGES | | |
|--|----------------------|-------------------------|--------------------------|
| | fresh | ready for re-use | before concreting |
| Density | < 1.10 | < 1.25 | < 1.20 |
| Marsh value | 32 to 50 | 32 to 60 | 32 to 50 |
| Fluid loss | < 30 cm ³ | < 50 cm ³ | - |
| pH | 7 to 11 | 7 to 12 | - |
| Sand content | < 15 % | < 15 % | < 4 % |
| Filter cake | < 3 mm | < 6 mm | - |

Test

The CONTRACTOR shall submit to the approval of the Owner's Representative the test method he intends to apply on site. The proposed method shall be equivalent to the one described hereunder :

The Marsh value, the fluid loss, the sand content, the filter cake and the 10 minutes gel strength (using a Fann viscometer), will be measured using the tests described in the American Petroleum Institute document "Recommended Practice Standard Procedure for Field Testing Water-Based Drilling Fluids" (reference : American Petroleum Institute Recommended Practice 13B-1, June 1, 1990). The main characteristics of these tests are as follows :

- Marsh value : a marsh funnel with a capacity of 946 cm³ is used.

The dimensions are :

| | | |
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| cone : | length : | 305 mm |
| | diameter : | 152 mm |
| | capacity to bottom of screen : | 1500 cm ³ |
| orifice : | length : | 50.8 mm |
| | inside diameter : | 4.7 mm |
| screen : (fixed 19.0 mm below top of funnel) | openings : | 1.6 mm |

- fluid loss and filter cake : a filter press is used.

The main dimensions and parameters are :

| | | |
|-------------------|-------------------|---------------------------|
| a mud cell : | inside diameter : | 76.2 mm |
| | height : | 64 mm |
| filtration area : | | 4580 ± 60 mm ² |
| pressure : | | 690 ± 35 kPa |
| time : | | 30 minutes |

- sand content : this value is the volume percent of particles larger than 74 mm. It is measured by sand-screen set.
- Fann viscometer 10 minutes gel strength : the instrument is of rotational type, which allows controlled roto speeds (600 rpm, 300 rpm and 3 rpm). The 10 minutes gel strength is measured using the 3 rpm speed, after a 10 minutes reset.

Remark

Works will not start if control equipment has not been approved by the Owner’s Representative.

Polymers

Polymers, sometimes in addition with bentonite, may be used as supporting fluids on the basis of a certain experience, including :

- either previous cases for similar or worse geotechnical conditions,
- or according to full-scale trial trenches on the site.

A reasonable extrapolation of previous cases may be made with the support of laboratory tests and theories.

Stability during excavation

The stability of the hole/trench during excavation is due to the stabilising loads of the supporting fluid acting against the walls of the hole/trench. This action is due to the formation of a cake of bentonite mud by filtration at the contact with the soil.

The main factors affecting the stability, which can be controlled during the execution are:

- the level and the density of the supporting fluid
- the length of the pile/panels
- the time during which the hole/trench is left open, related to the soil and groundwater conditions (loss of shear strength with time).

The stability of the hole/trench shall be determined on the basis of comparable experience in similar geotechnical conditions.

When a loss of supporting fluid occurs, one of the following measures may be adopted :

- addition of filler material in the bentonite suspension,
- filling the trench with lean mix concrete and re-excavating up to grade level,

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- grouting the layers concerned before excavating the trench.

Control pipe + borings

If required by the Particular Technical SPECIFICATION, each pile shall be equipped with 3 vertical steel rigid pipes which shall be linked to the reinforcement cage (located inside the cage each 120°) by means of a system avoiding any deformation of these pipes during insertion of the cage down to the boring and during concreting.

These pipes shall allow the core boring controls of the bearing soil -pile base contact and, if required, the grouting process after concreting. The inner diameter of these pipes shall allow the insertion of boring and grouting equipment (at least 100 mm). The length of pipes shall be 100 cm smaller than the whole pile length and shall allow the access to the top of the pipes for boring/grouting operation.

Both ends of the pipes will be hermetically closed by PVC stoppers to avoid any insertion of soils, cement-wash or concrete at the bottom and any obstruction at the top. The steel pipes must be connected by screw-coupling.

21 days after the concreting of the pile, the CONTRACTOR shall drill into 5% of all steel pipes and into all piles pipes where execution and concreting problems were recorded in order to take core samples from 1 m above base level down to min. 1.2 meter below this level and to allow setting up of tub-a-manchette for grouting down to 2 pile diameters (min. 1, 2 m) of pile below the base level of the pile. This drilling can be performed by core boring with record of bore parameters.

When the pile base contact will be found to be unsatisfactory by the Owner's Representative, the base grouting will be carried out.

3.4.3. Mixing of Concrete

The requirements of 3.3.4 apply.

3.4.4. Placing of Concrete

3.4.4.1. Concreting of bored piles with permanent casing

The concrete needed by the concreting of a pile has to be supplied regularly. The waiting times between the concrete-trucks have to be reduced to a minimum. No concreting interruption will be tolerated.

Before starting the concreting, the cleaning at the bottom of the hole has to be made. All loose, disturbed or remoulded soil will be removed from the base of the hole.

This operation is to be executed immediately before starting the concreting. It means after the introduction of the steel reinforcement cage and not only at the end of the boring (and within the hour of the starting of concreting).

The waiting time between the end of boring and the start of concreting may not exceed 10 hours for each pile.

All concrete is to be placed by tremie (grouting) pipe; the starting of the concreting by this method has to be particularly well executed. The good quality of concrete at the base of the pile is mainly concerned by this operation.

When the top of concrete is below the level of the working platform, the corresponding hole is immediately filled by gravely sand after the end of concreting.

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After concreting of each pile, the concrete volume will be checked in relation with the theoretical bore-hole volume; for this purpose, a concrete-curve is drawn up for each pile, truck by truck. A complete concrete-curve is established from the measurements of concrete consumption every meter on the length of the pile for 1 pile each 50 piles.

If the concrete consumption is not normal (under-volumes or more than 30 % of over-volumes), special procedures will be taken by the CONTRACTOR in agreement with the Owner's Representative.

3.4.4.2. Concreting of bored piles with temporary casing

The bore is cleaned at least 1 hour before starting of concreting except special cares against decantation.

Water level within the hole must be permanently higher than the groundwater level during concreting.

The concrete will be poured by tremie pipe.

3.4.4.3. Concreting under water or drilling mud

When concreting under water or drilling mud, all soft or loose material shall be removed from the bottom of the hole and concrete pumping or an efficient tremie technique shall be used. The following procedures shall apply to the use of tremie concrete in piles.

- a) The concrete shall be cohesive, rich in cement (i.e. not less than 400 kg/m³) and of slump not less than 150 mm.
- b) The sides of the borehole shall be stable. This shall be achieved by maintaining an adequate head of fluid or by the provision of a temporary casing of the necessary length.
- c) The tremie shall be watertight throughout its length and have a hopper attached at its head by a watertight connection.
- d) The tremie pipe shall be large enough in relation to the size of aggregate. For 20 mm aggregate the tremie pipe shall be of diameter not less than 150 mm, and for larger aggregate tremie pipes of larger diameter are required.
- e) The tremie pipe shall be lowered to the bottom of the boreholes allowing ground water to rise inside it. It is essential to prevent the tremie concrete from mixing with water in the tremie pipe and to this end a plug or other device shall be used.
- f) The tremie pipe shall always be kept full of concrete and shall penetrate well into the concrete in the borehole with an adequate margin of safety against accidental withdrawal.
- g) The pile shall be concreted wholly by tremie and the method of disposition shall not be changed part way up the pile, to prevent the laitance from being entrapped within the pile.
- h) If the time taken to form large piles is likely to be excessive the use of set retarding admixtures shall be considered, particularly in the case of high ambient temperatures.
- i) All tremie tubes shall be scrupulously cleaned before use.
- j) When drilling muds such as bentonite suspension are used, the fluid at the pile base shall be checked for contamination before concreting to ensure that it will be readily displaced by the rising concrete.

3.4.5. Finishing of Pile Heads

The requirements of 3.3.6 apply.

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3.4.6. Reinforcement

The reinforcement shall extend along the whole length of the piles. It shall be adequately assured in position.

A minimum concrete cover of 70 mm shall be maintained with help of circular concrete covers to achieve the proper cover between reinforcement and casing.

Except otherwise specified, the main longitudinal reinforcement shall not be less than 0,8 % of the cross pile section with a minimum of 6 bars diameter 12 mm and a maximum distance of 200 mm between the longitudinal bars. Longitudinal bars shall be one stretch, by means of butt-welded standard lengths of bars and executed in full accordance with IS:1786-1985.

The spiral reinforcement shall be at least 10 mm diameter at a 200 mm pitch and shall be carefully welded to the main reinforcement.

The spacers can be either vertical pipes or individual units (pads, rollers,...) made of a material different from steel, with a chemical resistance at least equal to the one of the concrete.

3.4.7. Grouting for bored piles with mud

If required by the Particular Technical SPECIFICATION, grouting shall be carried out through control pipes below pile level with a mixture of cement + bentonite slurry (see British CODE of Practice BS 8004 or AFTES STANDARDS).

The nature and setting time of this grout shall be submitted by the CONTRACTOR to the approval of the Owner's Representative.

The grouting shall be performed by rising steps under high pressure. The pressure must be permanently under control by the CONTRACTOR who must limit the pressure to avoid any dislocation of the soils or heaving of piles and of any other structure.

This limit must be submitted by the CONTRACTOR to the approval of the Owner's Representative.

In order to respect this limit, the CONTRACTOR shall provide a pressure-limit device at the output of the grouting installation and deformation captors at the most critical locations above the soils to be grouted.

The grout is mechanically malaxed and sifted in order to be homogeneous and without deposits during the grouting. The CONTRACTOR shall provide an extensive procedure for the grouting of the piles.

The grouting procedure will include:

- type and proportioning of the grout,
- grouting velocity and pressure,
- quantities to be grouted, pressures to be obtained gradually or by steps,
- water tests, sequence of the zones to be grouted,

The procedure shall be submitted by the CONTRACTOR to the approval of the Owner's Representative. The proposed grouts have to be tested by the CONTRACTOR with its equipment on site.

3.5. Execution of Precast Concrete Pile

3.5.1. General

Precast concrete piles can be of a constant cross section or can have an enlarged pile tip. In any case the pile tip shall be adequately reinforced with a pile shoe made in steel plate of appropriate thickness and anchored in the concrete by means of hooks.

3.5.2. Equipment

The CONTRACTOR shall satisfy the Owner's Representative regarding the suitability, efficiency and energy of the driving equipment.

3.5.3. Driving of Precast Concrete Piles

Precast concrete piles shall not be driven until the concrete has achieved the specified characteristic strength.

The length of pile to be driven in any position shall be approved.

At all stages during driving and until incorporation in the superstructure the pile shall be adequately supported and restrained by means of trestles, temporary supports or other guide arrangements to maintain position and alignment and to prevent buckling. These arrangements shall be such that damage to the pile does not occur.

Each pile shall be driven continuously until the specified or approved set and/or depth has been reached, except that the Owner's Representative may permit the suspension of driving if he is satisfied that the rate of penetration prior to the cessation of driving will be substantially re-established on its resumption or if he is satisfied that the suspension of driving is beyond the control of the CONTRACTOR.

The CONTRACTOR shall inform the Owner's Representative without delay if an unexpected change in driving characteristics is noted.

A detailed record of the driving resistance over the full length of the nearest available pile shall be taken if required.

4. CUTTING PILE HEADS

4.1. Procedure

Head of already cast RCC piles shall be cut after 28 days of casting up to a length and elevation as shown on the drawing by chiselling taking all necessary safety precautions. Care shall be taken that pile reinforcement is not cut or damaged during chiselling operation. All debris and loose or cracked concrete in the pile shall be removed and disposed off within the plant boundary as per the directions of the Owner's Representative and site shall be left clean for casting of pile caps. The surface of reinforcement bars shall be cleaned, if required by wire brushing, so that no old concrete sticks to them.

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5. BUILDING-UP PILE HEADS

5.1. Procedure

Concrete in existing piles shall be chiselled off minimum upto the lap-length of the reinforcements in the pile. In cases where reinforcements are longer than the concreted piles, the top concrete of the existing piles shall be chiselled off upto a length of 800 mm.

Concrete surface and reinforcement of pile shall be cleaned of any dirt, grease, debris etc. and concrete surface shall be made rough by hacking. Reinforcement shall be lapped/welded as per the direction of the Owner's Representative. Neat cement slurry shall be applied on top surface of concrete and using approved formwork concreting shall be done upto the level shown on the drawing or as directed by the Owner's Representative.

6. FIELD QUALITY CONTROL

6.1. Testing of Concrete / Reinforcement Bars

For testing of concrete and reinforcement bars, refer GTS Z/02/0004.

6.2. Testing of Piles

Static loading tests

If required by the Particular Technical SPECIFICATION or by the contractual documents, the CONTRACTOR shall execute static loading tests on 5% of the total quantity of the piles.

The pile(s) to be tested shall be indicated by the Owner's Representative. The procedure to be followed is provided by IS:2911-1985.

Unless other delays provided by the Owner's Representative, the test has to be carried out more than 4 weeks after concreting of the pile.

The loading materials and equipment, the measurement devices and procedures have to be submitted to the Owner's Representative's approval by the CONTRACTOR. In particular the foundations soil may not be disturbed by using of anchoring.

All tests shall be carried out only under the direction of an experienced and qualified supervisor familiar with the test equipment and test procedure. All personnel operating the test equipment shall have been trained in that field.

The number of increments of load shall be at least four, with a decreasing of load down to zero after reaching of the net vertical load.

If tests prove unsuccessful, the CONTRACTOR shall propose all necessary adaptation to the foundations. These proposals shall be submitted to the Owner's Representative. All costs requested to perform the foundation adaptation shall be at the CONTRACTOR'S cost.

Except where otherwise indicated herein payment will be made for satisfactory tests only and for not those resulting in failure. If any pile fails under test, it shall be replaced at the CONTRACTOR'S cost by pile as indicated by the Owner's Representative.

Presentation of results

The CONTRACTOR shall submit to the Owner's Representative the results of the test in two stages as follows:

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- a) within 24 hours of the completion of the test, unless otherwise agreed, the maintained load and the period for which it was held for each stage of the test and the maximum settlement recorded;
- b) within 7 days of the completion of the test unless otherwise agreed by the Owner's Representative, a complete report on the test with descriptions of the testing equipment, the methods used to record load and settlement and results in tabular and graphical form with recorded load against settlement with times.

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PLASTERING AND POINTING

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1. GENERAL

This GTS covers the plastering of all types of concrete and / or masonry surfaces in all kind of work.

1.1. REFERENCE

IS 1661 : Code of Practice for application of cement and cement-lime plaster finishes.

IS 2250 : Code of Practice for preparation and use of masonry mortar.

2. MATERIALS

2.1. Cement

Cement shall be ordinary Portland Cement (Grade 43) conforming to IS 8112.

2.2. Sand

Sand for plaster and pointing shall conform to IS:1542 and grading of sand shall be as per Table I of IS1542. Sand shall be hard, durable, clean and free from adherent coatings and organic matter and shall not contain any appreciable amount of silt, day bails or pellets. Sand shall not contain harmful impurities such as iron pyrites, coal particles, lignite, mica shale etc.

Sand whose grading falls outside the limits of IS:460 due to excess or deficiency of coarse or fine particles shall be processed to comply with the standards.

Fine sand shall be obtained from river beds not affected by tidal water of the sea and shall be clean, sharp and free from excessive deleterious matter. The sand shall not contain more than 8 per cent of mud and silt as determined by field test with a measuring cylinder.

2.3. Gypsum

Gypsum for use in plaster of paris work shall be according to IS 2333. For lath plastering, wherever specified galvanised hexagonal wire netting conforming to IS 3150 shall be used.

2.4. Water

Water for plastering and pointing shall conform to 'GTS for Structural Concrete' – Z/02/004.

2.5. Mixing of Cement Mortar

Unless specified cement sand mortar shall be used. Cement mortars shall be prepared by mixing cement and sand in specified proportion by volume in mechanical mixer. Cement sand in specified proportion shall be fed into the mixer and mixed dry thoroughly in the mixer. Water shall then be added gradually and the wet mixing shall be continued for at least 3 minutes. Hand mixing shall be permitted on a clean approved platform in special cases only.

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Plastering

The mix proportion and thickness of plaster for various surfaces shall be specified or indicated in the relevant drawings.

2.6. Cement Mortar with Waterproofing Compound

Waterproof compound shall conform to IS:2645 of approved make. The compound shall be well mixed with dry cement in the proportion of 3% by weight or as recommended by manufacturer. Further procedures for preparation of cement mortar shall be as per above clause (viz. 2.5).

3. WORKMANSHIP

3.1. Preparation of Background Surface

The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surfaces shall be roughened by wire brushing or hacking for non-hard and hard surfaces respectively. Projections on surfaces shall be trimmed wherever necessary to get even surfaces. In case of brick/stone masonry, raking of joints shall be carried out wherever necessary. The masonry shall be allowed to dry out for sufficient period before carrying out the plaster work. The masonry shall not be soaked but only damped evenly thereafter before applying the plaster.

In case of concrete work, projecting blurs of mortar formed due to the gaps of joints in shuttering shall be removed. Such surface shall be scrubbed clean with wire brushes. The surface shall be pock marked with a pointed tool at spacing of not more than 50 mm centers, the pocks being made not less than 3 mm deep to ensure a proper key for the plaster. The surface shall be washed off and cleaned of all oil, grease etc. and damped evenly before the application of plaster.

3.2. Sequence of Operations

For external plaster, the plastering operations shall be started from the top floor and carried downwards. For internal plaster, the plastering may be started wherever the building frame, roofing and brick work are ready.

The surfaces to be plastered, shall first be prepared as described in Clause 3.1.

The first underlayer shall then be applied to ceilings. After the ceiling plaster is complete and scaffolding for the same removed, plastering on wall shall be started.

After a suitable time interval as detailed under various types of plaster in subsequent paras, depending upon the type of mortar, the secondary layers if required shall be applied. After the suitable elapse of time as detailed under various type of plaster in subsequent paras, the finishing coat shall be applied first to the ceiling and then to the walls.

Plastering of cornices, decorative features, etc. shall be completed before the finishing coat is applied. Unless otherwise specified corners and edges shall be rounded off to a radius of 25 mm, such rounding off shall be complete along with the finishing coat to prevent any joint marks showing out later.

Chicken mesh must be provided at the jointing of RCC and Brick work with an overlap of minimum 150 mm. Groove also shall be provided at the beam and column location as per the guidance of Owner / Owner's Representative.

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3.3. Scaffolding

Scaffolding/staging for plastering/pointing shall be as per ‘Technical Specification for Brick Masonry.

3.4. Damage Rectification

Any cracks, damages, any part of work which sound hollow when tapped or found damaged or defective otherwise shall be cut out in rectangular shape and redone as directed by Owner’s Representative.

4. PLAIN CEMENT PLASTER

4.1. Preparation of Mortars

The mortars of specified mix. shall be used as per the specifications of ‘Cement Mortar’ as described in clause no. 2.5 above.

4.2. Application of Plaster

4.2.1. One Layer Plaster Work

To ensure even, specified thickness, plaster of 150 mm x 150 mm shall be first applied horizontally and vertically at not more than 2 meter interval over the entire surface to serve as gauges. The surface of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall be brought to true surface by working with a wooden straight edge reaching across the gauges with small upward and sideways movements at a time. Finally the surface shall be finished off true with a trowel or wooden float to obtain a smooth texture. Excessive trowelling or overworking the float shall be avoided. All corners, arises, angles and junctions shall be truly vertical/horizontal and shall be carefully finished. Rounding or chamfering of corners, arises, junctions etc. shall be carried out with proper templates to the size required.

In suspending the work, the plaster shall be left, cut clean to line, both horizontally and vertically. When recommencing the plastering the edge of the old work shall be scrapped clean and wetted before plastering the adjoining area. Plastering work shall be closed on the border of the wall and nearer than 150 mm to any corners or arises and shall not be closed on the body of the features such as plaster bands, cornices nor at the corners or arises.

4.2.2. Two Layer Plaster Work

4.2.2.1. *First or Under Layer*

The first or underlayer of the specified thickness shall be applied as described in clause no. 4.2.1 above. Before the first coat hardens, surface of it shall be beaten up by edges of wooden tapers and close dents shall be made on the surface. The subsequent coat shall be applied after this coat has been allowed to set for 3 to 5 days depending upon weather conditions. The surface shall not be allowed to dry during this period.

4.2.2.2. *Second or Finishing Layer*

The second layer shall be complete to the specified thickness in the same manner as for first layer.

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4.3. Curing

Curing shall be started 24 hours after finishing the plaster. The plaster shall be kept wet for a period of 7 days. During this period the plaster shall be suitably protected from all damages at the Contractor's expense by such means as approved by the Owner's Representative. The date of execution of plastering shall be marked on the plastering to ensure the proper duration of curing.

5. SAND FACE PLASTER

5.1. Preparation of Mortar

The mortar of specified mix shall be used as per the specifications of cement mortar as described in clause no. 2.5 above.

5.2. Application of Plaster

Sand face plaster shall consist of 12 mm thick (1 cement : 4 coarse sand by volume) underlayer and 6 mm thick (1 cement : 2 coarse sand by volume) top layer. Application of plaster shall be as described in 'two coat plaster work' in clause no. 4.2.2 above.

The surface of the sand face plaster shall be finished rough with sponge or as directed by the Owner's Representative.

5.3. Curing

Curing shall be as described in clause 4.3 above.

6. EXPOSED AGGREGATE FINISH

6.1. Preparation of Mortar

The mortar of specified mix shall be used as per the specifications of 'cement mortar' as described in clause no. 1.4 above. White and coloured marble chips shall be of 6 mm to 12 mm size out of Makrana/Ambaji, grade I or Dongri Chittor Brown/Rajnagar/Abu green grade-1 quality as specified. Marble dust shall be obtained from crushing hard marble stone.

6.2. Application of Plaster

Exposed aggregate finish plaster shall consist of 12 mm thick plain cement plaster underlayer (1 cement : 4 coarse sand by volume) finished rough and 20 mm thick top layer. Underlayer shall be applied in accordance with 'One Layer Plaster Work' as described in clause no. 3.2.1 above.

Top layer shall be 20 mm thick admixture of white cement and grey cement (mix. Ratio 1:1 by volume) mixed with white/coloured marble chips/pebbles of 6 mm to 12 mm nominal size as per item description. Mix ratio shall be 1 cement : 1 marble chips/pebbles by volume. Marble dust @ 15% by volume shall be added to the admixture. The pebbles to be used shall be well washed and drained. The admixture shall be thrown wet on to the underlayer while it is still plastic using strong whipping motion at right angles to the face of the wall. One coat of neat cement slurry @ 2.75 kg cement per square metre of area shall be applied on to the underlayer to receive the top layer. The whole plastering shall be laid in panels of maximum 1.2

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M x 1.2 M or as per drawing with 12 mm x 20 mm grooves in between formed by holding removable wooden battens of 12 mm x 25 mm size over the under layer.

Loose mortar etc. on the top surface shall be cleaned/removed by brushing/washing/ spraying with water jet after initial setting of mortar.

6.3. Curing

Curing shall be as described in clause no. 3.3 above.

7. POINTING

Pointing shall be of the type specified such as flush, cut or weather struck, raised and cut etc.

7.1. Preparation of Base Surface

The joints shall be raked to such a depth that the minimum depth of the new mortar measured from either the sunk surface of the finished pointing or from the edge of the brick shall be less than 20 mm.

7.2. Mortar

Mortar shall be in accordance with the specifications of cement mortar as described in clause no. 1.4 above.

7.3. Application of Mortar and Finishing

The mortar shall be pressed into the raked out joints with a pointing trowel according to the type of pointing specified. The mortar shall be spread over the corner edges or surfaces of the masonry. The pointing shall then be finished with the pointed tool. The superfluous mortar shall be cut off from the edges.

7.4. Flush Pointing

The mortar shall be pressed into joints and shall be finished off flush and levelled. The edges shall be neatly trimmed with trowel and straight edges.

7.5. 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 15 mm with the pointing tool so that the joint is sloping from top to bottom. The vertical joint shall also be similarly pointed. The junctions of vertical joints with the horizontal joints shall be at true right angles in case of brick and coursed rubble masonry.

7.6. 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 6 mm and width 10 mm more as directed. The pointing shall be finished to a smooth but hard surface.

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7.7. Curing

Curing shall be as described in clause no. 3.3 above.

8. LATH PLASTER & GRADING UNDER BED

The lath plaster shall be applied over structural steel members.

Before plastering, the surface of metal type shall be brushed over with the cement slurry or given a protective coat of bitumen oil paint unless specified otherwise.

Plastering shall be carried out in two coats. Mortars for the first coat shall be of stiff consistency and applied as evenly as possible to give a uniform good cover to the lathing. It shall be allowed to dry until all shrinkage movement has ceased before the second coat applied. Too much pressure shall not be used in applying plaster to lathing to guard against distortion.

Galvanised chicken wire mesh wherever specified shall be provided for lath plaster.

Cement-sand mortar grading under bed shall be provided upto an average thickness of 25mm. The underbed shall be laid to the specified slope.

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PLUMBING AND BUILDING DRAINAGE

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1. SCOPE

- 1.1. The specification is intended to establish and define the materials and constructional requirements for plumbing and building drainage works.
- 1.2. All materials, fixtures and workmanship shall be in accordance with the relevant Indian Standards Specifications, Codes of Practices and good engineering practices.

2. STOP COCKS

- 2.1. Stop cocks of screw-down type shall conform to IS:781. All taps shall be of heavy grade. The taps shall be chromium plated brass or ordinary easy cleaning type as specified.
- 2.2. The payment shall be made on units basis. The rate quoted shall include supplying and fixing bib or stop cocks with white zinc and yarn etc. complete.

3. H.C.I. NAHNI TRAP (FLOOR TRAP)

- 3.1. Nahni trap shall be of heavy cast iron as per IS:3989 with 100 mm inlet and 80/100 mm outlet with CP pressed steel grating. It shall be of self-cleaning design. Grating shall be of either hinged or screwed down type.

It shall be fixed in cement mortar 1:2 and as directed by Owner’s Representative.
- 3.2. The payment shall be made per number basis. The rate shall include supplying and fixing Nahni trap, including cement mortar, cutting walls and floors and making good the same, providing and fixing chromium plated pressed steel grating all complete.

4. STONEWARE GULLY TRAP CHAMBER

- 4.1. The square mouth gully trap shall be of 100 mm dia, conforming to IS:651 of specified and/or approved quality stoneware, complete with cast iron grating, and shall be got approved by the Owner’s Representative. The size of CI frame and cover shall be of 300 mm x 300 mm. It shall be properly fixed as directed by the Owner’s Representative.

The size of the chamber shall be 300 x 300 x 675 mm (internal) it shall be constructed of brick masonry walls 125 mm thick in 1.4 cement mortar and M-15 concrete foundations. Inside and outside faces of the masonry walls shall be plastered with 1:3 cement mortar. The top of the chamber shall be provided with CI cover and frame.

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- 4.2. The payment shall be made on per number basis. The rate shall include supplying and fixing of stoneware gully trap, CI grating, construction of masonry chamber, providing and fixing CI frame and cover, earthwork in excavation, foundation concrete and backfilling removal of surplus earth upto a lead of 30 m etc. and labour and material complete

5. BRICK MASONRY(MANHOLES/INSPECTION CHAMBER & VALVE CHAMBER)

- 5.1. The size of the manholes and valve chambers shall be as specified in the drawings or items. It shall be constructed to brick masonry walls 230 mm thick in CM 1:4 (1 cement, 4 sand) resting on M-15 concrete foundations. The inside and outside face of the masonry wall shall be plastered with 13 mm thick plaster of cement mortar 1:3 (1 cement, 3 sand).

The top of chamber shall be heavy duty CI cover frame.

M.S. rungs made out of 16 mm dia M.S. bars shall be fixed inside the manhole as shown in the drawing after applying two coats of anticorrosive paint.

Valve chambers shall be provided and fixed with a heavy duty CI cover and frame.

The top of chamber shall be provided with reinforced cement concrete M-15 grade as per drawings and direction of Owner's Representative.

The C.I. manhole covers and frames shall conform to IS:1726. The type size and grade shall be as per drawing, schedule of items and the directions of the Owner's Representative.

The frame shall be fixed in position during concreting of top slab, inside faces of frame and cover shall be given two coats of approved anti-corrosive paint.

The specification for brick masonry, plastering, concreting, excavation and backfilling etc. as given under relevant clauses shall be applicable for this work also.

- 5.2. Payment shall be made as per number basis including excavation, backfilling, removal of earth, construction of the chamber/manhole, making connections of pipes through the walls, cost of M.S. rungs, cover slab, cost of CI cover and frame, etc. as per the directions of the Owner's Representative.

The rate shall include breaking concrete or brick masonry work and making good the same with 1:4 cement mortar if necessary, finishing, painting, etc. as per directions of Owner's Representative.

6. C.I. SOIL/WASTE PIPES

- 6.1. Cast iron pipe, socket and spigot shall be of standard quality conforming to IS:486 (heavy duty).

The spigot of the pipe shall be placed fully resting inside the socket and hemp caulked home to leave space for lead depth as specified. Lead conforming to IS:782 in molten state shall then be poured into the joint filling the same in one pouring. The lead shall be caulked by proper tools to make it even all round. Depths of lead in the joints from the top of the socket shall be 37 mm for 150 mm dia pipes, 25 mm for 100 mm and 50 mm dia pipes. All pipes shall be fixed 25 mm clear of the wall with MS holder bat clamps or as approved by the Owner's Representative. All holes in walls and floors shall be made good by cement concrete M-15 grade and should be leak proof. All soil and waste pipes shall be tested for leakage by hydraulic test.

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All pipes shall be painted with two coats of paint of approved make and shade over a coat of prime. Earthwork in excavation backfilling and removal of surplus earth shall be considered as a part of the work. No separate payment will be made for the same.

- 6.2. The payment shall be made per running metre of pipe laid with fitting as required on site. The rate quoted shall include supplying and fixing of pipes and necessary specials including cowl with hemp and lead, jointing and testing, bat clamps, fixtures painting, cutting of walls, floors and making good the same and necessary scaffolding, earthwork in excavation, backfilling and removal of surplus earth etc. complete.

7. CI/SOIL/VENT PIPES

- 7.1. CI pipes shall be standard quality conforming to IS:1729. The supply shall include all necessary accessories e.g. bends, tees etc. complete.

Jute yarn gasket of suitable diameter shall be used as required to support the spigot of the pipe at the proper grade and make truly concentric joints. Single piece of sufficient length shall be used to pass around the pipe and lap at the top and shall be thoroughly saturated in bitumen. This gasket shall be laid in the socket for lower third of the circumference of the joint and covered with cement mortar. The spigot of the pipe thoroughly cleaned with wet brush, inserted and carefully driven home after which a small amount of cement mortar (1:2) shall be inserted in the annular space around the entire circumference of pipe and solidly rammed into the joint with caulking tool. The joint shall then be completely filled with mortar and bevelled off at angle of 45° with outside of the pipe: Cement used to joint shall conform to IS:269.

All holes in walls and floors shall be made good by cement concrete M-15 grade.

All CI pipes shall be painted with two coats of anticorrosive bituminous paint externally.

- 7.2. The payments shall be on running metre basis of pipes laid. The rate shall include supplying and fixing pipes jute gaskets dipped into bitumen and cement mortar and necessary specials including jointing with clamps, painting, cutting of walls, floor and making good the same, necessary scaffolding etc. complete.

8. GI PIPES AND FITTINGS

- 8.1. All G.I. pipes and fittings shall conform to IS:1239 and shall be of medium grade for water supply system.

All screwed tubes and sockets shall have pipe threads in accordance with the requirements specified in IS:554. Unless specified otherwise, pipes shall be supplied screwed with taper threads and sockets parallel thread.

All fittings shall be malleable galvanised iron approved by the Owner's Representative. Fittings in GI line shall include all couplings, elbows tees, bends, unions, nipples, reducers, flanged with nuts bolts and rubber insertions, bushes and all other fittings to make a complete job. Screwed GI pipes shall be jointed with screwed socket joints using screwed fittings. Care shall be taken to remove any burr from the end of the pipes after threading. While lead with a few strands of fine hemp shall be applied while tightening. Compounds containing red lead shall not be used.

All pipes above ground shall be fixed with GI holders bat clamps clear off the wall at 1.2 M centres. If the pipes are fixed in encased or embedded in wall, they shall be secured in position by iron hoops at 1.2 M centres. All visible pipes and clamps within and outside building shall be painted with two coats of white paint or aluminium paint as directed by the Owner's Representative. No extra payment shall be made for clamps, hooks, cutting holes in walls, chasing and making good the same.

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All underground pipes shall have a minimum earth cover of 600 mm or as directed by the Owner's Representative. No extra payment shall be made for excavation in trenches, refilling the same and removal of surplus earth. Before any pipes are painted or covered up they shall be tested to a hydro-static pressure of 6 kg/sq.cm.

- 8.2. Payment shall be on running metre basis of actual pipeline laid. In addition to the Sectional testing of water supply piping, the Contractor shall test entire installation on completion of the job to the satisfaction of the Owner's Representative. No extra payment shall be made for testing. The Contractor shall make his own arrangement for supply of water for testing at his own cost. The rate for this item shall include supply and laying of GI pipes with necessary fittings, cutting of pipes to required lengths, threadings; making holes in walls and floors and making good the same, jointing, painting, excavation and refilling including the testing and directions by the Owner's Representative.

9. GUN METAL VALVE

- 9.1. All full way and globe valves shall be of heavy gunmetal and tested at 300 psi and shall be approved by the Owner's Representative. Valves shall conform to IS:778. Size of valve chamber shall be as per item description, construction of valve chamber shall be carried out as detailed in this specification. Valve chamber shall be provided and fixed with heavy duty CI surface box conforming to IS:3950. The surface box shall be hinged pin open type and shall be fixed in the chamber slab. It shall have a hole for opening.
- 9.2. The payment shall be made per number basis including valve chamber and surface box. The rate shall include construction of valve chamber supplying and fixing valves and surface box in position as per drawings and direction of the Owner's Representative.

10. HALF FOUND CHANNEL

- 10.1. Half round channel shall be plain or with stop end and shall have internal dia of 100 mm approved by the Owner's Representative. The jointing work shall be done with white cement slurry. The drains shall be provided with proper slopes as indicated in drawings or as specified by the Owner's Representative. Channel shall be covered with matching tiles leaving provision for cleaning the same.
- 10.2. The payment shall be made per metre basis and shall include all labour, material etc. complete including laying, jointing etc.

11. PRECAST R.C.C. PIPE

- 11.1. Materials

For pipe materials, the following specifications shall apply:

Specification for Precast Concrete Pipes (with and without reinforcement) IS:458

Code of practice for laying of concrete pipes IS:783

For cement sand, mortar, water etc. the specifications laid down for concrete works shall apply.

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All pipes must be new and perfectly sound, free from cracks, cylindrical, straight, and of standard nominal diameter and length with even texture. Each pipe shall have one collar with it.

The Contractor shall submit manufacturer's test certificate whenever demanded by Owner's Representative. Spun yarn for pipe joints shall be of best quality. It shall be free from dust etc.

11.2. Transportation and Stacking

The transportation of materials to the work site and stacking shall be done in a manner to cause minimum inconvenience to the traffic and other construction works. The pipe shall be protected during handling against impact, shocks and free fall to avoid cracks and damage.

The Contractor shall be fully responsible for the safety and security of materials transported and stacked in the field.

11.3. Lowering and Laying of Pipes

11.3.1. General

The laying and jointing of pipes shall conform to IS:783. The trench shall be checked for proper level, gradient and alignment before lowering the pipes.

11.3.2. Lowering

The pipes shall be lowered cautiously to prevent disturbance of the bed and sides of the trench. The heavy pipes shall be lowered by means of proper shear legs, chain pulley blocks or as directed by Owner's Representative. Great care should be taken to prevent sand etc. from entering the pipes.

11.3.3. Laying

Laying of pipes shall proceed up grade of slopes. The error of grade shall not be rectified by packing up earth underneath the pipes. If required, concrete shall be used for packing. The ends of the pipes shall be kept closed to keep dirt, mud and foreign materials, out. Adequate provision shall be made to prevent floating of pipe in the event of flooding of trenches.

The body of the pipe for its entire length shall rest on an even bed in the trench and places shall be excavated to receive the collar for the purpose of jointing.

11.4. Jointing of Pipes

Joint in the pipe line shall be of the socket and spigot type and conforming to relevant Indian Standards.

As per IS:458-1988 joint in pressure pipes shall be flexible rubber ring joint only. Contractor shall provide pipes of socket and spigot type meeting the above requirement. Concrete pipe where permitted by site incharge with collar shall be water tight.

A few skeins of spun yarn soaked in neat cement wash shall be inserted in the groove at the end of the pipe and the two adjoining pipes butted against each other. Collar shall be slipped over the joint covering equally both the pipes. Spun yarn soaked in neat cement wash shall be passed round the pipes and inserted in the joint by means of caulking tools from both ends of the collar. More skeins of yarn shall be added and well rammed home. The object of the yarn is to centre the two ends of the pipes within the collar.

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Cement mortar 1:2 (1 cement, 2 sand) shall be slightly moistened and must on no account be soft or sloppy and shall be carefully inserted by hand into the joint. The mortar shall then be punched and caulked into the joint and more cement mortar added until the space of the joint has been filled completely with tightly caulked mortar. The joint shall be finished off neatly outside the collar on both side at an angle of 45°.

Any surplus mortar projecting inside the joint is to be removed and to guard against any such projections. Sack or gunny bags shall be drawn past each joint after completion.

11.5. Curing

The cement mortar joints shall be cured at least for seven days.

11.6. Testing

All joints in the pipes shall be tested to a head of 1.5 metres of water above the top of the highest pipe.

11.7. Payment for supplying, lowering, laying, jointing and testing shall be made on running meter basis. The length of pipes laid include collars and the rate shall include all supplies and works mentioned in proceeding paras, including excavation backfilling, concrete, removal surplus earth etc. complete.

12. M.S. RUNGS / C.I. STEPS

12.1. The rungs for pits/manholes and septic tanks shall be of MS conforming to Indian Standard and to the shape and size as shown in drawings.

CI steps for manholes if needed shall be as per IS:5455.

M.S. rungs shall be coated with 2 coats of approved bituminous paint.

12.2. Payment for rungs steps shall be made as per number and the rate shall include supply, fixing, finishing the walls, painting etc. complete.

13. SOAK PITS

13.1. All earthwork in excavation, brick work etc. shall conform to relevant IS Standard.

The brick bats should preferably be slightly overburnt or thoroughly well burnt, deep red in colour with some proportion of deep blue or black veins. Spongy or vitrified material as a result of excessive over burning is useless and shall be rejected. Brick bats bigger than specified size shall be reduced to required size (40 to 50 mm) before filling in soak pit and no extra payment shall be made for this. It shall be stacked at site as directed by Owner's Representative. Soak pit and septic tank shall be connected with required piping.

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- 13.2. Payment of soak pit shall be made per number basis. Rate quoted shall include brick masonry work, providing and filling brick bats, earthwork in excavation backfilling making inlet connection with pipe and connecting same to septic tank etc. complete as shown in drawing.

14. SEPTIC TANK

- 14.1. Septic tank consisting of sewage receiving chamber inspection door, vent pipe, inlet and outlet connections, manhole cover, C.I. steps etc. shall be used.




Design, testing and commissioning shall conform to IS:2470, Part-I.

Access opening shall be provided for dislodging and inspection.

The ventilating pipe shall be provided with pipe of at least 50 mm dia extended 2 meters above the nearest working platform level.

- 14.2. Payment of septic tank shall be made per number basis and rate shall include all accessories like, inlet, outlet, vent pipe, manhole cover and CI steps, earthwork in excavation and backfilling removal of surplus earth etc. complete.

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CHAPTER I : CONCRETE PAVEMENT

1. SCOPE

This specification covers the requirements of Material. Laying and finishing concrete pavement.

2. MATERIALS

2.1. Water

Water used for cement concrete, mortar, plaster, grout, curing etc. shall be clear and free from injurious amounts of oils, acids, alkalis, organic matters or other harmful substances. Only natural water suitable for drinking shall be used. It shall conform to IS:456.

2.2. Aggregate for Concrete

The aggregates for concrete shall comply in all respects with IS:383 and IS:456. This should be furnished in at least two separate sizes with separation at 20mm IS sieve when combined material graded from 5 to 38 mm is specified and at 25mm IS sieve when combined material graded from 20 to 50 mm is specified. This shall be obtained from a source approved by Owner's Representative and shall be chemically inert, strong, hard, durable and of limited porosity. This shall be of the gauge specified in the schedule of rates and approximately cubical in shape. It shall be free from soft or decayed pieces, dirt, clay, leaves or any organic matter. The aggregate shall not have any injurious effect when mixed with cement nor shall it corrode the reinforcement, nor otherwise impair the strength and durability of the concrete. The size of coarse aggregate mentioned in this specification denotes maximum size of aggregate and the same shall be grade downward as per IS: 383.

2.3. Sand for Concrete and Mortar

Fine aggregate shall preferably be natural sands. In case of crushed sand the very fine natural sand amount passing IS: NO. 383. Sand shall consist of clean, hard, strong, sharp, durable uncoated particles free from any mix of clay, dust, vegetable matter, mica, iron pyrites, shells, soft or flakey and elongated particles, alkali organic matter, salts, loam and other impurities which may be considered by the Owner's Representative as harmful. Sulphate content should not exceed 1%. Total content of all deleterious matter should not exceed 5%. This source of sand shall be approved by the Owner's Representative. Sand obtained from river bed subject to tidal effect will not be allowed in works. All sand shall be washed before being brought to site.

2.4. Storage of Aggregates

The subcontractor shall at all time maintain at the site of work such quantities of aggregates as are considered by the Owner's Representative to be sufficient to ensure continuity of work.

Each type and grade of aggregates shall be stored separately. This ground on which the aggregates are stored shall be firm and have sufficient slope to ensure adequate drainage of rain water.

Any aggregate delivered to site wet shall be placed in storage for atleast 24 hours to ensure adequate drainage before it is used for concreting.

Sand heaps shall be covered with bricks or such other materials to prevent blowing off and to assist in good house keeping.

2.5. Cement

2.5.1. The cement used shall be ordinary Portland cement, conforming to IS:269, unless otherwise specified.

2.5.2. The cement issued to the contractor shall be stored in a suitable weather tight building and in such a manner as to permit easy access for proper inspection. All cement stored at site by the contractor shall be arranged in batches and used in the same order as received from owner. Contractor shall maintain a cement register in which all entries shall be completed day-to-day showing quantities received, date of receipt and daily cement consumption.

2.5.3. Rejection of Cement

The Owner's Representative may reject cement which has deteriorated after issue to the contractor owing to inadequate protection against moisture or other causes or in any other case where the cement is not to his satisfaction.

2.5.4. Admixture

No admixture shall be normally permitted for concrete or mortar. Water proofing compound to be used in concrete, plaster, damp proof course etc. where specified, shall be of approved make. It shall be mixed as per manufacturers specifications and as approved and directed by the Owner's Representative.

2.5.5. Joint sealing in pavements and around equipments structural columns shall be approved compound conforming to IS: 1834 TYPE 'b' (Shalitex or approved equivalent).

3. GRADES AND PROPORTIONING

3.1. The grades indicated in drawings and schedules shall conform to IS: 456, the strengths being indicated below.

Min. Crushing Strength of 15 cm. Cube in Kg/sq.cm at 28 days.

| Grade | Prel. Test | Works cube test |
|-------|------------|-----------------|
| M- 10 | 135 | 100 |
| M-15 | 200 | 150 |
| M-20 | 260 | 200 |
| M-25 | 320 | 250 |
| M-30 | 380 | 300 |

3.2. The water cement ratio, aggregates and grading for each mix shall be predetermined from the results of cube tests of trial mixes. The mix proportions determined thus shall be followed at site and shall in no way relieve the contractor of his responsibility as regards the prescribed strength of mix. The mix proportions,

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however, shall be revised if the results of the cube tests during the construction show consistently lower or higher strength than the prescribed one. No claim to alter the rates of concrete work will be entertained due to such changes in mix designs, as the contractor will be responsible to produce the concrete of required grade. The slump of concrete mix for pavements compacted by vibrations should not be more than 25 mm and that for manual compaction not more than 50 mm.

- 3.3. All concrete shall be controlled concrete conforming to IS: 456. For mud-mat and filling purpose ordinary concrete of 1:4:8 mix proportion may be used or as indicated in drawings.

4. EQUIPMENT

All equipment like weighting devices, measuring boxes, mixers, sub-grade templates, hand tempers, vibrating screens, internal vibrators, longitudinal floats, bridges, belts, push brooms, straight edges, edging tools etc. shall be on the worksite in first class working condition and shall have been inspected by the Owner's Representative before paving operations are permitted to start. Throughout the construction period the contractor shall maintain adequate equipment in first class working conditions to ensure the proper execution of the work.

5. PREPARATION OF SUB GRADE

- 5.1. The sub grade or sub base for laying of the concrete slabs shall comply with the following requirements.
- 5.1.1. That no soft spots are present in the sub grade or sub base.
- 5.1.2. That the uniformly compacted subgrade or subbase extends atleast 300mm on either side of the width to be concreted.
- 5.1.3. That the subgrade is properly drained.
- 5.1.4. That the minimum modulus of subgrade reaction obtained with a plate bearing test shall be 5.54 Kg/cm².
- 5.2. Sub grade shall be prepared to the lines and grades shown on the drawings.
- 5.3. No concrete shall be placed around manholes or other structure until they have been brought to required grade and alignment.
- 5.4. The subgrade shall be in moist condition at time of concrete placement.

6. FORMS

- 6.1. All side forms shall be of mild steel unless use of wooden sections are specially permitted. The steel forms shall be MS channel sections and their depth shall be equal to thickness of the pavement. The sections shall have a length of atleast 3.0m except on curves, where shorter sections may be used. These forms should be provided with ample bracing and supports to prevent the springing of the forms under the concrete pressure or thrust of machinery operating nearby.

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- 6.2. The forms should be in sufficient number and they should not be removed until concrete is hardened sufficiently.

- 6.3. In case wooden forms are permitted, these shall have minimum base width of 100mm for 200mm slabs and 150mm for more than 200mm thickness.

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7. REINFORCEMENT

- 7.1. All reinforcement work shall conform to IS: 456. Reinforcing steel shall be free from dirt scale or other foreign matter and rust. The number, size, form and position of all the reinforcement shall unless otherwise directed or authorised by Owner's Representative be strictly as per drawings. The placing of reinforcement shall be such that when properly placed into the work, extreme longitudinal bars will be located not less than 50mm nor more than 100mm from the edges of the slab except for dummy joints, the length of reinforcement will keep clear of transverse joints by not less than 50mm nor more than 100mm as measured from the centre of the joint to the ends of longitudinal bars.
- 7.2. While overlapping the bars in either direction the overlap shall be atleast equal to spacing between bars in the respective direction.
- 7.3. To prevent displacement before or during concreting, the bars shall be secured to one another with 16 SWG black soft annealed binding wire. Wooden planks provided for labour to move shall be supported independent of reinforcement and the cage shall never be permitted to sag or get displaced during concreting. Concrete blocks shall be used to ensure correct cover of concrete over bars as shown in drawings.
- 7.4. Dowels if used as load transferring device shall be checked for exact position before concreting. Dowels shall be parallel to the surface and perpendicular to the joint and shall not place any restraint on the movement of the joint.

8. MIXING

- 8.1. Mixing should be carried out in mechanical mixers. Drum of the mixer shall rotate at a peripheral speed of 60RPM (Rotation per minute). Hand mixing can, however, be permitted by Owner's Representative in special cases. Water cement ratio shall be rigidly controlled during mixing. Mixers shall be fitted with automatic devices to discharge measured quantity of water directly into the mixing pan. The water shall be introduced into the drum within first 15 seconds of mixing, but not until all the cement and aggregate constituting the batch are thoroughly mixed. Mixing shall continue until the concrete is uniform in colour and for not less than 2 minutes after all the materials and water are in the drum. The entire content of the drum shall be discharged before any materials are placed therein for the succeeding batch.
- 8.2. Correction for Bulking – In volume batching suitable allowance shall be made for the bulking of fine aggregates due to presence of water. For this purpose the bulking shall be determined as directed by Owner's Representative.

9. PLACING

- 9.1. The place where concrete is to be poured should be clean and free from all loose dirt, standing water etc.
- 9.2. Walking on reinforcement layers is not permissible. Walkways of wooden planks or similar material can be placed with removable supports and should be independent of the reinforcement. The reinforcement position should not be disturbed nor should it sag during carriage and placement of concrete.
- 9.3. Placing and vibration should not take totally more than 20 minutes from time of mixing. Method of placing should be got approved by Owner's Representative. Segregation during carriage and placement should be avoided. If during carriage concrete segregates, it should be remixed before placement.
- 9.4. Concrete should not be dropped from a height of over 1.5m.
- 9.5. To ensure bond and water tightness between old concrete surface and fresh concrete to be placed, the surface should be cleaned and roughened by "initial green cut" by wire brushing or chipping. The initial green may be done by wire brush after 6 hours of placing concrete in order to facilitate the work. Chipping can be done only after 48 hours. A layer of cement slurry with 1:1 mix (1 cement:1 sand) should be poured to obtain a uniform coating on old concrete. Immediately thereafter, the fresh concrete should be poured.
- 9.6. Concrete shall be mixed in quantities required for immediate use and shall be deposited on the sub-grade in a single operation to the required depth and width of the pavement. Spreading shall be as uniform as possible to avoid re-handling of concrete. Where however, a certain amount of redistribution is necessary it shall be done with shovels and not with rakes. Concrete shall be vibrated with internal vibrators. Concrete shall be placed continuously until completion of the part of the work between construction joints or as directed by Owner's Representative continuously until completion of the part of the work between construction joints or as directed by Owner's Representative.
- 9.7. Placing in inclement weather
- All precautions shall be taken for concreting in extreme weather in accordance with the relevant clauses of IS:456. Due protection shall be provided to prevent cement being blown away while proportioning and mixing during windy weather. No concreting shall be carried out in continuous heavy rains. Necessary arrangements to cover the freshly poured concrete shall be provided, to protect it from the direct rays of the sun and from drying winds.
- 9.8. All concreting placement should be co-ordinated with placement of conduits, inserts, embedded parts etc. executed either by same agency or separately.
- 9.9. Concrete in standing water shall be executed strictly as per IS:456 . this shall be paid as a separate item where applicable.
- 9.10. The concrete shall be laid in panels not exceeding 4M x4M as shown in layout drawing or as directed by Owner's Representative.

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10. COMPACTION & FINISHING

10.1. Compaction

The surface of the pavement shall be compacted either by means of power driven finish machine or a vibrating hand screed. For areas where width of the slab is very small as the corner of street junction etc. hand consolidation and finishing shall be done as follows:

10.1.1. Concrete as soon as placed, shall be struck off uniformly and screeded to the crown and cross-section shown on the plans and to such level above the base that when compacted and finished, the pavement shall conform to the grade and cross section indicated by the plans. The entire surface shall then be tamped until a close knit dense surface is obtained.

10.1.2. The tamper shall rest on the side forms and shall be drawn ahead with a swing motion in combination with a series of lifts and drops alternating with lateral shifts, the aim of this operation being compaction and screeding to the approximate level required. Subsequent tamping should advance 75mm at a time in the direction in which the work is proceeding and in final stages the tamping should be closer about 12mm at a time until a level and dense surface is obtained.

10.1.3. If so directed by Owner's Representative, hand operated vibrating tamper consisting of normal type of hand tamper attached to a pneumatic or electric vibrating unit shall be used for compaction.

10.1.4. Segregated particles of coarse aggregate which collect in front of the tamper shall be thrown outside the forms or thoroughly mixed by hand with a mass; of concrete already on the base.

10.1.5. Compaction by tamping shall be carried on till the mortar in the mix just works upto the surface. The surface shall be examined after compaction correction, if needed, shall be made by adding or removing concrete followed by further compaction and finishing.

10.2. Floating

As soon as practicable, after concrete has been struck off and compacted, it shall be further smoothed and compacted by means of a longitudinal float 1200 mm long and 75mm wide operated from a foot bridge.

10.3. Straight Edging

After floating is completed and excess water removed but while concrete is still plastic the slab surface shall be tested for trueness with a straight edge and rectified, if necessary.

10.4. Belting

Just before the concrete becomes non-plastic, the surface shall be belted with a two ply canvas belt not less than 200mm wide and atleast 1.0M longer than the width of the slab. Hand belts shall have suitable handles to permit controlled uniform manipulation. The belt shall be operated with short strokes transverse to the carriage way centreline and a rapid advance parallel to the center line.

10.5. Brooming

After belting and as soon as surplus water has risen to the surface the pavement shall be given a broom finish to produce corrugations of uniform appearance of not more than 1/16 inch in depth.

10.6. Edging

Before the concrete has its initial set the edges shall be carefully finished with an edger of the radius required and pavement edge shall be left smooth and true to line.

11. CURING

11.1. Initial Curing

Immediately, after the completion of the finishing operations, the surface of pavement shall be entirely covered with wetted burlap, cotton or jute mats.

11.2. Final Curing

Upon the removal of the mats, the slab shall be thoroughly wetted and covered by the following method:

Curing with wet earth- A system of transverse and longitudinal dykes of clay about 50mm high shall be laid over the slab. These dykes shall be blanketed with sandy soils free from stones to prevent drying up. The rest of the slab shall be covered with sufficient sandy soil so as to produce a blanket of earth not less than 37mm depth after wetting. This earth shall be kept thoroughly wet till the concrete has attained the required strength but not less than 14 days.

12. JOINTS

12.1. Wherever called for on the drawings expansion joints, dummy joints and longitudinal joints shall be provided as per details indicated in the drawing and as directed by Owner's Representative.

12.2. Sealing of Joints

12.2.1. After the curing, the temporary seal or other intruded materials of all expansion and contraction joints shall be removed completely and the slots filled with approved joint sealing compound.

12.2.2. The edges of the joints shall thoroughly cleaned and primed with a thin bituminous paint which shall be allowed to dry before the sealing compound is applied.

12.2.3. The primer shall be applied with a brush. The composition of primer shall be as follows:

| Name of Material | Percent by weight | |
|------------------------------|-------------------|---------|
| 1. 200 – Penetration Bitumen | 66) | Blended |
| 2. Light creosote oil | 14) | Cold |
| 3. Solvent Naphtha | 20) | |

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The bitumen shall be melted and fluxed with oil. When cold, solvent Naphtha shall be added. BITUMINOUS emulsion shall not be used as primers. Care shall be taken to ensure that the sealing compound is not heated above 200⁰C and the temperature does not exceed 180⁰C for long periods.

- 12.2.4. Sealing compound shall be poured into the joint opening in such a manner that the material will not be spilled on the exposed surface of the concrete. When required to prevent pick up under traffic, the exposed surface of the sealing compound shall be dusted with hydrated lime.

13. OPENING TO TRAFFIC

- 13.1. Traffic shall not be allowed for a period of 28 days after laying of concrete.
- 13.2. Before opening the roads to traffic all joints shall be filled and trimmed or topped out as required.

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CHAPTER II : FLEXIBLE PAVEMENT (UPTO WBM LAYER)

1. SCOPE

This specification covers the material construction details for earthwork in filling for embankments, filling with sand/murrum, WBM sub-base, WBM base course and shoulders for roads and flexible pavements.

2. REFERENCE CODES AND STANDARDS

2.1. B.I.S. Specifications.

IS : 2720- methods of Test of Soil.

2.2. Indian Road Congress Standards.

IRC:19-Standards Specification and Code of Practice for Water Bound Macadam.

3. EARTH WORK FILLING

3.1. Materials

Only material considered suitable by the Owner’s Representative shall be employed for the construction and that considered unsuitable shall be disposed off as directed by Owner’s Representative at his own cost and no claim for compensation will be entertained. The Contractor shall give the samples of earth, he proposes to use for filling along with the following characteristics of the sample to Owner’s Representative prior to collection and use, for approval.

- i. Mechanical analysis or grain size analysis as per IS:2720 Part IV.
- ii. Liquid limit as per IS: 2720 Part V
- iii. Plastic limit as per IS: 2720 Part V.
- iv. Moisture density relationship as per IS: 2720 Part VIII.

The material (soil) used for filling shall be free from boulders, lumps, tree roots, rubbish or any organic deleterious matter.

Material (soil) having plasticity index less than 20 shall be used for filling purposes. Soil having laboratory maximum dry density of less than 1.5 gm/cc shall not be used.

Care shall be taken to see that unsuitable waste material is disposed off in such a manner that there is no likelihood of its getting mixed with the materials proposed to be used for filling.

The work shall be so planned and executed such that the best available material (soil) is reserved for the top portion of embankment.

3.2. Filling for Embankments and Shoulders

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- 3.2.1. The area where filling is to be placed must be cleared of all loose material and virgin soil must be exposed. Such exposed surface must be consolidated properly to obtain 90% of maximum laboratory dry density of the soil. All soft patches must be worked out to remove the soft soil and selected approved earth must be filled back and compacted.
- 3.2.2. Payment for the removal of loose top soil as described in clause 3.2.1 above shall be included in the item for earthwork in filling. No separate payment for consolidation of exposed ground surface will be made. The rate quoted for the earthfill shall be inclusive of the cost of clearing and stripping, consolidation, including watering, testing etc. of the exposed ground.
- 3.2.3. Approved fill material shall be spread in uniform layers not exceeding 20 cms in loose depth for embankment filling. Shoulder construction shall be so organised as to keep pace with the construction of different layers of the pavement, which may require earth fill thickness less than 20 cm. All clods, lumps etc. shall be broken before compaction.
- 3.2.4. In general the soil shall be spread uniformly over the entire width of embankment or shoulder as the case may be. For large embankments, the spreading of soil shall be as directed by Engineer-in Charge.
- 3.2.5. Successive layers of filling shall not be placed until the layer under construction has been thoroughly compacted to satisfy the requirements laid down in this specification.
- 3.2.6. Prior to rolling, the moisture content of material shall be brought to within plus or minus 2% of the optimum moisture content as described in IS: 2720- Part-VIII. The moisture content shall preferably be on the wet side for potentially expensive soils.
- 3.2.7. After adjusting the moisture content as described in Clause 3.2.6, the layers shall be thoroughly compacted by means of rollers till 90% of maximum laboratory dry density is obtained as per IS:2720 Part VIII.
- 3.2.8. Each layer shall be tested in field for density and accepted by Owner's Representative subjected to achieving the required density before laying the next layer. A minimum of one test per 500 M2 area for each layer shall be conducted.00
- 3.2.9. All type of rollers that should be employed for compaction shall be as per direction of Owner's Representative.
- 3.2.10. If the layer fails to meet the required density, it shall be reworked or the material shall be replaced and method of construction altered as directed by Owner's Representative to obtain the required density.
- 3.2.11. The filling shall be finished in conformity with alignment, levels, cross sections and dimensions as shown in the drawings.
- 3.2.12. Extra material shall be removed and disposed off as directed by Owner's Representative.
- 3.3. Tolerance
- Embankment and shoulders for roads, units etc. shall be carried to within a tolerance of cm. From final lines but shall be to required grades and slopes.

4. FILLING WITH SAND/ MURRUM

- 4.1. Sand for filling shall preferably be locally available sand clean and free from any chemical or other impurities. Murrum for filling shall be clean and well graded. Sand/ Murrum shall not contain any vegetation, organic, clayey or other material and shall be obtained from a source approved by Owner's Representative.
- 4.2. Murrum/ Sand shall be spread in layers not exceeding 15 cm in loose thickness over the areas. Each layer shall be uniform in density, quality of material and moisture content before compaction. The moisture content shall be within two percent of the optimum moisture content as per IS: 2720 Part VIII.
 - 4.2.1. In case of pure sand, flooding with water is permissible.
- 4.3. Compaction of each layer shall be by mechanical means as per directions of Owner's Representative. Only in accessible reaches shall be worked manually. Each layer shall be uniformly compacted to obtain 90% of maximum laboratory dry density of the material. If the material fails to achieve the required density, the layer shall be reworked with necessary alteration in compaction, so that the required compaction is obtained. A minimum of one test per M2 area for each layer shall be conducted.
- 4.4. Subsequent layers shall be placed only after the layer already laid has been compacted to the required density and approved by Owner's Representative.
- 4.5. The finish surface must be dressed to required grade and slope. Excess material must be removed from compaction site, as directed by Owner's Representative.

5. WATER BOUND MACADAM SUB BASE/ BASE COURSE

The sub-base course shall consist of one or more layers, each of 100 mm compacted thickness.
 The base course shall consist of one or more layers, each of 75 mm compacted thickness.

- 5.1. Stone Aggregate for WBM
 - 5.1.1. The coarse aggregates shall be hard, crushed or broken stone metal from quarries approved by Owner's Representative, it shall be hard durable and free from flat elongated, soft and disintegrated particles. It shall not have excess of dirt and other objectionable matter. The quality, size and grading of the coarse aggregate shall be conforming to IRC 19 : Std Spec and code of practice for WBM.
 - a) The grading of the coarse aggregates for the sub-base course shall be as below:

| Size Range | Sieve Designation (IS : 460) | % by weight passing the sieve |
|---------------|------------------------------|-------------------------------|
| 90mm to 45 mm | 125 mm | 100 |
| Grade-I | 90 mm | 90-100 |